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1 INTRODUCTION

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1.2 Terms of Reference

The North Western Working Group (Chairman: J. Reinert, Faroe Islands) met at ICES Headquarters from 1-8 May 1996 to:

a) assess the status of and provide catch options for 1997 for the combined Greenland/Icelandic cod stock;

b) assess the status of and provide catch options for 1997 for the stocks of redfish in Sub-areas V, VI, XII, and XIV, Greenland halibut in Subareas V and XIV, saithe in Division Va and Division Vb, and cod and haddock in Division Vb;

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

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

e) provide a detailed description of the various fleets (i.e. gears, seasons, main fishing grounds, and main species) and, where possible, provide the landings, selection parameters, and annual mortalities by fleet and species;

f) update information on the stock identity, migration, spawning areas and state of exploitation of the oceanic stock of *Sebastes mentella*, paying particular attention to the question of whether the assessment based on acoustic and catch data represents the total exploitable stock taking into account the latest survey data;

Since the above terms of reference were decided, ICES have received the official request for advice from the North-East Atlantic Fisheries Commission. In addition to their standard requests which are addressed in the above terms of reference, the Commission has made additional requests which necessitate adding new items to the terms of reference. ACFM have therefore decided to ask the Working Group to:

g) provide information on the relationship between pelagic "deep sea" *Sebastes mentella* the *S. mentella* fished in demersal fisheries on the continental shelf and slope;

h) evaluate the medium-term consequences of an adaptive harvesting strategy, based on a constant annual catch within each 5 year period, set at a level required to obtain sustainable yields of "Oceanic" *S. mentella* and "deep sea" *S. mentella*.

2 DEMERSAL STOCKS IN THE FAROE AREA (DIVISIONS Vb AND IIa)

2.1 General Trends in Demersal Fisheries in the Faroe Area

Tables 2.1.1 to 2.1.3 show the yields of cod, haddock and saithe for Faroese fleet categories. The fishery at the Faroes may be considered a multi-fleet and multi-species fishery. The catches of cod have been very low in recent years but in 1995 all fleet categories increased theirs catches. The cod catches increase by 10,000 tonnes (gutted weight) in 1995. The haddock remain at low level as in previous years and the saithe catches declined to 25,000 tonnes. In 1995 several fleets increased theirs effort (Table 2.1.4).

In 1977 an EEZ was introduced in the Faroe area, (Figure 2.1.1). The demersal fishery by foreign nations have since decreased. The fishing mortalities on cod has remained at a high level. For saithe there has been a substantial increase in the fishing mortalities. This is mainly due to the investment in pair trawlers.

During the 1980s the Faroese authorities have attempted to regulate the fishery and the investment in fishing vessels. In 1987 a system of fishing licenses was introduced. The fishery also has been regulated by technical means such as legislation on the mesh size, closed areas, import ban on fishing vessels and a programme of buying back fishing licenses. Mesh size regulations and closed areas are still enforced.

In March 1994 the Faroese Parliament passed a law on the regulation of fisheries within the EEZ. This law introduces quotas for 5 demersal stocks including the Faroe Plateau and the Faroe Bank Cod, Faroe Haddock, Faroe Saithe and redfish. The quotas are allocated to each fleet category by percentage of the total quota and then equally divided between all vessels in each category.

The quota year starts 1 September and ends 31 August the following year. The quota for Faroe Plateau cod for 1995/96 was at the first set to 12,500 tonnes, raised to 18,500 tonnes in November 1995 and then raised to more than 21,250 tonnes in April 1996 together with the opportunities for the authorities to give by catch quotas. The haddock quota has been set at 12,600 tonnes, the saithe quota at 40,950 tonnes and the quota for redfish at 11,550 tonnes. The cod quota at Faroe Bank is 1050 tonnes.

2.1.1 Revised management system

The catch quota management system introduced in the Faroese fisheries in 1994 has been met with considerable criticism and it has resulted in at least some fleets misreporting substantial portions of their catches. As a result of the dissatisfaction with the catch quota management system, the Faroese Parliament has adopted a law stipulating that the system would end as of May 31, 1996. In addition, the Faroese government has developed, in close cooperation with the fishing industry, a new system based on individual transferable effort quotas in days. The new system has been submitted to the Parliament for approval. If approved by the Parliament, the effort quota system would enter into force on 1 June 1996.

The individual transferable effort quotas apply to 1) the longliners less than 100 GRT and the jiggers, 2) the single trawlers less than 400 HP, 3) the pair trawlers and 4) the longliners greater than 100 GRT. The single trawlers 400-1000 HP and greater than 1000 do not have effort limitations, but they are not allowed to fish within the 12 n. miles limit and the areas closed to them as well to the pairtrawlers have increased in area and time. Their harvest of cod and haddock will be limited by maximum by-catch allocation. The single trawlers < 400 HP are given special licenses to fish inside 12 n. miles with a by-catch allocation of 30% cod and 10% haddock. Holders of individual transferable effort quotas who fish outside of an area where cod and haddock are normally found can fish 3 days for each day allocated within the area of cod and haddock distribution. One fishing days by longliners less than 100 GRT is considered equivalent to two fishing days for jiggers in the same gear category. Therefore longliners less than 100 GRT could double their allocation by converting to jigging.

The effort quotas are transferable within gear categories but not between gears. The allocation of number of days by gear categories has been made such that the fixed allocation of catches in tons under the present management regime are expected to be maintained.

The number of days fished by gear category since 1985, the average for 1990-1995 and the proposed number of days by category for 1996 are presented in Table 2.1.5.

2.2 Faroe Plateau Cod

2.2.1 Trends in landings

The nominal landings of cod (1985-1995) from the Faroe Plateau by nations as officially reported to ICES, are given in Table 2.2.1. The relatively high recruitment in 1980-1983 maintained the good fishery for cod from 1983 to 1986 when the catches reached almost 40,000 t. The catches have steadily decreased afterwards to the point where only 6,000 tonnes were taken in 1993. This was the lowest catch on record. In 1995 the officially reported catches increased to 19,800 t. Preliminary information from the fishery during the first months of 1996 indicate further increase in the catches. Figure 2.2.12 A shows the landings of Faroe Plateau cod for 1961 to 1995.

In recent years, statistics for the Faroese fishery in that part of Sub-division IIa (Figure 2.1.1) which is within the Faroese EEZ, have become available. It is expected that these catches are taken from the Faroe Plateau area so they are included in the total catches used in the assessment. This is depicted in Table 2.2.2 under the row labelled "Total used in the assessment". No information on the Faroese catches in IIa were available for 1993-1995, however. The French catches of Faroe Plateau cod in 1989 and 1990 as reported to the Faroese authorities are also included

The fishery for Faroe Plateau cod has been considerable better in 1995 than in previous years. Due to the low individual quotas compared to the catch rates, substantial misreporting and discard is expected to have taken place. Informal information from the fishing industry indicate a misreported quantity in 1995 in the order of 3,000 tonnes (gutted weight) and the working group used this information in the assessment of the Faroe Plateau cod. The misreported catches are added to the officially reported catches as 3,330 t nominal weight, Table 2.2.2

During the last 15 years, the Faroe Plateau Cod has almost entirely been exploited by the Faroese fishing fleet. Table 2.1.1 and Table 2.2.3 show the landings disaggregated between the most important fleet categories. In recent years, the long liners and the pair trawlers have taken most of the catches. The long liners, at least those lesser than 100 GRT, have a directed fishery for cod during the entire year while the pair trawlers take cod mainly as by-catch in the saithe fishery.

Figure 2.2.1 shows the catch rates per day from 1985 to 1995 for the long liners, trawlers and jiggers. The catch rates have steadily decreased until 1992 while in the most recent years an increase is seen. Preliminary information from the fishery during the first months of 1996, indicates higher catch rates than in the same period in recent years.

2.2.2 Catch-at-age

Catch in numbers-at-age in 1995 is provided for the Faroese fishery in Table 2.2.4. Faroese landings from most of the fleet categories were sampled. The catch-in-numbers for the fleets covered by the sampling scheme were calculated from the age composition in each fleet category and raised by their respective catches. Catch-in-numbers for the catches taken by Norway were raised using the age composition of the long liners > 100 GRT. Catch-in-numbers for the other fleets fishing cod on the Faroe Plateau were raised using the overall Faroese age composition. The catch-at-age in number in recent years was revised according to the updated fishery statistics.

2.2.3 Mean weight-at-age

Mean weight-at-age data for 1995 are provided for the Faroese fishery in Table 2.2.5. These were calculated using the length/weight relationship based on individual length/weight measurements of samples from the landings. The sum-of-products-check for 1995 showed a discrepancy of 1 %.

Figure 2.2.2 shows the mean weight-at-age for 1978 to 1995. Since 1991 an increasing trend in the growth rates has been observed. Information on the mean weight-at-age in the 1st quarter in 1996 do not show an increasing trend compared to the same period in the years before (Figure 2.2.3).

2.2.4 Maturity-at-age

The proportion of mature cod by age are given in Table 2.2.6 and shown in Figure 2.2.4. Data are available back to 1983. The data were obtained during the Faroese groundfish surveys carried out in the spawning period (March). For the years prior to 1983 a knife-edge maturity ogive has been used in the past. In this year's assessment the average maturity at age for 1983 to 1996 were used for the years prior to 1983. The data files were revised accordingly.

Considerable changes have been observed in the proportion mature at age between years. In 1994 the proportion increase for most of the ages, particularly for age groups 2, 3 and 4. The working group considered smoothing of the data by using running averages rather than the observed estimates (Figure 2.2.4). Comparisons of the spawning stock size calculated by using the smoothed values instead of the observed did not reveal any substantial changes in the spawning stock size with exception in 1994 and 1995 (Figure 2.2.5). Therefore it was decided to continue to use the observed proportion mature for the years 1983 to 1996 as in previous years.

2.2.5 Groundfish surveys

The groundfish surveys in Faroese waters were initiated in 1983 and the research vessel *Magnus Heinason* has been used in the survey each year. Up to 1991 three cruises each year, with approximately 50 trawl stations in each cruise, have been conducted between February and the end of March. In 1992 the period was shortend by dropping the first cruise. Random stratified sampling based on depth stratification and on general knowledge of the distribution of fish in the area has been used to select the trawl stations. In 1992 one third of the 1991-stations were used as fixed stations. Since 1993 all stations were fixed stations. The standard abundance estimates is the stratified mean catch per hour calculated using smoothed age/length keys.

The overall mean catch (kg) of cod per unit effort (trawl hour) 1982-1996 is given in Figure 2.2.6. In the recent two years the cod CPUE have increased substantially. The stratified mean catch per trawl hour by age groups 2 to 7 are shown in Figure 2.2.7. The indices for all age groups have increased in the two last years. The increase in 1995 may be due to increased availability because the abundance of all ages increases compared to 1994.

After the meeting of North-Western Working Group in May 1995 some coding errors have been discovered in the survey database. These are now corrected and survey abundance estimates have been revised.

2.2.6 Stock assessment

2.2.6.1 Tuning and estimates of fishing mortality

Eight catch and effort series were available for tuning of the VPA. One series is derived from the annual Faroese groundfish survey (Table 2.2.7). The estimates of stratified catches in number by age groups per unit time are used as the surveys represented one fleet with constant effort for all the years in the tuning process. To use the results from the survey in 1996 in the assessment the results each year were shifted back in time by approximately three months.

The other catch and effort series available are obtained from long liners and trawlers (Table 2.2.8 - Table 2.2.14). The series consist of catch-at-age in numbers and the corresponding effort estimated as number of days at sea. Catches are broken down using the age composition from the sampling of the corresponding fleet categories. No attempt has been made to select those trips where the cod catches exceeded a certain percentage of the total catches.. The same series were also available to the North Western Working Group in 1995.

In the 1995 report of the North-Western Working Group, the tuning data series were analysed in depth and the same analysis is not performed this year. Following the findings of the 1995 North-Western Working Group neither the pairtrawlers series nor the single trawlers > 1000 HP are used for the assessment, age group 2 are removed from all of the commercial series and age group 3 fqr the single trawlers 400-1000 HP. The decision not to use these series was based on trends in the catchabilities.

One of the series used in the previous assessments of Faroe Plateau cod was the longliners < 100 GRT. They have usually caught 25 percent of the total cod catches (Table 2.2.3) on average but in recent years their share has dropped. It has been pointed out that this category may have changed their activity in recent years due to the low CPUE and partly due to the influence of changed management rules. This series was not used in the assessment as done by ACFM in the autumn of 1995.

In addition the series by the single trawlers < 400 HP is questionable because their fishing possibilities have been influenced by special management rules for this category only. These have been given special licenses for trawl fishery inside the 12 nautical miles zone during part of the year and different closed areas outside 12 n. mile, mainly to reduce their catches of cod. Also in the quota management system for the last two years this fleet has been given conditions that may affect the usefulness of the series in the Faroe Plateau cod assessment.

The remaining fleets are not expected to have been affected by misreporting of catches to any degree and the tuning data are not adjusted for misreporting in 1995.

In the autumn of 1995, ACFM concluded that the 1995 survey results for Faroe Plateau cod should be considered as outliers based on a multiplicative analysis of the survey results (Cook 1995). The Working Group attempted replicated the analysis with the same data and including values for 1996. The results shown in Figure 2.2.16 indicate that the 1995 and 1996 survey results should be considered as outliers.

In order to further evaluate whether the survey series could be used as a consistent index of stock size for 1983 to 1996, a series of ADAPT calibrations were done for 9 periods of 5 years of catch at age data, 1983 to 1987, 1984 to 1988 and 1991 to 1995 using only the survey results as indices of stock size. The survey results for the year following the last year of catch data were used in the calibration, i.e. the 1988 survey results were used for the 1983 to 1987 calibration, and the 1996 results in the 1991 to 1995 calibration. The ADAPT formulation used minimized the sum of squares between the natural log of predicted stock size indices and the natural log of observed stock size indices assuming that the two quantities are related by a linear relationship. The predicted indices are calculated as k.N by age where k are age specific calibration coefficient and N are the VPA numbers. The inverse of k, (1/k), can be seen as the factor by which the survey indices should be multiplied to obtain the VPA numbers, and this factor would be expected to be reasonably stable over time if the survey is to be used as a consistent index of stock size over the time period. The results of the calibrations are presented in Table 2.2.15 and Figure 2.2.8.

Except for age 2, the inverse of k can be considered to be relatively stable over the period studied except for the last one, 1991 to 1995 due to the 1995 and 1996 results. This suggests that "availability" to the survey would have increased considerably for all ages compared with previous years. Based on these results and on the multiplicative analyses presented to ACFM last year, the Working Group concluded that the substantially increased survey indices in 1995 and 1996 likely reflect increased availability of cod and therefore the survey results should not be used in the calibrations. Therefore, only the longliners greater than 100 GRT and the single trawlers 400 to 999 GRT were used in the ESA calibrations reported below as the other indices previously used, the small longliners and the large trawlers appeared to suffer from trends in catchabilities over time.

Fishing for cod on Faroe Plateau in 1995 and in the first part of 1996 has been very successful and it is possible that the commercial indices of stock size used in the calibrations have also been affected by increased availability. The increase in CPUE for these fleets is less than that for the surveys, and it is possible that the increased availability would be particularly high during spawning time, when the survey is conducted. If the commercial indices were also rejected, there would be no basis to conduct a calibrated VPA assessment. The Working Group therefore went ahead with the calibrations using the two commercial indices, bearing in mind that availability might also have increased for these gear types.

The final assessment was done by using the XSA method assuming the catchability of age groups < 3 years being dependent of year class strength, the catchability being independent of age for age groups 6 and older, using shrinkage of s.e.= 0.5 and survivors estimates shrunk towards the mean F of the final 5 years or the 5 oldest ages.

The residuals of log catchabilities are shown in Figure 2.2.9. The results from the retrospective analysis of the XSA (Figure 2.2.10) show that including the 1995 point has a large influence on the results of the assessments.

Figure 2.2.11 shows that using XSA or ADAPT gives almost the same results regarding the fishing mortality, the spawning stock size and the recruitment

The estimates of the fishing mortalities derived from the XSA tuning process and the diagnostics information are given in Table 2.2.16. The s.e. of log q are quite high, but at the same level as the accepted final XSA run last year.

The estimated fishing mortalities are shown in Table 2.2.17 and in Figure 2.2.12.A. The average F for age groups 3 to 7 in 1995 ($F_{(3-7)}$) is estimated at 0.56 compared to $F_{(3-7)}$= 0.32 in 1994. The average fishing mortality is far above F_{max}. (F_{max}.= 0.38).

2.2.6.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.2.18. A summary of the VPA, with recruitment set at 2 years old, and biomass estimates are given in Table 2.2.19 and in Figure 2.2.12.B. The stock-recruitment relationship is presented in Figure 2.2.13.

The assessment confirms the poor recruitment observed in the Faroe Plateau cod stock for the 1984 to 1991 year classes. Due to this continuous poor recruitment and the high fishing mortalities, the spawning stock biomass has steadily declined from 1983 to 1992 when it was lowest on record at 17,000 t. In 1994 it increased sharply to 55,000 t from 26,000 t in 1993. The increase is partly due to a very high proportion of mature for ages 2 and 3 (Table 2.2.6) and an incoming year class (1992) larger than all the previous ones. For 1995 it is estimated at the same level as in 1994. The assessment indicate the 1992 year class to be above the long term average level and the 1993 year class to be well above the same level.

2.2.7 Predictions of catch and biomass

2.2.7.1 Short-term prediction

In the short-term predictions the estimates of the year classes 1992 and older were used as they are estimated in the final VPA. The year classes 1993 to 1995 were predicted using the RCT3-program. As input for running RCT3, stratified mean catch-per-hour of age group 2 to 4 in the Faroese groundfish surveys were used as well as the index obtained from the annual 0-group surveys at Faroes, Table 2.2.20. The output of the RCT3 prediction of the recruitment program is given in Table 2.2.21.

No data are available to estimate the 1996 year class. In recent years the recruitment to the Faroe Plateau cod stock has been poor although the data indicate better recruitment from the 1992 and the 1993 year classes. Based on this, the average of the 1984 to 1992 year classes, as estimated from VPA (9.7 millions at an age of 2), was used as input for the 1996 year class.

The input data for the short-term prediction are given in Table 2.2.23. The exploitation pattern in the short term prediction was the average level of F's in 1993-1995 rescaled to the level of F in 1995. A trend of an increase in the mean weight at age since 1991 was observed (Figure 2.2.2) but as mean weight at age data for January-March 1986-1996 (Figure 2.2.3) do not indicate any further increase in the mean weights it was decided to use the most recent observed mean weights (from 1995) as input parameter for 1995 and for 1997 and 1998 the average of 1993-1995 was used. The proportion mature as seen in the Faroese groundfish surveys in 1996 was used for 1996 while for 1997 and 1998 the average of the maturity ogive for 1983 to 1996 was used.

Predictions based on two different assumptions regarding the fishing mortality in 1996 were done. The first was based on *status quo* F in 1996 compared to 1995. The results from this prediction are shown in Table 2.2.23, and in Figure 2.2.12 D. The spawning stock in 1996 and 1997 is estimated at 55,000 t, which is well above the spawning stock sizes in recent years. Keeping the fishing mortality in 1997 at the 1995 level will lead to a decrease in the spawning stock size. The catches in 1996 increase to 27,000 tonnes and to 29,000 t in 1997 by keeping the fishing mortality at the 1995 level.

In addition a short-term prediction taken into account anticipated changes in the effort for cod in 1996 based on the new management scheme expected to be implemented 1 June was also done. (The changes are described in Section 2.1.1). At present it is not possible exactly to state the effect of the changes of management since it has not yet been approved by the Parliament. Taking into account that the effort quotas will be implemented from 1 June the number of fishing days in the proposal indicate a reduction of the effort by 23 % compared to 1995 regarding the cod fishery, however. Therefore another prediction was made with F in 1996 derived as the 1995

F times 0.5 plus the 1995 F times 0.5 reduced by 23 %.. This gives an average fishing mortality in 1996 of 0.50 corresponding to a F factor in 1996 of 0.895. Following this the catches are predicted slightly lower in 1996 and 1997 and the spawning stock slightly higher than in the *status quo* F prediction, Table 2.2.24.

2.2.7.2 Medium-term prediction model and input data

This required first fitting the Ricker stock-recruitment curve given in Figure 2.2.13. This relationship was used for the 1996 year class and onwards.

Simulations were then performed by assuming random (log normal) recruitment around the stock-recruitment relationship and (log normal) uncertainty in the current (1996) stock estimate. The catches taken each year were simply fixed at a specified level, although other management strategies could have been tested.

Results from the simulations are given in Figure 2.2.14. Simulations were done assuming a fixed catch quota of 20,000 t and 25,000 t each year, respectively.

It should be noted that one of the sources of problems in the assessments and predictions for this stock has been the change in mean weight-at-age. This uncertainty has not been taken into account in the simulations.

2.2.7.3 Minimum biological acceptable level (MBAL)

The stock-recruitment scatterplot (Figure 2.2.13) was examined to identify MBAL. There are no clear breaking point where the possibility of average or above average year-class is lower at lower SSB's. Although no strong year-class have been produced at SSB's lower than 70,000t , the Working Group was not able to identify an MBAL.

2.2.7.4 Long-term prediction

The input data for the yield-per-recruit calculations (long-term predictions) are given in Table 2.2.25. The long term (1961-1995) exploitation pattern was used as input in the prediction. The Working Group furthermore inspected a prediction using a short term exploitation pattern (1993-1995) but since only small differences were obtained compared to the other one it was decided to use the long term exploitation pattern. As input for mean weight-at-age the average for 1978 to 1995 was used and for the proportion of mature-by-age groups, the average for the years 1983 to 1995 was used as input.

The output from the yield-per-recruit calculations is shown in Table 2.2.26. and in Figure 2.2.15 C. $F_{0.1}$ and F_{max} are calculated to be 0.17 and 0.38, respectively. These values should be compared with the present average fishing mortality in 1995 of 0.56. From Figure 2.2.13, showing the spawning stock biomass per recruit relationship, the values of F_{med}=0.47 and F_{high}=1.25 were estimated.

2.2.8 Management considerations

The new management system proposed by the Faroese government could reduce the fishing mortality on cod in 1996 by a maximum of about 23% if all the factors relating nominal fishing effort to fishing mortality were the same in 1996 as in 1995 except for the number of days fished. It is highly unlikely, however, that all factors will remain the same, and the decrease in fishing mortality will probably be less than 23%. It is also possible that the fishing mortality will not decrease at all.

Management systems based on effort controls are expected to lead to overcapitalisation in the fishing fleets because fishing captains will want to maximise the catch they can harvest with the fishing effort allocation they have received. In the medium to long term, this process will lead to increased fishing efficiency of the fleets and it will be necessary to decrease the total number of fishing days available to be allocated in order not to exert excessive fishing mortality. In extreme cases, effort controls can lead to the fishery being open only for a few days per year as happened for Pacific Halibut in certain areas.

2.2.9 Comments on the assessment

ACFM, in October considered the increase in the 1995 survey index of the stock size to be an outlier. The analyses reported here support this conclusion and suggest that the 1996 survey index should also be considered an outlier. The assessment is based on two indices of stock size derived from the commercial fishery which may have been affected by management measures and technological changes.

The assessment of the Faroe Plateau cod presented in this report indicate that the stock size has increased substantially from its previous very low level. Some of this increase can be attributed to the average 1992 year-class and the above average 1993 year-class, but the current assessment also shows several other year-classes as being more abundant than in the previous assessment. It is therefore possible that the increase is only apparent, perhaps as a result of increased availability. If this were the case, the existing fishing effort could exert very high fishing mortality.

2.3 Faroe Bank Cod

2.3.1 Trends in landings and effort

Total nominal landings of the Faroe Bank cod from 1985 to 1995 as officially reported to ICES are given in Table 2.3.1. The catches reached a maximum of 5,000 t in 1973. In recent years the catches have declined from 3,000 t in 1987 to only 325 t in 1992. In 1994 the catches increased to 950 t and decreased to 675 t in 1995..

Due to the decreasing trend in the cod catches at Faroe Bank, ACFM in 1990 advised the Faroese authorities to close the Bank to all fishing. This advice was followed for depths shallower than 200 meters. In 1992 and 1993 long liners and jiggers were allowed to participate in an experimental fishery inside the 200 meter depth contour. The catches reported for 1992-1994, therefore, partly originate from the shallower parts of the Bank. For the quota year 1 September 1995 to 31 August 1996 a fixed quota of 1,050 t has been set.

2.3.2 Stock assessment

The available data for the Faroe Bank cod is not adequate to allow for a detailed analytical assessment of the stock, but the results of a tentative general production model are presented.

Figure 2.3.1 shows catch per unit effort (kg/day) of cod on the Faroe Bank for two categories of longliners. The CPUE declined after 1989 and have been at a low level in recent years.

The Faroese groundfish surveys covers waters on the Faroe Bank. Cod is mainly taken within the 200 m depth contour. The catches of cod per trawl hour in water shallower than 200 meter are shown in Figure 2.3.2. The CPUE declined from 220 kg in 1984 to only 25 kg in 1990. The index of stock size increases in recent years, reaching its highest value in 1996.

The length distributions in the long line fishery in 1 quarter 1994-1996 are shown in Figure 2.2.3. In 1994 the catches consisted of fish from 40 to 100 cm while in 1995 the catches mainly consisted of fish between 45-80 cm. In 1996 it consist of 40-50 cm and of fish between 65-80 cm, age group 2 and 3 respectively.

A Schaefer general production model was fit to the Faroe Bank cod landings data using the research vessel survey results for 1984 to 1995 in kg/hour as an index of stock biomass. The Schaefer model is defined by three parameters, the intrinsic rate of growth of the stock (r), the virgin biomass or carrying capacity (k) and the catchability coefficient (q). In addition, it is necessary to have an estimate of the initial biomass at the start of the time series in order to derive yearly estimates.

The model was fitted using Excel Solver to minimize the sum of squared residuals between the observed CPUE and the predicted CPUE where the predicted CPUE is:

$$CPUEpred_t = B_t \cdot q$$

and the biomass is:

$$Bt+1 = Bt + (r \cdot Bt \cdot (1\text{-}Bt/k)) - Ct$$

where C is catch.

Preliminary estimates of feasible catchability coefficients (q) were calculated by assuming that the average harvest rate for 1983 to 1995 was 0.6 and by dividing by the average fishing effort over the period, obtained by dividing the total catch by the CPUE. An initial estimate of q=0.03 was used. The virgin biomass (k) was constrained to be higher than the assumed initial biomass of 5,000 tons, r was constrained to be between zero and one, while q was constrained to be higher than 0.001.

Initial guesses to start the calculations were r=0.9, k=10,000 t, q=.03 and initial biomass = 5,000 t. Several minimizations, one parameter at a time, then two, three and finally four at a time were made until reasonably stable results were obtained.

The minimization was done for 1984 to 1995 with the initial biomass estimated for 1983. Landings, CPUE, predicted CPUE and the residuals are presented in Table 2.3.2 while the equilibrium production curves with the transient points, the residuals vs CPUE and vs time and the CPUE observed and predicted versus time are shown in figure 2.3.4. The parameter estimates are given in the text table below:

Virgin Biomass	Rate of increase	q	Init. Biomass
11654 t.	.558	.027	9294

MSY would be about 1,900 t at a harvest rate of 0.35. The results presented above should be used with caution as they are based on very limited data, several assumptions and that different minimizations may give different results. They nevertheless indicate that the current TAC of 1,000 t for 1996, if caught, could result in an exploitation rate in the order of .26.

2.3.3 Management considerations

The data presented indicate that the stock appears to be increasing from its previous low abundance. However, similar to Faroe Plateau cod, it is not known if the increase in the survey is due to increase abundance or increased availability. Therefore, caution should continue to be exercised in order to rebuild the biomass to values which will produce good recruitment on a sustained basis.

2.4 Faroe Haddock

2.4.1 Landings and trends in the fishery

Officially reported catches of haddock from the Faroe Plateau increased from a low level of 10,000 t in 1982 to 14,000 t in 1987, but later decreased to a very low level in 1993 and 1994 below 4,000 t; a slight increase to about 4,600 t was noted for 1995 (Table 2.4.1). Officially reported catches for 1981-1992 from the Faroe Bank have varied between 500 and 1,600 t (on average 1,000 t), but dropped in 1993-1995 to 300-350 t. The closure of the fishery on the shallower parts of the Bank in 1990 and the introduction of a controlled fishery there since 1993, as described in section 2.1, reduced the Faroese catches (Table 2.4.2) whereas Scottish catches remained relatively high in 1990-92. However, in the assessment only the fraction of the Scottish catches which have been reported to the Faroese authorities are included. In addition, some minor French catches in Division Vb, reported to the Faroese authorities, and minor Faroese catches of haddock in ICES Sub-Division IIa4 close to the boundary with Sub-Division Vb1 (see Figure 2.1.5), are used in the assessment (Table 2.4.1).

Faroese vessels have taken almost the entire catch in recent years. Table 2.4.3 shows the Faroese landings since 1985 and the proportion taken by each fleet category. Pair trawlers and longliners took most of the catches in these years and within these two groups the relative importance of the larger vessels has increased. Due to poor catches and poor economic conditions, the effort of most fleets has decreased during the most recent years with a slight increase in 1995 (Tables 2.1.4 and 2.4.8). In addition, the fishing ban on the cod spawning grounds before and during the spawning period of cod since 1992 (Section 2.1) has had an impact on the haddock fishery as well. The catch per unit effort for most fleets has declined drastically since the late 1980s. However, the decline for the long liners seems to have levelled off in 1993-95, while the CPUE for the trawler fleets has risen slightly during these years (Figures 2.4.1-2.4.3).

The 1995 monthly Faroese landings of haddock by fleet category from Sub-Divisions Vb1 and Vb2, are shown on Figures 2.4.4-2.4.5. In both areas most of the catches are taken prior to and during the spawning season in the spring and in November/December. Due to fisheries regulations (see Section 2.1), the longliners take almost all the catch on the Faroe Bank; on the Faroe Plateau the longliner catches are substantial except during the summer months when most of the longliners fish in deeper waters and/or outside the Faroese EEZ.. The longline fishery mostly targets both cod and haddock, while trawler catches of haddock in the most recent years must be regarded as a by-catch.

2.4.2 Catch at age

For the Faroese landings, catch-at-age data were provided for fish taken from the Faroe Plateau and the Faroe Bank. Data from the two areas were combined as the fish are believed to belong to the same stock.. Samples from each fleet category were disaggregated by season and then raised by the catch proportions to give the 1995 catch at age in numbers for each fleet (Table 2.4.4). Catches of some minor fleets have been included under the others heading. No catch-at-age data were available from other nations fishing in Faroese waters. Therefore, catches by UK trawlers were assumed to have the same age composition as Faroese otter board trawlers greater than 1000 HP. The Norwegian longliners were assumed to have the same age distribution as the Faroese longliners greater than 100 GRT. The most recent data were revised according to the final catch figures. The resulting total catch at age in numbers are given in Table 2.4.4 and Table 2.4.5.

2.4.3 Weight at age

Mean weight-at-age data are provided for the Faroese fishery (Table 2.4.6). The sum-of-products check for 1995 was 1.03. Figure 2.4.6 shows that the mean weights-at-age for most age groups, which were declining since the mid-1980s, stabilized at a low level for 2-3 years and increased again in 1993-1995. The weights of the 2 and 3 year old seem to have stabilized, however. The growth by each of the 1975-1992 year classes (Figure 2.4.7) also show increased growth in these years. The increase in growth seems to continue in 1996 as the mean weights at age for the commercial landings in the first quarter of 1996 are considerably higher than the corresponding weights in the 1st quarter of 1995 for all ages except the 2 and 3 years old.

2.4.4 Maturity at age

Maturity-at-age data were available from the Faroese Groundfish Surveys 1982-1996 (Table 2.4.7). The surveys are carried out in March-April, so the maturity at age is determined just prior to the spawning of haddock in Faroese waters and the determinations of the different maturity stages should be relatively easy. In order to reduce eventual year to year effects due to possible inadequate sampling and at the same time allow for trends in the series, a 3 year running average was used every year in the series. For the years prior to 1982, average maturity at age from the surveys 1982-1995 was adopted.

2.4.5 Assessment

2.4.5.1 Tuning and estimates of fishing mortality

Following numerous analyses of all available series of catch and effort data, it was decided at the 1995 meeting of the North Western Working Group to reduce the number of fleets to five and omit some years and ages from the series. The same revised fleets have been updated to include the 1995-data and are used for tuning of the VPA in this assessment. The trawl survey is carried out every year in February-March, so the results are available prior to the annual North Western Working Group meeting; the estimates of catches in numbers at age per trawl hour in the surveys are used as if they represented one fleet with the same effort for all the years in the tuning process. The commercial series consist of effort measured in number of fishing days and the corresponding catch at age in numbers for each fleet (Table 2.4.8).

Initially, two XSA runs based on these five fleets using default settings were made. In one case, the survey estimates in the spring 1986-95 were used, in the other the survey estimates 1986-96 were shifted back to the end of the year before. The retrospective patterns of the resulting fishing mortalities in each of these two runs (Figures 2.4.8 - 2.4.9) are almost identical, and it was decided to use the shifted survey series, because it contains more recent information. Two additional XSA runs (using the shifted survey), and shrunk 0.3 and 0.7, respectively, did not show improved retrospective patterns compared to the one with default settings (Figures 2.4.10-2.4.11).

The diagnostics from the XSA are shown in Table 2.4.9, and a plot of the log catchability residuals for each of the five fleets is shown in Figure 2.4.12. In general, both the diagnostics and the residual plots show high CV's, and the residual plots are more noisy and even with some trends compared to the plots in last years report when the fleets were analysed separately using Laurec-Shepherd *ad hoc tuning*. This could be an effect of some interactions between fleets. In addition, it should be noted that the 1995 survey estimates were revised after the North Western Working Group-meeting resulting in higher estimates for most ages (Maguire *et al,* 1995).

Additional XSA runs were done removing some of the fleets and ages from the tuning. When the small longliners were excluded, the XSA resulted in extremely low fishing mortalities, while removal of age 4 in the large longliners or the survey (partial or totally) did not change the fishing mortality level substantially. It was therefore decided to use the above mentioned XSA (with four commercial fleets and the shifted survey) in this assessment.

The fishing mortalities from the final XSA run are given in Table 2.4.10 and in Figure 2.4.13A. Up to 1991 there was an increase in fishing mortality. This is consistent with the decreasing stock sizes and the information on increased effort (more hooks per set) and decreased hook sizes in the long line fishery. However from 1992, the mean F for ages 3-7 decreased again which may be partly explained by the introduction of a fishing ban on the cod spawning grounds before and during the cod spawning season, and the poor economic situation for most fleets which is reflected in the decline in number of fishing days in 1993 and 1994 as seen in Table 2.1.4. In these two years, the fishing mortality is estimated to be below the natural mortality of 0.2. A slight increase in mean F is noted in 1995.

2.4.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.4.11 and a summary of the "VPA" with the biomass estimates is given in Table 2.4.13B. The spawning stock biomass has decreased from over 68,000 t in 1987 to 20,000 t in 1994 with a slight increase to 21,000 t in 1995. However, this decline in the spawning stock begun in the late 1970s due to very poor recruitment in those years. The stabilisation in the spawning stock biomass at a relatively high level in the mid-1980s was due to the relatively good 1982 and 1983 year classes, but the decline since then was partly due to poor year classes since the mid-1980s, as well as the pronounced decline in the mean weights at age in the stock. The mean weights at age seem, however, to have increased again for most ages from 1993 onwards (Figures 2.4.6-2.4.7), and the most recent recruitment indices are optimistic regarding the 1993 and 1994 year classes (see below).

2.4.6 Prediction of catch and biomass

2.4.6.1 Input data

2.4.6.1.1 Short-term prediction

The input data for the short-term predictions are given in Table 2.4.16

The year classes up to 1992 inclusive are from the final VPA while the 1993-95 year classes at age 2 were predicted using the RCT3 program. As input for RCT3, stratified mean-catch-per-hour of age groups 1-3 in the Faroese groundfish survey 1986-96 were used (Table 2.4.13). A second run was made based on the full survey series back to 1983, but the output is not presented in the report, as the diagnostics from the regressions were poor, and there is considerable doubt regarding the indices from the early years in the survey series. However, the estimates of the 1993- and 1994 year class abundances in this run almost doubled compared to the accepted run. The output from the RCT3 is given in Table 2.4.14. The 1993 year class at age 3 is estimated from the RCT3 value at age 2 using a natural mortality of 0.2 and a mean fishing mortality for 2 year olds in 1992-94. The 1996 year class at age 2 was estimated as the average of the 2 years old in 1986-95.

The exploitation pattern used in the prediction was derived from averaging the 1993-1995 fishing mortality matrices from the final VPA and then rescaling the averages to the 1995 level.

By comparing mean weights at age for the first quarter of 1995 and 1996, respectively, it is seen, that the mean weights at age are still increasing. However, this increase seems to level off. Mean weights at age now are near the highest observed. The mean weights-at-age in the stock and catch 1996 were therefore calculated by adding the average annual growth by age group in 1993-95 to the observed weights at age in 1995 (Average annual growth = w(a+1,y+1) - w(a,y)). The 1996 mean weights at age were also applied for 1996 and 1997 as the growth is not expected to increase further. The mean weights at age for the two year olds in each of the years 1996-98 were calculated as the average weight at age for age 2 in 1992-94.

The maturity ogive for 1996-98 is based on samples from the Faroese Groundfish Surveys and estimated as the average of the observations in 1994-96.

2.4.6.1.2 Medium-term prediction

The Working Group considered the medium term consequences of different management strategies for this stock in a medium prediction model (risk-analysis) for 1996-2005. The input data for the risk analysis are similar to those used in the short-term prediction. The first step was to fit a Ricker stock-recruitment curve to the stock-recruitment data (Figure 2.4.16). This relationship was applied for the year classes from 1996 onwards. Simulations were then performed by assuming random (log normal) recruitment relationship and (log normal) uncertainty in the current (1996) stock estimate. Three different approaches were made: The catches taken each year were simply fixed 1) at a specified level, i.e. the predicted 1996 catch assuming status quo F 2) at a specified level, i.e. the actual quota on 12,600 t and 3) as 1/3 of the spawning stock biomass.

2.4.6.1.3 Long-term Prediction

The input data for the long-term yield and spawning stock biomass (yield per recruit calculations) are listed in Table 2.4.18. Mean weights-at-age are averages for the 1977-1995 period. The maturity ogives are averages for the years 1983-96. The exploitation pattern was derived from the fishing mortality matrix from the final VPA as average F-values for the long time period. Before averaging the annual fishing mortalities were scaled to let the Fbar(age3-7) equal 1.0. In the input table the values are rescaled again to the Fbar(age3-7) long term average. An additional long-term prediction was done using a recent exploitation pattern, i.e. the pattern used in the short-term prediction.

2.4.6.2 Biological reference points

The yield- and spawning stock biomass per recruit (age 2) based on the long-term data are shown in Table 2.4.19 and Figure 2.4.14C. F_{max} and $F_{0.1}$ are indicated here as 0.54 and 0.18, respectively. From Figure 2.4.15, showing the recruit/spawning stock relationship, and from Table 2.4.19, F_{med} and F_{high} were calculated to be 0.24 and 0.7, respectively.

The results of the additional prediction are not presented in the report, but the F_{max} and $F_{0.1}$ were estimated at 0.47 and 0.14, corresponding to yields of 623 g and 523 g, respectively.

2.4.6.3 Projections of catch and biomass

2.4.6.3.1 Short-term prediction

The TAC for the fishing year 1995-96 has recently been increased to 12,600 t. Assuming the same TAC for the next fiscal year and that this amount will be caught, the calendar year catches in 1996 could reach 12,600 t. In such a case the F-factor has to be set at 1.87 resulting in a reference F of 0.39. Observations from the fishery in 1996 and the possible implementation of a new management regime during 1996 (Section 2.1) would suggest that it is not likely that this catch level will be taken. It was therefore decided to run the prediction with a status quo reference F in 1996. The catch in 1996 is then predicted to be about 7,300 t and continuing with this fishing mortality will result in a 1997 catch of 9,300 t. The SSB will in this case increase from 27,000 t in 1996 to 49,000 t in 1998. The results of the short-term prediction are shown in Table 2.4.17 and Figure 2.4.14D.

2.4.6.3.2 Medium-term prediction

The results of the risk analysis indicate that if the predicted 1996 catch of 7,300 t assuming *status quo* F is applied for each year in the period 1996-2005, the spawning stock biomass most likely will continue to increase during the period to more than 60,000 t (Figure 2.4.17). If the agreed TAC of 12,600 t is taken each year, the initial increase in the spawning stock biomass due to the recruiting 1993 and 1994 year classes will cease within few years and the stock will slowly decrease during the period on a low level below 30,000 t (Figure 2.4.18). If 1/3 of the spawning stock biomass is taken each year 1996-2005, the stock most likely will stabilise at a level of 35-37,000 t (Figure 2.4.19).

2.4.7 MBAL

An MBAL of 40,000 t has been applied to this stock by ACFM. This was evaluated during the Working Group-meeting. A ranking of the estimates of year class strength from the final 1996 VPA is shown on Table 2.4.15. Tentatively, year classes falling within the first quartile are considered poor, those within the second and third as medium strength year classes and those within the fourth quartile as good. Accordingly, two horizontal lines were drawn on the SSB-R plot, Figure 2.4.15. Two vertical lines can now be drawn, one at SSB equal to about 40,000 t, below which only poor recruitment has been observed, and one at SSB equal to about 65,000 t, to the right of which no good year classes have been observed. Based on this splitting of the scatter diagram, the probability of obtaining a certain year class strength at the three SSB regimes was calculated (Table 2.4.17A). From this calculation it appears advisable to let the SSB stay at the 40-60,000 t level, suggesting that the former definition of MBAL for this stock would seem reasonable. However, the 1993- and 1994 year classes are in this assessment predicted to be near the long term average (open dots in Figure 2.4.15), and the SSB is estimated to be below the assumed MBAL.

The reasons for this discrepancy could be related to ecological phenomena because good year classes seem to occur in many areas at the same time. Another possible explanation could be the structure or quality of the SSB. Inspecting the stock in number table (Table 2.4.11) it is seen, that even if the stock at present is small, the proportion of old fish in the stock is high. This may enhance reproductive success.

2.4.8 Management considerations

The present assessment confirms that the spawning stock biomass is still at the lowest level on record. Reasons for this are mainly the low level of recruitment and the pronounced small mean weight-at-age in recent years. The growth has, however, improved since 1992, and the 1993 and 1994 year classes are predicted to be near the long term average strength. There seems to be good possibility, that the stock will reach safe biological limits within a few years.

2.5 Faroe Saithe

2.5.1 Landings and trends in the fishery

Saithe landings from the Faroese grounds were stable at around 40,000 - 45,000 t in the period 1985-1989 (Table 2.5.1). In 1990 the catches reached a record high of about 60,000 t. Since then catches have steadily decreased and were about 27,000-33,000 t in 1993-95. Preliminary statistics for the first quarter of 1996 show the total landings to about 7,250 t compared to about 9,450 t in 1995.

For all practical purposes saithe has been fished only by Faroese vessels since the introduction of the 200 nm EEZ in 1977. The principal fleet consists of large pair trawlers, with engines larger than 1000 HP, accounting for 60% of the catches in 1993-95. In the same period the smaller pair trawlers (<1000 HP) caught 19%, jiggers 11% and large single trawlers 8%. All other vessels only had small catches of saithe as by-catch.

Generally speaking effort has increased in 1995 compared with the previous year, Figure 2.1.4. The effort of the larger pair trawlers increased from around 3,000 days at sea to 7,700 days in the period 1985-91. It has since declined to about 5,300 days in 1994 but increased to 6,700 days in 1995. In the smaller pair trawler fleet effort was at a stable level at around 5,500 days in the period 1985-91 and then dropped to 2,000 days in 1994 and increased again to 2,600 days in 1995. Since 1985 effort of the large single trawlers declined from 5,300 days to around 3,500 days in 1990 and stayed at that level until 1995 when it increased to 4,300 days. The effort of jiggers has increased through the period 1985-95 from 3,000 days to an intermediate level of 8,000-10,000 days in 1988-93 and increased to 19,000 days in 1995.

In the last ten years the larger pair trawlers CPUE has ranged between 2.1 t/day to 3.5 t/day. It has varied between about 1.4 t/day to 2.8 t/day for smaller pair trawlers (Table 2.5.3). For both groups of pair trawlers there has been an increase in CPUE in the period 1992-94 but a decrease in 1995. In the period 1985-95 there has been a downwards trend in CPUE for single trawlers. For the larger single trawlers catch rates went down from about 2.4 t/day to about 0.6 t/day whereas for the smaller single trawlers the drop was from about 1.3 t/day to 0.2 t/day. Except for one year in the period 1985-95 the CPUE for jiggers has varied between 0.3-0.5 t/day. Since 1991 there has been a downwards trend in CPUE for this fleet category.

Catches used in the assessment are presented in Table 2.5.2. These include foreign catches that have been reported to the Faroese Authorities but not officially reported to ICES. Also catches in that part of Sub-division IIa which lies immediately north of the Islands have been included .

2.5.2 Catch at age

Catch at age are based on length and otolith samples from Faroese landings mostly in the fleet categories small and large pair trawlers and jiggers and landing statistics by fleet provided by the Faroese Statistical Department for Faroese landings and the Faroese Coast Guard for catches by foreign vessels. Catch at age was calculated by each fleet and by each third of the year before the numbers were combined. Finally the numbers were raised by the foreign catches.

Catches and effort are shown by fleet categories for the period 1985-1995 in Tables 2.1.3 and 2.1.4 and CPUE by fleet categories is presented in Table 2.5.3 and Figure 2.5.1.

Catch at age data in previous years were revised according to the final catch statistics.

2.5.3 Weight at age

Through the period 1961-1995 mean weight at age has varied, *e.g.* with mean weights for age 5 between about 1.5 kg to 3.4 kg and for age 7 between 3.1 kg and 5.3 kg, Table 2.5.5 and Figure 2.5.2. In the period 1984-1986 mean weight at age values were high and dropped to a low level in the years 1990-1991. Mean weights have generally been increasing since, although, they have stabilised or decreased for some ages in 1995.

The SOP for 1995 shows a discrepancy of 2% which was not corrected for by the working Group (Table 2.5.4).

2.5.4 Maturity at age

Maturity at age data are available for the period 1983-1996 (Table 2.5.6). Because of poor sampling in 1988 the proportion mature for that year was calculated as the average of 1987 and 1989. In 1994 and 1995 the values for proportion mature were unrealistically high probably caused by biased sampling. Data for the period 1983-1996 were used to fit a sigmoid model to the proportion mature and it was decided to use these (Table 2.5.6 and Figure 2.5.3). In the period 1961-1982 the average for the period 1983-1992 was used.

2.5.5 Stock assessment

2.5.5.1 Tuning and estimation of fishing mortality

Three tuning series were available: research vessel trawl survey data for the period 1983-1996, a series from commercial pair trawlers (also referred to as the Cuba trawlers) for 1982-1995 and a commercial jiggers series for 1991-1995. The Cuba trawler series extends back to 1982 and consists of data from 8 pair trawlers larger than 1000 HP which specialise in fishery on saithe and account for 5,000-8,000 t of saithe each year, Table 2.5.7.

ADAPT calibrations were performed using the three available tuning series. Each stock size index was examined individually and combined with the Cuba trawler fleet, the index used in previous Faroe saithe assessments. The ADAPT methodology used here minimized the sum of squares between the natural log of predicted stock size indices and the natural log of observed stock size indices assuming that the two quantities are related by a linear relationship. The calibrations were aimed at evaluating the usefulness of the various tuning series.

Positive, statistically significant correlations were obtained between the stock size index and VPA population estimates with each one of the three stock size indices. The 1996 indices at age for the research survey are substantially lower than those for 1995 for all ages, sometimes by an order of magnitude, and, for many ages, they are by far the lowest in the time series. Although there are no *a priori* reasons to reject the 1996 survey values, the calibrations with the research survey data used the data for 1983 to 1995. The following table lists the runs made and the mean square residual of the calibration, a measure of the goodness of fit.

Number	Model	Mean Square Residual
1	Cuba trawlers ages 3-8	.142011
2	Cuba trawlers ages 3-8 adjusted	.15839
3	Research survey 1983-1995 ages 4-7	.30423
4	Jiggers 1991-1995 ages 6(excl.95),7,8,9,11,12	.25719
5	No 1 an 3	.87021
6	No 1 and 4	.20427
7	No 1, 3 and 4	.79148

The RV and Jigger series, even when outliers are excluded from the calibrations, are clearly more variable than the Cuba trawlers series. Combining the Cuba trawlers and the jiggers provides a reasonably low mean square residual, but the fishing mortalities thus estimated are all greater than 2.5 for age 9 and older. The mean square residual increases considerably when the research survey results are combined with the Cuba trawlers, either alone, or in combination with the jiggers.

Based on these calibrations, the jiggers and the RV series were not considered to be useful indices of stock sizes at this time. Further work and the addition of new data points could change this perception.

Only the commercial pair trawlers tuning data series was used in the assessment similar to previous years for the reasons explained in the 1993 Working Group report (Anon., 1993) .

The log catchability residuals from the XSA tuning for age 4-8 are presented in Figure 2.5.4 and they indicate a downwards trend over the period 1986-93 with increases in 1994-95.

An XSA run was made with almost the same parameters as last year except that q was assumed dependent on stock size for ages less than 4 and for time tapering applied on 20 years rather than 12 in last year's assessment. The diagnostics from this run are shown in Table 2.5.8. The estimated fishing mortalities from the XSA are presented in Table 2.5.8 and the long term fishing mortalities for 1961-1995 in Table 2.5.9. The average fishing mortality for age groups 4-8 was 0.42 in 1995.

The corresponding retrospective analysis for age 4-8 is presented in Figure 2.5.5 and shows a reasonably good convergence for the last 5 years.

2.5.5.2 Stock estimates and recruitment

The spawning stock biomass reached its historical lowest values in 1992-1995 even if recruitment has seldom been below the long term average geometric mean recruitment of 22 millions in the period 1980-93 (Figure 2.5.6B). A summary of recruitment, total biomass, spawning stock biomass etc. for the period 1961-1995 is given in Table 2.5.11.

Stock in numbers at age as estimated by the VPA are presented in Table 2.5.10. The high numbers in the stock in 1986-1990 are due to very good recruitment. The long term mean of recruits as 3 year old for the period 1961-95 is 22 mill. (geometric mean). The recruits in 1991 and 1993 are about 26 million, a little above long term mean whereas the recruits in 1992 are about 17 mill.

Spawning stock biomass is given Figure 2.5.6B. The decline of the spawning stock biomass from about 110,000 t in 1988 to a level of 70,000-75,000 t in 1992-94 is continuing to a record low 66,000 t in 1995.

2.5.6 Prediction of catch and biomass

2.5.6.1 Input data

Input data for prediction with management option are presented in Table 2.5.12 and input data for the yield per recruit calculations are given in Table 2.5.14. Stock in numbers up to year class 1992 are from the final VPA whereas for the 1993-1995 year classes both the geometric mean recruitment of the period 1961-95 and the arithmetic mean of the 3 most recent years were used.

For all three years in the short term prediction (prediction with management options) the mean weight at ages 4-8 were predicted using mean weight in 1995 and adding mean weight increase for the three previous years in each age group. For other age groups in 1995 the mean weight was calculated as the average for 1993-1995. In the long term prediction (yield per recruit) mean weight for 1961-1995 was used. Weights in the stock were set equal to the average weights in the catches.

In the short term prediction the fitted values for the maturity ogive from the Faroese bottom trawl survey in 1996 was used for that year and for 1997 and 1998 the mean of the fitted values for 1983-1996 were used. This long term mean was also used in the long term prediction.

In the short term prediction the exploitation pattern was the average pattern in 1993-1995 taken from the final VPA. The exploitation pattern was the average of exploitation patterns for 1993-1995 scaled by Fbar (age 4-8) in 1995 before the average was calculated. In the long term prediction the exploitation pattern was derived from the fishing mortality matrix from the final VPA as average F-values for 1961-1995.

2.5.6.2 Biological reference points

The yield per recruit and spawning stock biomass per recruit curves are presented in Figure 2.5.7C. Compared to the fishing mortality level in age-groups 4-8 in 1995 of 0.42, the reference values for F_{max} is 0.45 and $F_{0.1}$ is 0.18. F_{low}, F_{med} and F_{high} were estimated to 0.11, 0.34 and 0.53, respectively, (Table 2.5.15, Figure 2.5.7C and Figure 2.5.8). The average fishing mortality for age 4-8 in 1995 thus coincides with F_{max} . The stock-recruitment scatter plot suggest that the probability of above average recruitment is substantially decreased when the spawning stock biomass is less than 85,000 to 90,000 tons which suggest that the minimum biologically acceptable level (MBAL) is probably in that range of spawning stock biomass.

2.5.6.3 Projection of catch and biomass

No index of recruitment is available and therefore two scenarios are presented, one with 16.9 mill. recruits derived by calculating the arithmetic mean of the recruitment in the period 1993-95 and another with 22 mill. recruits, the geometric mean for the whole period. Results from the prediction with the lower estimate of recruitment are presented in Table 2.5.13 and Figure 2.5.7D. Fishing in 1996 at the same level as in 1995 will result in catches of 27,000 and decline further to 26,000 t in 1997. The spawning stock biomass for the period 1996-1998 will lie between 58,000 t-65,000 t with unchanged fishing mortality . For the second scenario with the long term geometric mean recruitment and status quo F in 1996 catches will be 27,000 t and remain stable at 28,000 t in 1997. The spawning stock biomass for the period 1996-1998 will lie between 59,000-67,000 t with unchanged fishing mortality.

Results from the yield per recruit estimates are shown in Table 2.5.15 and Figure 2.5.7C. With an average recruitment of 22 mill. recruits entering the stock each year and a yield per recruit of 1.54 kg, catches in the long term would average 34,000 t.

2.5.7 Management considerations

The spawning stock biomass is continuing its downward trend, and it is expected to be below MBAL during the period of the short term prediction while fishing mortality is above Fmed. Strict measures to reduce fishing mortality to allow the spawning stock biomass to increase should be seriously considered.

2.5.8 Comments on the assessment

Saithe in the Faroes is known to be affected by immigration and emigration mainly with Iceland but also with areas west of Scotland, the North Sea and the Barents Sea. The extent of such migrations and their effect on the assessment are not known.

The problem of the high sampling variation which is introducing noise into the proportion maturity table was solved by fitting a sigmoid model to the observations.

3 DEMERSAL STOCKS AT ICELAND (DIVISION VA)

3.1 Regulation of Demersal Fisheries

With the extension of fisheries jurisdiction to 200 miles in 1975, Iceland introduced new measures to protect juvenile fish. In the cod, saithe, and haddock fisheries, the mesh size in trawls was increased from 120 mm to 135 mm in 1976 and to 155 mm the following year. Only in the fisheries for redfish was 135 mm allowed in certain areas. Also the mesh size in Danish seines was increased to 170 mm to aim for flatfish, but that fishery turned out not to be profitable. It was, therefore, found necessary to change to a smaller mesh size of 135 mm.

In certain areas outside the 12-mile limit, a temporary protection for trawling was introduced. In addition a system was implemented whereby fishing can be forbidden immediately in areas where the number of small fish in the catches exceeds a certain percentage (25% < 55 cm for cod and saithe and 25% < 48 cm for haddock). These areas have usually been closed for a week. If small fish are still found to be present at the end of that time, the same process is either repeated or regulations are drawn up and the area closed for a longer period of time.

The frequency with which such closures have had to be implemented varies widely from year to year and depends on the year-class strength and the age structure of the stock. When strong year classes are entering the fishery, immediate closures are often necessary. On the other hand, when there are few small fish, such closures are much more infrequent.

Increases in trawl mesh size and closure of nursery areas have reduced mortality directly due to fishing effort among small cod and haddock aged three and, to some extent, four years, from the levels which they had reached before these measures were implemented. However, this proved in no way sufficient to protect the stocks. Since 1975, the Marine Research Institute in Iceland has recommended TACs for cod and a few years later also for other important demersal species. A quota system was not introduced, however, until 1984.

Attempts were made to limit cod catches from 1977-1983 by means of the so-called *scratch-days* system, by which cod fishing was limited to a certain number of days each year. This system failed to limit fishing effort sufficiently and the quota system was adopted instead. The quotas are transferable boat quotas. The agreed quotas were based on the Marine Research Institute's TAC recommendations, also taking socio-economic effects into account.

Until 1990, the quota year corresponded to the calendar year but at present the quota, or so-called fishing year, starts on 1 September and ends on 31 August of the following year. This was done to meet the need of the fishing industry.

In order to manage the cod fisheries, a catch rule was introduced by the Icelandic government in spring 1995 and was enforced from the beginning of 1995/1996 fishing year, i.e. 1 September 1995. According to this management scheme, catch will be limited to 25% of the fishable (4+) stock biomass calculated from the average stock at 1 January of the previous fishing year and 1 January of the coming fishing year, with a minimum catch level of 155,000 t.

3.2 Icelandic Saithe

3.2.1 Trends in landings

Saithe landings from Icelandic grounds (Division Va) fluctuated between 57,000 t and 70,000 t during the period 1981-1986 (Table 3.2.1). From 1987 to 1989, annual landings were about 80,000 t. In 1990, landings increased by more than 20% to 98,000 t and in 1991 the catches reached 103,000 t. Since 1991, landings have decreased to the 1981-1986 level. Preliminary reported 1995 landings for Saithe in Division Va are 48,528 t (Table 3.2.1) which compares to 61,000 t expected by the Working Group last year.

About 61 % of the catches were taken by bottom trawl, 32 % by gillnets and the rest by hooks. This is about the same gear proportions as in the two previous years (Figure 3.2.1).

The Icelandic landings in the quota year September-August 1994/1995 amounted to about 50,000t whereas the national TAC for the same period was 75,000. This can partly be explained by lower effort because of a limiting quota in the cod fishery and also by decreases in both Saithe recruitment and stock size.

3.2.2 Catch in numbers

Minor changes were made to the 1994 catch in numbers at age to account for revised total landings. Data from bottom trawl and gillnets, which represented 95% of the Icelandic landings in 1995, were used to calculate the catch at age of the total landings used as input for the assessment (Table 3.2.2). Notably, catches from hooks are included with bottom trawl catches.

Compared to last years prognosis, a higher proportion of age group 3 and 5 were observed in the 1995 landings (Figure 3.2.2). As no recruitment indices are available for this stock the size of the 1990 year-class was taken at "face value" from VPA in the 1995 assessment.

3.2.3 Mean weight at age in the landings

Mean weight at age in the landings are computed on the basis of samples of otoliths and lengths along with length distributions and length-weight relationships. The mean weights at age are computed for the same categories as the catch numbers at age and are then weighted across the fleets. Increased mean weight at age was observed in 1995 for age groups 4 to 6 and 8 while there was a decrease in other age groups (Table 3.2.3). These weights at age where used as stock weights as well.

3.2.4 Maturity at age in the landings

In 1995 a sharp decrease in the proportion mature at age was observed for all age groups except for age group 3 (Table 3.2.4). As has been pointed out in earlier reports of this working group, the raw maturity at age data for saithe can be misleading due to the nature of the fishery and of the species. A GLM model, described in the 1993 Working Group report (Anon. C.M.1993/Assess:18), was used to explain maturity at age as a function of age and year class strength. The raw data given in Table 3.2.4 was then used to predict the entire maturity at age table for 1980-1998 (Table 3.2.4 and Figure 3.2.3). The maturity at age prior to 1980 (Table 3.2.5) are derived from Anon. ICES, Doc. C.M. 1979/G:6.

3.2.5 Stock Assessment

3.2.5.1 Tuning input

CPUE data, based on Icelandic trawler logbooks are available. The basic method for computing an aggregate CPUE index consists of first selecting individual tows where the catch contains more than 70 % saithe (lower proportions show similar patterns in CPUE). The catches and towing times are then added and the ratio computed. As the CPUE series derived from the first part of the year showed markedly different behaviour in recent years from the series based on the latter part of the year, the two series were age-disaggregated separately (Table 3.2.6) and both used in the tuning module. The age-disaggregation was based on otolith samples taken from commercial trawlers in the respective time periods. Another series was based on trawler effort (TRW EFFORT Table 3.2.6), calculated by dividing trawlers landings with the annual CPUE. A tuning data set was then constructed from the effort measure along with catch-in-numbers from the same fleet.

3.2.5.2 Estimates of fishing mortality

Two different runs were attempted using an XSA based on the two data sets. Tuning diagnostics are relatively poor in both cases (Tables 3.2.7 and 3.2.8). The resulting mean F in 1995 for age groups 4-9 from these runs was 0.27.

The time series analysis was carried out as described in "Time series analysis of catch-at-age observations" by Gudmundsson (Applied Statistics (1994) 43 No.1 pp 117-126). Two different runs were done. One using only catch at age data and the second using catch at age data with Trawlers cpue in June-December, age groups 5-7. The resulting F mean for age groups 4-9 was 0.30 and 0.29, respectively. The results are shown in Table 3.2.9.

Measurement errors of log C and transitory variations of log F for the best observed ages are supposed to be equal and estimated as 0.18. The variability is higher for the youngest and oldest fish.

Joint permanent (i.e. random walk) variations of log F at all ages are estimated with a standard deviation of 0.046 and joint permanent variations in selectivity and joint transitory variations were negligible.

Serial correlation between catch prediction errors within each year are modelled and other serial correlations were negligible.

The estimated stocks and fishing mortality rates do not exactly fit the observed catch-at-age data because measurement errors are taken into account. (In VPA measurement errors are implicitly assumed to be zero and whereas in CAGEAN all variability of individual values are assigned to measurement errors and none to F). The approximations introduced to apply the Kalman filter to non-linear equations produce a slight discrepancy between estimated stocks and fishing mortality rates.

The estimated standard deviations of individual values of log CPUE values from trawlers (June-December), ages 5-7 years was 0.24 and 0.14 for joint variations. Because of the small joint variations of log F, introduction of the CPUE values has very little effect upon the estimated values from catch-at-age observations only.

At the 1993 Working Group meeting, retrospective analyses were performed on six different combinations of fleets and methods. Time series analysis (TSA), using only catch at age data, was the most consistent one and has therefore been used in most recent assessments.

Because of the differences in reference F's between XSA (0.27) and TSA (0.30) runs in this assessment, a retrospective analysis was performed for the different methods and fleets. The TSA runs seems to be more consistent (Figure 3.2.4) than the XSA runs. The TSA retrospective analysis including the cpue value does not differ markedly from the one using catch-at-age observations only. Notably, the TSA seems to consistently underestimate the present fishing mortalities but nevertheless ends up with higher reference F's in 1995 than the XSA.

The terminal fishing mortalities from the TSA were used to run a traditional VPA and the F`s for the oldest age groups were taken as the mean of the four younger ages. Natural mortality was set to a value of 0.2. The results of this run are given in Tables 3.2.10 - 3.2.12 and Figures 3.2.5.A and 3.2.5.B.

3.2.5.3 Spawning stock and recruitment

The spawning stock biomass is shown in Figure 3.2.5.B and Table 3.2.12. After a decline from 1970-1977, the spawning stock biomass averaged between 160-180,000 t in 1978-1989 and increased to about 200,000 t in 1990. Since 1992 the spawning stock biomass declined again to a minimum in 1994 of about 160,000 t which is about the same size as in the years 1978-1980, the lowest recorded levels for last 20 years. In 1995 the spawning stock biomass increased to about 180,000 t. The estimated spawning stock biomass in the beginning of 1996 is only 147,000 t, the lowest recorded since 1961-1964.

Estimates of recruitment at age 3 are plotted in Figure 3.2.6.B. The 1983 to 1985 year-classes are all well above the 1967-1987 long-term average (about 40 million). The 1984 year-class is the highest on record at about 110 million. All year-classes after 1985 are well below average. The average size of the 1986-1990 year classes is only estimated at 28 million recruits.

As no information is available for the more recent year classes, the 1991-1994 year classes were set at the same level as the average for the 1967-1987 year classes, excluding the strong year classes in the early 1960s.

3.2.6 Prediction of catch and biomass

3.2.6.1 Input data

The input data for the catch projections are shown in Table 3.2.13.

For catch predictions and stock biomass calculations, the mean weight at ages 4-9 were predicted using a multiple regression analysis where the mean weight at age was predicted by the mean weight of the year class in the previous year and year class strength. Since the regression analysis showed significant relationships only for the above age groups the mean weight at age for other age groups were averaged over the 1993 to 1995 period.

For the short-term predictions, the maturity at age was predicted as described in Section 3.2.4.

For long term predictions, averages over the period 1980-1995 were used.

It is expected that the catches in 1996 will only reach 46,000 t because the landings during first three months of 1996 were only 80% of those in 1995. This is in a accordance with observations of experienced fishermen who indicated that it was even more difficult to obtain good catches of Saithe in the beginning of 1996 when compared to their catches in the same period of 1995.

For long-term yield and spawning stock biomass per recruit, the exploitation pattern was taken as the average of the fishing mortalities during 1980-1995 from the standard VPA run. Averages over 1980-1995 for maturity and mean weight at age for all age groups were used, along with a natural mortality of 0.2 (Table 3.2.15).

A yield curve using last three years averages (1993-1995) as an input was also calculated resulting in about the same $F_{\max}$ and $F_{0.1}$ values but a slightly lower yield per recruit.

3.2.6.2 Biological reference points

The yield- and spawning stock biomass-per-recruit (age 3) curves are shown in Figure 3.2.6.C.

Compared to the 1995 fishing mortality level of F_{4-9} = 0.30, the reference values for $F_{\max}$ and $F_{0.1}$ are 0.44 and 0.18, respectively (Table 3.2.16). From Figure 3.2.7 showing the recruit/spawning stock relationship and Figure 3.2.6.C showing the spawning stock biomass-per-recruit relationship F_{med} = 0.28 and F_{high} = 0.9 were estimated.

The stock-recruitment scatter plot does not provide a basis do define MBAL as the recruitment seems to be higher at the lower end of the SSB range.

3.2.6.3 Projections of catch and biomass

Based on the input data given in Table 3.2.13, options for 1997 were calculated and are given in Table 3.2.14 and Figure 3.2.6.D.

As can be read from the prediction (Table 3.2.14), assuming a 46,000 t total catch in 1996 will lead to about a 15% reduction in the fishing mortalities in 1996 compared to 1995. The resulting stock size in the beginning of 1997 will be about 345,000 t which is a little higher than in the beginning of 1996 (315,000 t). The spawning stock biomass in the beginning of 1997 will also show a slight increase compared to 1996, i.e. about 160,000 t. The same reference F in 1997 compared to 1996 will result in a yield of about 50,000 t, and both total and spawning stock biomasses in 1998 will increase from the 1996 level.

3.2.7 Management considerations

The stock seems to be in a fairly stable state, the reference F values have been substantially over $F_{0.1}$, slightly above F_{med}, but below F_{max} in recent years. Increasing effort from the present level will not lead to gains in the long run. Recruitment in recent years (since 1986 year-class) has been below long term average.

3.2.8 Comments on the assessment

As mentioned in the last years report, catch at age data for Icelandic Saithe seem to be relatively consistent which is reflected in the low standard deviations of the log F's from the TSA.

3.3 Icelandic cod (Division Va)

3.3.1 Groundfish survey design

Icelandic Groundfish Survey (IceGFS) started in 1985. The area of investigation covers the Icelandic shelf down to the 500 m depth contour. 600 stations were considered a reasonable effort to reach an acceptable level of coefficient of variation of cod indices. In order to work the 600 stations within a reasonable time limit, 5 commercial, standardized, stern trawlers are leased.

The allocation of trawling stations is based on the stratified random sampling theory. The stratification scheme is based on pre-estimated cod density patterns derived from commercial as well as research vessel catch data, which were summarized by statistical squares. The statistical square basis allows flexibility in post-stratifications with respect to different species.

Based on biological and hydrographical considerations, the survey area was divided into two areas, a northern and a southern area for design purposes.

The allocation of statistical squares to strata is based on the estimated density of cod in each square. Information on cod density was derived from three different sources: The trawler captains and their advisors graded each square with respect to their experience of fishing in March. Commercial fisheries data yielded additional information on cod density, as did results from previous research surveys.

Ten strata were constructed from the statistical squares, 4 in the southern area and 6 in the northern one. Statistical squares in each strata are not necessarily adjacent, which allows more possibilities in constructing homogeneous strata with regard to fish density.

Stations were divided between strata in direct proportion to the product of the area of each stratum and its estimated cod density. Finally, the trawl stations of a stratum were allocated to each square within the stratum in direct proportion to the area of the square.

Stations within each statistical square were divided equally between fishermen and project members from the Marine Research Institute (MRI). Project members selected random positions for their stations. Fishermen were asked to fix their stations in each square in accordance with their knowledge and experience of fishing and fishing grounds. Trawling is done both day and night, and sampling is distributed uniformly over the 24 hours.

This sampling method may be classified as "semi-random stratified" since only half of the stations are randomly selected.

In 1996 the Groundfish Survey design was analyzed and revised with the aim to reduce the total survey cost but keeping about the same level of accuracy. Stations which have only be taken occasionally during the survey period since the beginning of the survey in 1985 and other stations with low or zero catches especially in the south-eastern area were omitted. Recalculation of the survey indices resulted in a minor differences compared to the previous estimates. Accordingly, the numbers of stations were reduced to 540 (instead of the 600 originally) in 1996 and the survey was carried out using 4 trawlers instead of 5 earlier.

3.3.2 Trends in landings and effort

In the period 1978-1981 landings of cod increased from 320,000t to 469,000t due to immigration of the strong 1973 year class combined with an increase in fishing effort. Catches then declined rapidly to only 280,000 t in 1983. Although cod catches have been regulated by quotas since 1984, catches increased to 392,000 t in 1987 due to the recruitment of the 1983 and 1984 year classes to the fishable stock in those years (Table 3.3.1).

Since 1988 all year classes entering the fishable stock have been well below average, or even poor, resulting in a continuous decline in the landings. The 1995 catch of only 170,000 t is the lowest catch level since 1942. Fishing effort on cod decreased in 1994 compared to 1993 . This trend continued in 1995 and a marked reduction in effort against cod has taken place in the most recent years due to further reduction in quota and a diversion of the effort towards other stocks and areas. As a result of this catch rates in cod fisheries both for the trawlers and the gillnet fleet have been increasing as expected (Table 3.3.2.).

3.3.3 Catch in numbers at age

The fleets (or "metiers") are defined by the gear, season and area combinations. The gears are long lines, bottom trawl, gillnets, handline lines and Danish seine. In the historical data sets each of these classes may contain related gears (based on sparseness of data and low catches). Notably handlines are included with long lines and pelagic trawl is included with the bottom trawl. The basic areas splits are the "northern" and "southern" areas. In the historical data set, seasons are split into the "spawning" season (January-May) and "non-spawning" season (June-December). Historically, there have been some changes in fleet definitions and thus there does not currently exist a fully consistent set of catch-at-age data on a per-fleet basis.

Total catch at age (aggregated across fleets) was used as VPA input, and seasonal data (aggregated across gears and regions) were used to estimate the proportion of fishing mortality in January-May.

The total catch-at-age data is given in Table 3.3.3. For the longer VPA runs the catches at age in numbers in Anon.1976/F:6 were used for the years 1955-1969. It should be noted that much higher proportions of the older age groups are taken during the first part of the year and this will considerably affect the estimation of the spawning stock at spawning time. Since the catch-at-age data have historically only been available for January to May, and not by shorter seasons, it is assumed that 60% of those catches were taken during January to March, i.e., before spawning time (Table 3.3.4).

3.3.4 Mean weight at age

3.3.4.1 Mean weight at age in the landings

Mean weight at age in the landings are computed on the basis of samples of otoliths and lengths along with length distributions and length-weight relationships.

The mean weights at age are computed for the same categories as the catch numbers at age and are then weighted together across the fleet categories. The data are given in Table 3.3.5. Mean weights at age are not available on an annual basis for catches taken before 1973, and hence the average across the years 1973 - 1991 is used as the constant (in time) mean weight at age for the years 1955-1972.

3.3.4.2 Mean weight at age in the stock

The weights at age in the landings have been used without modification to compute general stock biomasses, with the exception of the spawning stock biomass (see below).

The groundfish survey does provide better estimates of mean weights at age in the stock, but it is not at all clear how these should be combined across areas which have different catchabilities, and in any case these weights are only available back to 1985.

3.3.4.3 Mean weight at age in the spawning stock

For years up to 1995, data from the period January-May have been used for the estimation of the mean weights at age in the spawning stock. It is assumed that the catches in the different gears and areas appropriately reflect the stock composition with regard to mean weight at age. These weight-at-age data are presented in Table 3.3.6.

3.3.5 Maturity at age

Maturity at age is based on samples from the commercial fleets in the months January-May (Anon. 1992/Assess:14). It has been pointed out that using data collected throughout the year may bias the proportion mature in various ways (Stefansson, 1992). The approach taken is, therefore, to compute the proportion mature at the time of spawning, by considering only the first part of the year (January-May), but aggregating across gears and regions.

There has been a marked increase in the proportion of mature fish at age since 1992. This development continued in 1995 when the highest values ever were recorded (Figure 3.3.5.). However the results from the 1996 Groundfish survey show a downward trend in 1996. The maturity at age data are given in Table 3.3.7.

The maturity-at-age data are not available on an annual basis for the catches taken prior to 1973 and, hence, the average for the years 1973-1991 is used as a constant maturity at age for the years 1955-1972.

3.3.6 Stock Assessment

3.3.6.1 Tuning data

Commercial trawler CPUE data were analyzed as described in Stefansson (1988) to yield GLM indices of abundance (numbers) at age. The analysis takes into account catchability changes in the fleet due to vessel renewal and vessels shifting between regions, but not changes in the spatial distribution of the resource or changes within vessels in the fleet. For this reason the analysis of the logbook data was restricted to the years 1991-1995.

These indices are based on logbooks from demersal trawl fisheries for two parts of the year (January-May and June-December) and three areas i.e. southwest, southeast and northern areas (Table 3.3.8).

The same method was applied for the first time for the gillnet fleet. Logbooks for this fleet have been analyzed and are available since 1988. The gillnet fleet operates mainly during the spawning season and at the spawning grounds off the south and west coasts of the island. This fishery has often been referred to as "the spawning fishery" in earlier reports of this Working Group. The GLM indices presented here are based on the gillnet fishery in the south and west areas during January-May. These indices have been added to the assessment (Table 3.3.9)

The Icelandic groundfish survey data (Palsson *et al.*, 1989) are used as part of the assessment. The basic data are age-disaggregated (Palsson and Stefansson, 1991) and abundance indices computed by using the a modified Gamma-Bernoulli (G-B) method to accommodate spatial information in an appropriate manner. The method is described in Working Paper by H. Björnsson, (Anon.1994/Assess:19). Indices are calculated for each of the three areas separately, age groups 1 to 14 and for the years 1985-1996.

To use the latest information available, the 1996 survey abundance indices were moved back in time of approx. three months i.e. to December 1995. The same applies to abundance indices for the other survey years. The resulting indices are given in Table 3.3.10 by fleet, area and age group.

3.3.6.2 Assessment methods

Migrations from Greenland into the Icelandic cod stock can have major effects and hence these need to be taken into account in the assessments. Time series analysis (TSA) of Gudmundsson (1984) and an ADAPT-type of method (Stefansson 1992) which were applied to this stock earlier (Anon.1992/Assess:14) can estimate migration for a given year and age. The implementation of the ADAPT-method used an average selection pattern in determining the terminal fishing mortality recent changes in fishing pattern could not be accounted for. The Working Group therefore decided to use the XSA method.

XSA uses a cohort-analysis to project the stock (or back calculating):

$$N_{a,y} = e^{-M} N_{a-1,y-1} - e^{-M/2} C_{a-1,y-1} \quad \text{or}$$
$$N_{a-1,y-1} = e^{M} N_{a,y} + e^{M/2} C_{a-1,y-1}$$

were N is stock size and C is catch in numbers and M natural mortality. If fish of age a and in the year y is migrating, in amount of G, to the stock in the beginning of the year, then the cohort equation will be:

$$N_{a,y} = e^{-M} N_{a-1,y-1} - e^{-M/2} C_{a-1,y-1} + G_{a,y}$$

and in back calculation the equations will be:

$$\begin{aligned} N_{a-1,y-1} &= e^{M}\left(N_{a,y} - G_{a,y}\right) + e^{M/2} C_{a-1,y-1} \\ &= e^{M} N_{a,y} + e^{M/2}\left(C_{a-1,y-1} - e^{M/2} G_{a,y}\right) \end{aligned}$$

That is, if the size of the migration, G, is approximately known it can be implemented into the cohort equations by changing the catch-in-numbers the year before, for the cohort in question. The results are stock in numbers taking into account the migration but the fishing mortality given for age *a-1* and year *y-1* will be incorrect and the correct value can be calculated by:

$$F_{a,-1,y-1} = \ln\left(\frac{N_{a-1,y-1}}{N_{a,y} - G_{a,y}}\right) - M$$

For the Icelandic cod the estimated immigration of 6 years old cod in the year 1990 is about 30 millions at beginning of the year. The total catch of 5 years old cod in 1989 is estimated about 50 millions. The "corrected" catch of 5 years old cod of Icelandic origin in 1989 will then be:

$$50 - e^{0.2/2}30 = 16.8 \text{ millions}$$

which is the number used in the assessment.

3.3.6.3 Estimates of fishing mortality

Tuning was carried out with the same fleets as at the last working group meeting. Another run with the gillnet indices included gave similar results except for the oldest age groups. The Working Group decided to adopt the run with the most information included i.e. all fleets as the gillnet indices are the only available indices which deal with 9 and 10 year old cod. The retrospective analysis for this XSA with shrinkage of s.e.= 0.5 is given in Figure 3.3.3. The output of the XSA is given in Table 3.3.11.

The resulting fishing mortalities from the final XSA are given in Table 3.3.12. The fishing mortality reached a peak in 1988 decreased in 1989 but then rose to another peak in 1993. Due to further restriction of the cod quota effort has dropped markedly in 1994 and again in 1995. Fishing mortality has decreased correspondingly and has not been so low since the early sixties (see Table 3.3.15.).

3.3.6.4 Stock and recruitment estimates

The resulting stock size in numbers and spawning stock biomasses from the final VPA are given in Tables 3.3.13-14.

In the Stock in numbers table, the recruitment in the most recent years (year classes 1991-1993 as 3 year olds in 1994-1996) was estimated using RCT3 as described in Section 3.3.8.3.

The current spawning stock at spawning time and recruitment levels must be considered in relation to historical sizes. The migration estimates of 39 and 7 million immigrants of the 1973 year class in 1980 and 1981, respectively are taken from the 1993 ADAPT assessment (Anon.1993/Assess:18). With given migration estimates, the recruitment from the SSB can be recomputed by adding back calculated migration. The approach taken here is to do these back calculations with natural mortality only, since it would be incorrect to use the sometimes high fishing mortalities at Iceland. This back calculation revises the 1973 and 1984 year class estimates to 432 and 335 millions, respectively. The resulting SSB and recruitment estimates are given in Table 3.3.15 along with landings and average fishing mortalities. A better estimate might be obtained by back calculating using the fishing mortality at Greenland also, but this is unlikely to have major effects on the issue at hand which is the stock recruitment diagram.

3.3.7 Biological and technical interactions

Several important biological interactions in the ecosystem around Iceland are connected to the cod stock. The single most important relationship is the cod-capelin connection (Pálsson, 1981) and this has been studied in some detail (Magnússon and Pálsson, 1989 and 1991a and Steinarsson and Stefánsson, 1991). Another important interaction is between cod and shrimp. This has been studied by Magnússon and Pálsson (1991b) and Stefánsson *et al.* (1994). The cod-capelin interaction is used in the short-term prediction in Section 3.3.8. based on the results in Steinarsson and Stefánsson (1991).

A numerical description of interactions between fisheries and species requires data on landings as well as catches in numbers at age of each species by gear type, region and season. Such data for cod were available to the 1994 meeting, consisting of catches at age in numbers by *metier*, i.e. gear, area and season for each of the years 1989-1992. The resulting data were used to disaggregate fishing mortality by metier. For each fleet the fishing mortality vector was separated into an overall fishing mortality and a selection pattern which averaged to 1 over ages 5-10. The selection patterns were averaged in time to produce a single selection pattern for each fleet. The exercise has not been repeated in the present report.

3.3.8 Prediction of catch and biomass

3.3.8.1 Input data to the short-term prediction

For both sets of weight data, the mean weight at age for most of the important ages is found to be significantly correlated with the weight of the same year class the year before and the capelin biomass at the beginning of the year. This holds for ages 4-8 in the catches and ages 5-8 in the spawning stock at spawning time. Thus, these regressions are used to predict the mean weights at age for these age groups for the years 1996-1998. For 1997 onwards, the average capelin biomass is used. For ages 3 and 9-14 in both data sets and age 4 in the SSB, the average over the years 1991-1995 is used. Table 3.3.16 gives the size of the capelin stock on 1 January each year.

Care needs to be taken with the maturity at age in any prediction, as maturity at age can be a major source of error in SSB estimation (Anon.1994/D:1). The maturity at age is at record high levels in 1995, and it is not reasonable to let this drop to the long-term average in 1996 nor is it reasonable to assume these record-high levels far into the future. Preliminary data for 1996 based on Icelandic Groundfish Survey samples do indicate a decline in maturity at age in 1996. The approach taken is therefore to use a somewhat longer-term (1986-1995) average for 1998. For the purpose of obtaining an orderly development of trends in the maturity at age, linear interpolation between the record high 1995 and longer term 1998 values was used for 1996 and 1997.

The exploitation pattern used for the short-term predictions was taken as the average of the years 1993-1995 from the VPA.

3.3.8.2 Input data to the long-term prediction

For long-term predictions, fluctuating environmental conditions can be ignored, but it is essential to take into account potential changes due to density-dependent growth. These have been investigated for this stock (Steinarsson and Stefánsson, 1991 and Anon.1991/Assess:7) where no significant density-dependent relationships were found concerning growth. However, the results in Schopka (1994) contain indications of some density dependence of growth and this will affect the long-term results at low fishing mortalities. This is not taken into account in the yield-per-recruit calculation.

Mean weight and maturity at age have been predicted as the average over the years 1976-1995.

The average exploitation pattern over 1985-1990 has been used as input.

Another run with the same basic data but an average exploitation pattern in the most recent period i.e. 1993-1995 was also carried out.

3.3.8.3 Recruitment

The modified Gamma-Bernoulli (G-B) method (Anon. 1994/Assess:19) used for the analysis of the Icelandic Groundfish Survey and as tuning data for this stock was also used for recruitment prediction. The resulting indices used for recruitment prediction are given in Table 3.3.17. As an input to the RCT3 program age groups 1-4 from the survey were chosen.

The size of the year classes 1991-1995 has been estimated using RCT3, with the output as given in Table 3.3.18. The revised recruitment estimates are then discounted with natural and fishing mortalities for use in the predictions.

3.3.8.4 Short term prediction results

Input to the projections is given in Table 3.3.19. Results from projections up to the year 1997 with different fishing mortalities are given in Table 3.3.20.

Expected landings in 1996 will be 170,000t which mean a further decrease in fishing mortality to F=0.40 compared to F= 0.47 in 1995.

Continuing fishing in 1997 at the expected 1996 level of fishing mortality (F=0.40) will lead to a decrease in SSB on the short term.

A 15% reduction in fishing mortality from 1996 (to F=0.34) will stabilise the SSB at the 1996 level of about 380,000t on the short term. This requires a catch of 162,000t.

The average size of the incoming year classes (1987-1994) is 131 million. The yield-per-recruit computations indicate that the maximum obtainable yield per recruit is just under 1.8 kg. These two numbers indicate that the average yield from these year classes cannot be expected to exceed 235,000t.

3.3.8.5 Long-term prediction results and biological reference points

The yield-per-recruit curve based on the 1985-1990 exploitation pattern along with biological reference points is given in Figure 3.3.6 (Tables 3.3.21-22).

The biological reference values for F_{max} and $F_{0.1}$ are 0.37 and 0.21 respectively. Yield per recruit at F_{max}- level is around 1.8 kg. By choosing the 1993-1995 exploitation pattern the biological reference points are almost unchanged. On this curve F_{max} will be 0.36 and $F_{0.1}$=0.20. However, the Y/R at F_{max} decreases slightly to 1.76 kg which might be due to reduced fishing mortality on the oldest age groups.

A plot of the spawning stock biomass and recruitment is given in Figure 3.3.4. When using the period 1955-1994, the reference points F_{med} and F_{high} are about 0.45 and 0.70, respectively, as seen in Figure 3.3.4. Also shown in the same figure is the fitted Ricker curve. The position of the F_{high} line with respect to the stock recruitment curve implies that the stock would collapse quickly at such high fishing mortality. This contrasts earlier results (Anon. 1994/Assess:19) and is obtained here due to the inclusion of recent poor year classes at low stock sizes with the effect of lowering the stock-recruitment curve at low stock sizes, i.e. reducing the slope at the origin.

3.3.9 Management considerations

In most recent period there has been a substantial reduction in fishing effort directed against cod (Table 3.3.2 and Figure 3.3.1) and hence in fishing mortality. Fishing mortality was at the level of F=0.8-0.9 in 1992-1993 but dropped considerably in 1994 to F=0.64 and again in 1995 to F=0.47 which is slightly above F_{med}=0.45. In 1996 it is expected that the present restriction of the cod catches will result in F=0.40 which is in the vicinity of the F_{max} level.

The inclusion of the stock recruitment relationship has a major effect on the long-term predictions. From Table 3.3.4 it is seen that below-median recruitment occurs more frequently when the SSB is below-median than when the SSB is above the median. The increased probability of poor recruitment at low SSB levels is of major concern, with the time series shows that the five poorest year classes ever recorded have been generated in years when the spawning stock was lower than 300,000t.

In spite of poor recruitment in recent years the spawning stock has shown the first sign of recovery from the historical low level in most recent years. This is a result of the recent catch restrictions combined with an increase in maturity at age.

Medium-term predictions (risk analysis) were carried out at the two latest working group meetings (Anon.1995/Assess:19). The model used incorporated the cod, capelin and shrimp stocks to account for interaction between this stocks. Based on similar calculations, Iceland introduced a catch rule in 1995 which was enforced for the first time for the fishing year which started 1st of September 1995. According to this management scheme catches were limited to 25% of the 1995 and 1996 average fishable (4+) biomass, however with a minimum acceptable catch level of 155,000 t. Applying this rule for the 1996/1997 fishing year the catch will be 186,000 t which corresponds to the present (1996) expected fishing mortality of F=0.4.

3.3.10 Comments on the assessment

There has been a considerable decline in fishing mortality on this stock in the most recent period. This is verified in the sharp drop of effort for all fleets engaged in the cod fisheries (Table 3.3.2).

All short-term results on the size of SSB depend heavily on the assumed development in maturity at age, which is hard to estimate and predict accurately. Variations in this biological parameter are indicated by trends apparent in Figure 3.3.5.

Although there are some uncertainties in this assessment, it is clear that the stock has been heavily overfished for a long time but show now the first signs of recovery which is expected to continue under the newly adopted management scheme.

4 THE COD STOCK COMPLEX IN GREENLAND (NAFO SUB-AREA 1 AND ICES SUB-AREA XIV) AND ICELANDIC WATERS (DIVISION Va)

4.1 Inter-relationship Between the Cod Stocks in the Greenland-Iceland Area

Tagging experiments carried out at Greenland and Iceland show that mature cod at West Greenland migrate to East Greenland. Tagging experiments at East Greenland also show that mature cod from that area migrate to Iceland(Tåning, 1937; Hansen, 1949; and Anon. 1971). On the other hand, immature cod seem not to emigrate from East Greenland to Iceland, but in some years immature cod migrate from East Greenland to the West Greenland stock (Anon. 1971). Tagging experiments at Iceland show that migration of cod from Iceland to Greenland waters occurs very seldom and can be ignored in stock assessments (Jonsson 1965, 1986). Migrations from Greenland waters to Iceland can, therefore, be regarded as a one-way migration.

In egg and larval surveys cod eggs have been found in an almost continuos belt from Iceland to East Greenland, along the East Greenland coast, round Cape Farewell and over the banks at West Greenland (Tåning 1937, Anon 1963). From O-group surveys carried out in the East Greenland-Iceland area since 1970, it becomes quite evident that the drift of O-group cod from the Iceland spawning grounds to the different nursery areas at Iceland varies from year to year. The same applies to the drift of O-group cod with the currents from Iceland to East Greenland (Table 4.1.1). In some years it seems that no larval drift has taken place to the Greenland area, while in other years some, and in some years like 1973 and 1984, considerable numbers drifted to East Greenland waters (Vílhjalmsson and Fridgeirsson 1976, Vílhjalmsson and Magnússon 1984).

The 1973 and 1984 year classes have been very important to the fisheries off both West and East Greenland. Tagging results have shown that when these two year classes became mature, they had migrated in large numbers from West to East Greenland and, to some extent, to the spawning area off the southwest coast off Iceland. This migration of mature cod from Greenland to Iceland influences the assessment of these stocks (Schopka, 1993) and it cannot therefore be ignored in the assessments.

5 COD STOCKS IN THE GREENLAND AREA (NAFO AREA 1 AND ICES SUBDIVISION XIVB)

In previous analyses, the cod stocks off Greenland have been divided into West and East Greenland or treated as one stock unit to avoid migration effects. Fjord populations (inshore) have always been included. This year, the offshore component off West and East Greenland, the so called Bank Cod, is here assessed separately as one stock unit and distinguished from the inshore populations for the first time. The completion of a re-evaluation of available German sampling data for the offshore catches back to 1955 enabled such an analysis.

5.1 Cod off Greenland (offshore component)

5.1.1 Results of the German groundfish survey

Annual abundance and biomass indices have been derived using stratified random groundfish surveys covering shelf areas and the continental slope off West and East Greenland. Surveys commenced in 1982 and were primarily designed for the assessment of cod (*Gadus morhua* L.). A detailed description of the survey design and determination of these estimates is given in the report of the 1993 North-Western Working Group (Anon., 1993/Assess:16). In 1994 and 1995, the only changes made compared with former surveys where firstly, the new research vessel Walther Herwig III replaced the older Walther Herwig II and, secondly, slightly smaller doors in the trawl rigging were used to avoid net overspread as demonstrated by underwater observations. No attempt was made to adjust for changes in swept areas which are believed to be low. Figure 5.1.1 and Table 5.1.1 indicate names of the 14 strata, their geographic boundaries, depth ranges and areas in nautical square miles (nm^2). All strata were limited at the 3 mile line offshore except for some inshore regions in Strata 6.1 and 6.2 off East Greenland where there is a lack of adequate bathymetric measurements. Tables 5.1.2 and 5.1.3 list the trawl parameters of the survey and the sampling effort by year and stratum.

5.1.1.1 Stock abundance indices

Tables 5.1.4 and 5.1.5 list abundance and biomass indices by stratum, at West and East Greenland, respectively and then combined for the years 1982-95. Indices vary significantly between strata and years. Trends of the abundance and biomass estimates for West and East Greenland are shown in Figures 5.1.2 and 5.1.3, respectively. These Figures illustrate the pronounced increase in stock abundance and biomass indices from 23 million individuals and 45,000 tons in 1984 to 828 million individuals and 690,000 tons in 1987. This trend was the result of the recruitment of the predominating year classes 1984 and 1985, which were mainly distributed in the northern and the shallow strata 1.1, 2.1 and 3.1 off West Greenland during 1987-89. Such high indices were never observed in strata off East Greenland, although their abundance and biomass estimates increased during the period 1989-91 suggesting an eastward migration. During the period 1987-89, which were years with high abundance, the precision of survey indices is extremely low due to enormous variation in catch per tow data. Since 1988, stock abundance and biomass indices decreased dramatically by 99% to only 5 million fish and 6,000 tons in 1993. 1992 and 1994 survey coverage was incomplete for the East Greenland partly due to technical problems. Last year's (1995) coverage was again incomplete by 25% (West Greenland strata). However, the most recent indices were taken as representative for stock abundance and composition, mainly because the greater proportion of the stock has been distributed off East Greenland since 1993. Although the 1995 results show a slight increase in stock abundance and biomass from the record low values in 1993, they confirm the severely depleted status of the stock.

5.1.1.2 Age composition

Age disaggregated abundance indices for West and East Greenland and the total are listed in Tables 5.1.6, 5.1.7 and 5.1.8, respectively. In 1995, the age composition was found to be dominated by the age groups 2 and 5 years contributing 37 and 23%, respectively. While almost all fish caught off West Greenland were 2 years old, the age composition off East Greenland was found to be more diverse and comprised both juveniles and a few mature cod (>6 years, 20%). Recruitment is classified as poor, so, there is no indication of recovery.

5.1.1.3 Mean weight at age

Mean weight of the age groups 1-10 years for West and East Greenland and weighted by abundance to the total are listed in Tables 5.1.9-11, respectively. Weight (g) at age calculations are based on the regression $f(x)=0.00895x^{3.00589}$, x=length (cm), which has been determined on the basis of 3,482 individual measurements. The trends of these values are illustrated in Figure 5.1.4 for the period 1982-95. They reveal pronounced area and year effects. Age groups 2-10 years off East Greenland were found to be bigger than those off West Greenland. Possibly driven by the high abundance of cod off West Greenland, weighted mean length and weight for the age groups 1-5 display a decrease during 1986-87 and remained at low levels until 1991. The mean length and weight for age groups 1-6 have been increasing from low values since 1991. Clear indications for factors controlling the size of fish at age caught during the survey period are lacking, because correlations with trends in survey abundance, temperature and fishing effort are inconsistent. More detailed analysis to explain these pronounced trends will be carried out in the future.

5.1.2 Trends in landings and fisheries

Officially reported catches are given in Tables 5.1.12 and 5.1.13 for West and East Greenland including inshore catches, respectively. Landings as used by the working group are listed in Table 5.1.14 and trends are illustrated in Fig. 5.1.5 by gear, inshore, and offshore areas for both West and East Greenland combined. Until 1975, offshore catches have dominated the total figures by more than 90%. Thereafter, the proportions taken offshore declined to 40-50% and the most recent yields have been dominated by inshore landings since 1993. Otter trawl board catches (OTB) were most important throughout the time series for offshore fisheries. Miscellaneous gears, mainly long lines and gill nets, contributed 30-40% until 1977 but have disappeared since then.

Annual landings taken offshore averaged about 300,000 t during the period 1955-60. Until 1968, figures increased to a higher level between 330,000 t and of 440,000 t in 1962. Landings decreased sharply by 90% to 46,000 t in 1973. Subsequently, the landings dropped below 40,000 t in 1977 and were very variable. The level of 40,000 t was only exceeded during the periods 1980-83 and 1988-1990. Since 1970, there have been large changes in effort which increased during exploitation of the strong year classes born in 1973, 1977, 1979, and 1980. The offshore fishery was closed in 1986 and for the first 10 months in 1987. During 1990-92, the landings decreased from 100,000 t by 90% to 11,000 t. Since then, no directed cod fishery has taken place. The reported landings in the redfish fishery declined from 828 t to 260 t in 1993-95, respectively.

It is important to note that catch figures, especially since 1992, are believed to be incomplete due to unreported by-catches in the shrimp fishery which has recently expanded to all traditional areas of the groundfish fisheries. A first assessment of the catch taken by the shrimp fishery amounting to 32 t or 110000 individuals in 1994 (WP No.18). This estimate is added to the catch figures used by the working group for the 1992-95 period.

5.1.3 Catches in numbers

Catch in numbers were re-evaluated for the German catches taken by OTB back to 1955 and used as input for the VPA. Sampling effort is described in WP No. 9. These data do not cover the catches taken by miscellaneous gears during 1955-77 for which no data are available. However, they were also split based on the OTB data assuming a similar age composition.

Catches at age were broken down separately for West and East Greenland. In 1982 and since 1991, the catches at age off West Greenland were calculated according to survey results and the same basis was used in 1992 and 1994 for East Greenland catches, respectively. In 1977, West Greenland catches were partitioned by age according to East Greenland samples due to a lack of data. Mean age in the landings is illustrated in Figures 5.1.6 and 5.1.7 for West and East Greenland, respectively. Both show a significant decreasing trend in mean age and were highly variable during the last 25 years when the catches where influenced by two strong year classes, namely those of 1973 and 1984.

In 1980 and 1981, the catch at age was increased by a number of 12 and 3.5 million individuals or 39,600 t and 16,450 t, respectively, as estimated by the assessment of the Icelandic cod stock to account for an emigration of the 1973 year class to Iceland. In addition, the catch at age figure for the 1984 year class in 1990 was raised by 13 million or 27,300 t for the same reason (Section 3.3.6.2).

5.1.4 Mean weight-at-age

Mean weight at age data were re-evaluated for the German catches taken by OTB back to 1955 for West and East Greenland, separately. Trends are illustrated in Figures 5.1.8 and 5.1.9 and show pronounced variations over time. During the late 50s, the size of cod at age 5-8 years increased and remained at a high level for both West and East Greenland. The size at age of cod was very small during the early 70s and 80s. Multiple linear growth models were formulated for the length at ages 5-8 years based on temperature, quarter of a given year and size at age in the previous year explaining 35 to 50% of the observed variation in growth (WP 9).

From these time series, input data for the VPA were calculated as weighted means according to the landing weight.

5.1.5 Natural mortality

The standard value of 0.2 was used for ages 3 and 4 years. These values were increased for age groups 5+ to 0.3 to account for an emigration to Iceland.

5.1.6 Maturity-at-age

Maturity data were taken from what is listed in previous Working Group reports. In years where no observations were available, maturity at age data was taken from adjacent years. There is only small variations in the VPA input data (Tab. 5.1.17).

5.1.7 Assessment

5.1.7.1 Tuning and estimates of terminal fishing mortality

Results from the German groundfish survey were used as the only available tuning fleet for the XSA. In order to take incomplete survey coverage in 1992 and 1994 off East Greenland into account, the age disaggregated indices were adjusted by averaging of the values of given year classes in the previous and following years. This was done for East Greenland results before adding the West Greenland results to get combined estimates. The data are given in Table 5.1.15.

As a first run, an XSA tuning exercise was performed based on default values including the most recent years and ages 3 to 10. This exercise resulted in very high standard errors of log-transformed qs exceeding 1.0. The residuals revealed high positive deviations in the most recent 3 years 1993-95. This result was caused by high variations on an extremely low level in age disaggregated indices of both the catches and the survey indices.

A second run, disregarded years after 1992 when no directed cod fishery took place. The XSA results based on the 1955-92 period are listed in Table 5.1.16. Resulting standard errors of log-transformed qs are much lower and average about 0.6. The positive deviations as derived from the first run disappeared when the 3 most recent years were excluded. Figure 5.1.10 shows the behaviour of estimates derived from the retrospective analysis. Most of these tunings reflected the expected low fishing mortalities in 1986 and 1987 when a trawling moratorium was in force for the whole year and the first 10 months, respectively. In the following period, the fishing effort increased. A substantial underestimation of fishing mortality is indicated for the 1988-90 period when compared with the 1991-92 values derived from the retrospective analysis. The Working Group decided to use the very high 1991-92 estimates of the fishing mortality as representative but did not consider them suitable for precise estimation of the present stock status.

5.1.7.2 Assessment of the historical stock status, fishing mortality and recruitment

The historical stock status is assessed based on the terminal Fs derived from the second tuning run, disregarding the years 1993-95, when no cod fishery took place and by-catches only were taken by fisheries directed towards redfish or shrimp. The VPA results are listed in Table 5.1.17.

Trends in yield and fishing mortality are shown in Figure 5.1.11. An increasing trend in fishing mortality from 0.1 to 0.4 is determined during the period 1955-68. During the same period, the yield increased from a level of 280,000 t to 380,000 t but decreased drastically to 100,000 t in the early 70s. Thereafter, the fishing mortality was highly variable and seems to be dependent on the changes in effort directed to the exploitation of individual relatively strong year classes. Periods when Fbar for ages 5-8 years exceeded 0.5 were 1974-1977, 1980-1984 and 1988-1992.

Figure 5.1.12 shows trends in spawning stock biomass and recruitment. During 1955 to 1973, the spawning biomass decreased almost continuously from 1.8 million t to 110,000 t, a decrease of 94%. Thereafter, the spawning stock biomass averaged 50,000 t. During the period 1955-73 before the spawning stock decreased below 100,000 t, the recruitment at age 3 varied enormously between 5 million and 700 million and averaged 220 million. Since 1974, the spawning stock varied around the mean of 50,000 t and produced an average recruitment of 41 million representing a mean reduction by 95% and 80%, respectively. The long term mean recruitment was not exceeded for 8 of 19 years from 1955 to 1973, while it has been below that value for 17 of 19 years since then. During the last 29 years, only 2 year classes have reached the long term mean recruitment level at age 3, namely those produced in 1973 and 1984.

5.1.8 Determination of MBAL

Recruitment at age 3 is plotted against the spawning stock biomass in Figure 5.1.13. There is some relationship between recruitment and the spawning stock biomass with stronger recruitment being produced when the spawning stock biomass is greater than about 750,000 t. This suggests that, given suitable environmental conditions, cod in the offshore areas of Greenland can be self-sustaining. For ecological reasons, i.e. mainly temperature and ocean current effects on migration, growth, spawning, larval survival and O-group drift from Iceland contributing to the recruitment, the Working Group had difficulties in identifying a MBAL value. Considering an Icelandic origin for the only 2 strong year classes 1973 and 1984 during the last 29 years, the impact of larval drift to the stock recruitment for Greenland cod must be considered to be low.

5.1.9 Management consideration

The first separate assessment of the offshore component of the cod stocks off Greenland reveals that overfishing was a major cause for the collapse of this unit in the beginning of the 70s. Since that time, the spawning stock has remained below 100,000 t and has not been able to produce an adequate recruitment. Only two strong year classes have been observed in 1976 and 1987 as 3 year olds. An increase in effort directed towards the 1973 and 1984 year classes has resulted in high fishing mortalities. Both year classes contributed only negligible amounts to the severely declined spawning stock. The most recent trend in the fishery and German survey data which are not included in this assessment, are consistent with this picture. Further, no indication of stock recovery is derivable based on the lack of strong pre-recruiting year classes. In the present situation, catches of young cod in the shrimp fishery should be kept to a minimum in order to increase the probability of stock recovery. No fishing should take place until a substantial increase in recruitment and biomass is evident.

5.1.10 Comments on the assessments

This assessment of the offshore component of the cod stocks off Greenland is affected by several uncertainties in data as well as ecological factors. The effect of emigration is only directly covered for the 1973 and 1984 year classes and has been taken into account by an increase of the natural mortality to 0.3 for age groups 5 and older. The sampling of commercial catches was historically rather inconsistent and did not cover the 30 % taken by miscellaneous gears, mainly loneliness and gill nets up to 1977. Since 1991, catch at age and weight at age data had to be calculated using survey data. Maturity data were poorly reported implying uncertainties in spawning stock estimates.

No XSA tuning could be applied for the most recent period 1993-95 when low levels in landings, effort and stock abundance were observed. The age disaggregated survey indices had to be adjusted to account for incomplete coverage of the survey area in 1992 and 1994.

5.2 Inshore cod stock off Greenland

In the last decade the inshore cod fishery at West Greenland has contained cod originating from two different spawning areas. Icelandic cod spawned off South-western Iceland witch in some years are carried by the Irminger current to settle off South Greenland, and local possibly self-sustained fjord populations. Spawning cod are found in several fjords of the west Greenland (Buch *et al.*, 1994) especially in NAFO Division 1B and NAFO Division. 1D. Tagging experiments and independent fluctuating recruitment in these fjords suggest that these stocks are more or less isolated.

5.2.1 Trends in Catch and Effort

Historically the inshore catches have been of limited importance as the inshore fisheries have accounted for no more than 5-10% of the total international catch (Fig 5.1.1). Annually catches about 15,000-20,000 t has been taken inshore during the period 1955-1973. Since then the catches have been varying in agreement with the recruitment of strong year classes to the offshore fishery. High catches of around 50,000 t in 1980 and 1989 have been followed by periods of very low catches. In 1993 and 1994 the catches amounted to only 1,925 t and 2,115 t and decreased further in 1995 to a record low catch of 1,703 tons.

The inshore fishery takes place from small vessels (<40 GRT). Pound net, gillnets and handlines contributes about 95% of the inshore catch.

Unlike the offshore fishery, the effort in the inshore fishery has not decreased much despite pronounced declining catches in recent years. No alternative species has been available for this small-vessel fishing fleet.

5.2.2 West Greenland young cod survey

During June -July 1995 Greenland carried out a gill-net survey on young cod in the three inshore areas off West Greenland : Qaqortoq (NAFO Div. 1F), Nuuk (Div. 1D) and Sisimiut (Div. 1B). The survey has been conducted at the same time since 1985. Three mesh-sizes (16.5, 24 and 33mm bar length) were used in the first two years, but in 1987 two additional mesh sizes were added (18.5 mm and 28 mm). An index of recruitment for each area is calculated as the mean catch of 2-year olds cod per hour taken by all five mesh sizes. Values for 1985-86 have been corrected to five mesh units based on the relationship between catches in the 3 and 5 mesh-series as found since 1987. The recruitment series is shown in Table 5.2.1.

The 1984 and 1985 year-classes, with are considered to have drifted from Iceland to Greenland, show high abundance at age 2 in all areas. For the other year-classes less resemblance is seen between the areas. For Div. 1F all year classes after 1985 are missing. This pattern of year class occurrence resembles that which has been found offshore indicating the Icelandic origin of cod in this area. In Div. 1B, where the highest CPUE's is generally seen, the year-classes 1986 to 1988 are also prominent whereas the 1989 and 1991 year-classes are very week and the 1992 and 1993-year-class is low. In Division 1D the year-classes of 1986-1987, and 1989-1990 are prominent whereas 1991-1993 are very weak.

5.2.3 Catch in numbers

In West Greenland, 9 samples from poundnet landings were used to convert the total inshore catch into numbers at age. Sampling in 1995 was difficult to perform due to the low catch levels. Sixty percent of the catch was broken down by samples to the respective area and month; the remaining catch had to be converted to numbers at age using samples taken from adjacent areas or months (Table 5.2.2).

Weight -at-age for West Greenland cod were based on samples from commercial inshore fisheries (Table 5.2.2). The overall mean weight was derived by weighting catch from the various areas and months. The mean weight of the age groups 5 and 6, witch contribute most to the catches, were approximately the same as in 1994, but low compared to the long term mean.

Adequate statistics for the commercial inshore fisheries are only available since 1982 and it is therefore only possible to estimate the catch at age back to 1982 (Table 5.2.3)

5.2.4 Management Considerations

The inshore stock component has never been assessed separately. The three latest year-classes in NAFO Div. 1B and Division 1D (the 1991, 1992 and 1993 year-classes) are estimated to be very poor in the young cod survey in 1995. Catches should therefor be kept at a minimum to enhance the recruitment prospects of the inshore stock.

6 GREENLAND HALIBUT IN SUB-AREAS V AND XIV

6.1 Trends in Landings and Fisheries

Total annual catches in Divisions Va, Vb and Sub-area XIV are presented for the years 1981-1995 in Tables 6.1.1-6.1.4. During the period 1982-1986, catches were stable at about 31,000-34,000 t. In the years 1987-1989 catches increased to about 62,000 t, followed by a decrease to about 35,000 t in 1992. The catches increased to 41,000 t in 1993, but decreased to about 37,000 t in 1994 and 36,000 t in 1995. Catches not officially reported to ICES have been included in the assessment. More than 75% of the total annual catch is taken in Division Va. Faroese catches in Vb have increased in recent years from a level of about 1,000 t in 1981-1991 to about 5,000 t in 1994 and 4,000 t in 1995. Catches in Greenland waters (Sub-area XIV) have increased from below 1,000 t in 1987-1991 to about 5,000 t in 1995.

Most of the fishery for Greenland halibut in Divisions Va, Vb and Sub-area XIV is a directed fishery, only minor catches in XIVb by Germany and the UK derives partly from a redfish fishery.

The fishing grounds in Va are restricted to an area west of Iceland (65°-66°N, 27°-29°W), an area north of Iceland (67°30-68°N, 18°-23°W), and an area east of Iceland (64°-66°N, 11°-13°W). The relative proportion of the catches taken on the western fishing grounds has decreased somewhat in the last 5 years. In 1995 73% of the Icelandic catch was taken on the western fishing grounds. The main fishing season in Division Va was formerly related to the spawning season in spring, but in recent years, the fishing season has expanded and the present fishery is conducted in late winter to early summer, with the bulk of the catches taken in April through June. The Icelandic trawlers moved to deeper parts of the continental slope around 1991-1992 (depth of approximately 1,000 m), partly due to an increase in vessel power.

The trawlers (single trawlers > 1,000 Hp) fishing in Division Vb are operating on relatively shallow parts of the continental slope, mainly in summer. The gillnet fishery in Division Vb started in 1993, and since then fishing grounds have changed. This fishery is carried out during the whole year with a peak in spring.

The fishing grounds in Division XIVb is on the continental slopes (61°N-65°N, 36°-41°W). The main fishing season is from June to September. A minor part of the trawl catches are by-catches in a redfish fishery. Both freezing trawlers and fresh fish trawlers operate in the area. In 1995 longliners moved to deeper waters (1,000-1,400m).

Annual catches in 1994 and 1995 are separated by gears in Tables 6.1.5-6.1.6.

6.2 Trends in Effort and CPUE

Commercial catch rates of Icelandic bottom trawlers have decreased for all fishing grounds since 1990. For the years 1990-1995 CPUE on the western fishing grounds have been about three times higher than for the other fishing grounds.

Indices of CPUE for the Icelandic trawl fleet for the period 1985-1995 (Table 6.2.1) are estimated from a GLIM multiplicative model, taking into account changes in the Icelandic trawl catch due to ship, statistical square, month and year effects. All hauls with Greenland halibut exceeding 50% of the total catch were included in the CPUE estimation. The CPUE indices from the Icelandic trawling fleet in Division Va were used to estimate the total effort for each year (y) for all the fleets operating on Greenland halibut in area V and XIV according to:

$$E_{y,V\&XIV} = Y_{y,V\&XIV} / CPUE_{y,Va_{trawl}}$$

where E is total effort, Y are the total reported landings in region V and XIV.

The total effort increased up to 1989, decreased somewhat in the next two years, but has been increasing steeply since 1991 and reached a maximum in 1995. The CPUE was relatively stable in 1985-1989, but has declined sharply since then to a historic low last year. The CPUE declined by 70% from 1985 to 1995. In the last two years the effort has increased by 30% and the CPUE decreased by 26%.

6.3 Catch in Numbers at Age

Although a Greenland/Norwegian age-length key for Division XIVb was available, it was assumed to be unreliable due to a change in personnel reading the otoliths from that area. The only other aged catch samples in 1995 were those obtained from the Icelandic trawl fleet operating in Division Va, and this was used to obtain catch in number for each of the following fleets and areas:

a) Trawl catch in Vb, using length measurements obtained from Faroese trawl catch in the same area.
b) Trawl catch in Va and XIV, using length measurements obtained from Icelandic trawl catch in Va.
c) Longline catch in V and XIV, using length measurements obtained from Icelandic longline catch in Va.
d) Gillnet catch in Vb, using length measurements obtained from Faroesese gillnet catch in the same area.
e) Gillnet catch in XIV, using length measurements obtained from Norwegian gillnet catch in the same area.

The length-weight relationship used was $W = 0.01758 * L^{2.84387}$ for a-d and $W=4.48*10^{-3}*L^{3.191}$ for e. The total catch in numbers (Table 6.3.1.) were obtained from the sum of the above weighted with the catch within each group (a-e).

6.4 Weight at Age

The mean weight at age in 1995 (Table 6.4.1.) was derived from the weighted average of the above groups (a-e). The estimates in 1994 were derived using Icelandic and Greenland data. The average weight of 5-year olds in 1992 was estimated from the mean of 1980-1991. Weights at age in the catch are also used as weights at age in the stock.

6.5 Maturity at Age

Data on maturity at age were available for the years 1982-1984 and 1991-1994, based on samples from the Icelandic trawl fishery. Data on maturity at age for the years 1985-1990 were not available. The maturity at age for these years was therefore estimated by averaging the data from the years 1982-1984 and 1991 (Table 6.5.1.). The data on maturity at age for 1994 showed exceptionally high values for the ages 6 and 7. The most likely explanation for this is that a substantial part of the Icelandic trawl fishery takes place in the period after spawning (late April-June), and that maturity determination and sampling may be misleading. Therefore it was decided to use the values from 1993 also in 1994 for these age groups. The data on maturity for 1995 were based on information from the Icelandic trawl fishery in division Va.

6.6 Stock Assessment

6.6.1 Tuning and estimates of fishing mortalities

Age-disaggregated CPUE values for age groups 7-14 over the period 1985-1995, obtained from the Icelandic trawling fleet operating in division Va, were initially used in the tuning process. Since the log q residuals and the mean log q for ages 13 and 14 are relatively high (Figure 6.6.1.1.) the Group decided to exclude these age groups from the tuning analysis.

Two further XSA runs were performed by the Working Group using the shorter age span (ages 7-12) for the tuning fleet. The setting for the first XSA was the default in terms of the weight of the shrinkage (Standard error to which the means of the last 5 years are shrunk, hereafter referred to as SEmshr = 0.5). The diagnostics showed that the catchability (Mean Log q) is relatively stable in age groups 9 and older, that the S.E. (Log q) is below 0.3 for all age groups, and also that log q residual variation between years are low (Figure 6.6.1.2.). Since the total effort has increased dramatically over the last 5 years (Table 6.2.1.) the applicability of using a shrinkage of the terminal F to the mean of some previous years, was questioned by the Group (and by ACFM last year). Thus, a second XSA tuning was performed where the weight of the shrinkage was reduced by increasing the SEmshr to 1.0. This resulted in the reduction of the scaled weight of the shrinkage from around 20% to around 7% in age groups 8-12. The diagnostics of the second run (Table 6.6.1.1.) show a reduction in standard error of the Log q, but was otherwise similar to the first run (Figure 6.6.1.2.). Variability in reference F values (Fbar 8-12) based on retrospective analysis (Figure 6.6.1.3.) are within acceptable levels. Both analyses tend to overestimate F by 4-15% in years 1992-1994, but underestimate F prior to that period. The lowering in the weight of the shrinkage resulted in higher terminal F values.

Although the increasing trend in effort is reflected in increasing trend in F, the F values in the two most recent years are somewhat lower than expected if the relationship between these two parameters are simply linear through the origin (Figure 6.6.1.4.). The Working Group thus decided to look at the outcome of a Laurec Shepherd tuning, with a SEmshr = 1.0, for comparison. The log q residuals show a similar trend (Figure 6.6.1.2), but the retrospective analysis gives a poorer performance than the XSA tuning (Figure 6.6.1.3.). The reference F values from the Laurec Shepherd tuning in the last 2-3 years showed similar deviation from a linear regression of F on effort (Figure 6.6.1.4.). Since the retrospective diagnostics of the Laurec Shepherd tuning was relatively poor and the terminal F-values were similar to that of the XSA, further analysis of the former model was terminated.

The terminal fishing mortalities from the XSA run with a Semshr = 1.0 were used to run a traditional VPA. Natural mortality was assumed to be 0.15 and the proportions of F and M before spawning were set to 0. The results of this run are given in Tables 6.6.1.2.-5. and Figures 6.6.1.5..A and B.

6.6.2 Spawning stock and recruitment

Spawning stock biomass is shown in Table 6.6.1.4. and Figure 6.6.1.5.B. The spawning stock was between 70 and 80,000 t between 1978-1983, and increased to a maximum of 121,000 t in 1988. Since 1988 it has declined to a low of 66,000 t in 1994. The increase in spawning stock to 76,000 t in 1995 is attributed to an increase in proportion of maturity in younger age groups.

Estimates of recruitment at age 5 is shown in Table 6.6.1.5 and Figure 6.6.1.5.B. The long term average for the period 1976-1993 is 32 million fish. The 1980 and 1981 year classes are the highest on record at about 45 million. Since then there has been decline in recruitment, the numbers reaching a record low of 22 million fish in 1987 year class. The size of the 1988 year class is also below average (25 million). Estimates of the more recent year classes of 1989 and 1990 are thought to be unreliable, since they are just entering the fisheries.

6.7 Prediction of Catch and Biomass

6.7.1 Input data

The input data for the short term prediction are given in Table 6.7.1.1. Mean weight at age and exploitation patterns are averages from 1993-1995. Maturity at age is the average of 1991-1995, exclusive of the year 1994 (since those are assumed values of 1993). Natural mortality was set to 0.15 and the proportions of F and M before spawning were set to 0. Year classes 1989-1991 were assumed to be equal to the lower 25th percentile recruitment value over the period 1976-1993. This is a reflection of the recruitment being below average since 1983 year class. A second projection is also provided, using the long term mean recruitment for 1976-1993, all other input parameters being the same as above (Table 6.7.1.2).

The prediction is based on a *status quo* F, using the same reference F in 1996 as in 1995.

The Y/R calculation uses the average number of 5 year old fish over the period 1976-1993 and the mean weight at age and the exploitation patterns were based on average over the period 1976-1995 (Table 6.7.1.3).

6.7.2 Biological reference points

$F_{0.1}$ was estimated to be 0.22 and F_{max} = 0.57 (Table 6.7.2.1, Figure 6.7.2.1). For comparison, yield per recruit based on short term exploitation patterns (1993-1995) were also calculated, the $F_{0.1}$ and F_{max} being 0.27 and 0.68, respectively (output not shown).

F_{med} and F_{high} are 0.42 and 0.60, respectively (Figure 6.7.2.2). MBAL could not be assessed from the available data.

6.7.3 Projections of catch and biomass

Table 6.7.3.1 shows the results of the predictions using the lower estimate of recruitment (26 million). At the beginning of 1996, the total stock is estimated to be about 141,000 t, and the spawning stock just below 51,000 t. To maintain the catch in 1997 at the level it has been in the past 6 years, an increase in F of 35% will be required. At a *status quo* F in 1996 and 1997, the stock biomass will decrease to 137,000 t in the beginning of 1997 and further to 135,000 t in 1998, and SSB will decrease to a record low of 43,000 t in 1998. A minimum of a 50% reduction in F is needed to increase SSB above 1996 level. This will result in catches less than 17,000 t in 1997.

Table 6.7.3.2 shows the results of predictions using a long term average of recruitment (32 million). At the beginning of 1996, the total stock is estimated to be about 162,000 t, and the spawning stock about 54,000 t. At a *status quo* F in 1996 and 1997, stock biomass, catch and SSB seem quite stable in 1997 and 1998.

6.8 Management Considerations

The Greenland halibut stock biomass has been falling rapidly from a peak in 1987. Catches in the last 6 years have remained around 37,000 t, despite drastic increase in F and effort over the period. The fishing mortality has been substantially above $F_{0.1}$ since 1986 and is currently at the level of F_{high} . The increase in effort in recent years is not reflected in proportional increases in terminal fishing mortality estimates. This in addition to redistribution of fishing efforts indicates that the terminal fishing mortality might be underestimated. Recruitment for year class 1983-1988 have been below average and recruitment of year classes 1989 and onward is unknown. Considerable reduction in catch are needed to rebuild the stock, necessitating strict management regulations.

6.9 Comments on the Assessment

Improved sampling of catch data are needed. Data on length composition from the trawl and long line fisheries in Sub-area XIV, which account for about 12% of the total catch in 1995, were not available. Information on age composition and maturity from the fisheries in XIV and Vb and from the longline fisheries in Va are also lacking.

Progress has been made in an attempt to quantify discrepancies and bias in age readings among Greenland halibut age readers in the last year and the work will conclude with an international workshop in Iceland this fall. Precision and standardisation in determination of maturity are badly needed.

The use of only one commercial fleet for tuning is a cause of concern since the fleet covers only a part of the total fishing area. Although the Icelanders are currently planning and implementing an annual fall survey on the Greenland Halibut grounds within Division Va, it will not become of use in stock assessment in the near future. In the interim period it is recommended that available log book information from regions XIV and Vb are compiled and made available to strengthen the basis of the stock assessment.

Short term predictions are based on assumed recruitment values. Indices of recruitment of Greenland halibut are an obvious prerequisite for sound management advise.

Although some tagging experiments and stock discrimination analysis (DNA, electrophoresis, meristic studies) have been carried out in recent years, further understanding on the basic biology of the Greenlandic halibut is needed.

7 REDFISH IN SUB-AREAS V, VI, XII AND XIV

7.1 Species and Stock Identification

In the northeast Atlantic there are three common species of redfish: *Sebastes viviparus*, *S. marinus* and *S. mentella*. In the southernmost part of the area, a fourth redfish species, *Helicolenus dactylopterus* (blue mouth), is also encountered. The three *Sebastes* species are found along the Norwegian coast, in the Barents Sea, at the Faroes, Iceland, East Greenland and in the Irminger Sea.

The adult and mature part of a special type of *S. mentella* called oceanic *S. mentella* (oceanic redfish) which is pelagic from less than 100 m to approx. 1,000 m in the Irminger Sea is considered a separate stock. The other *S.mentella* type connected to the continental slopes, is called deep-sea *S.mentella* (deep-sea redfish). In 1991, a *S.mentella* type resembling the deep-sea *S.mentella* was discovered by Icelandic scientists in the Irminger Sea pelagic deeper than 500 meters, far from the continental shelves. Until then, deep-sea *S.mentella* was considered to have its main distribution along the continental slopes in the region , similar to that of *S. marinus*. The differentiation of the two *S.mentella* types in the Irminger Sea has been based on the following criteria (e.g., Magnússon *et al.* 1994, Magnússon *et al.* 1995):

colour - the deep-sea type is redder, while the oceanic type is more greyish red.
length-weight relationship - the deep-sea type being more stout and heavier at a certain length than the oceanic.
length at first maturity - the deep-sea type being longer when first mature.
parasite infestation - the deep-sea type being less infested by the *Sphyrion lumpi* ectoparasite.

During the summer and autumn, the oceanic redfish in the Irminger Sea is most common in depths from 100 to 350 meters while the deep-sea redfish is most common below 500 meters. In late winter and spring (March to May), i.e., during the "pre"-spawning" and "spawning" period, the oceanic redfish inhabits deeper layers in the eastern part of the Irminger Sea. During that time there is a considerable overlap in the depth distribution of the two types of *S. mentella* (Magnússon, 1983; Magnússon *et al.*, 1995).

Separating the two pelagic *S.mentella* types in the Irminger Sea by morphological and biological criteria demands considerable experience, and, at present, it is only Icelandic scientists that have thoroughly investigated this matter and possess the necessary ability. A protocol which details the methodology to separate the two types is urgently required so that other researchers can investigate the separation criteria, the behaviour and interrelationship of the two types. This will also permit researchers to compare the pelagic deep-sea *S.mentella* in the Irminger Sea with the deep-sea *S.mentella* on the continental shelf and slope. Genetic analyses (both traditional electrophoresis of hemoglobin and tissue enzymes and DNA analyses) are currently being conducted at Iceland and Norway. Preliminary results so far show variation within the two *S.mentella* types, but more biological material and more research is required before anything can be concluded regarding the genetic identity of the two types.

In recent years, particularly since 1993, catches of deep-sea *S. mentella* in the Irminger Sea have increased but have been reported as oceanic redfish (Working Doc. no. 15). There is, at the moment, no way to separate the two types in the catches. Iceland has taken steps (sampling on board, at landing sites and by collecting log-book reportings on depth) which hopefully will enable separation of these types in the catches of the Icelandic fleet in the future. It is imperative that countries participating in this fishery should report monthly to NEAFC giving the catch in depth-intervals and by gear type.

ICES has been requested by the North-East Atlantic Fisheries Commission (NEAFC) to provide information on the relationship between pelagic deep-sea *S.mentella* and the deep-sea *S.mentella* fished in demersal fisheries on the continental shelf and slope. Work is currently being done to gain more knowledge about what is believed to be pelagic deep-sea *S.mentella* in the Irminger Sea (e.g., genetic analyses). More detailed results from this research is therefore needed before anything definite can be said about the requested relationship.

The Working Group continues to consider the *S. marinus* in East Greenland, Iceland and the Faroes as one stock. The deep-sea *S. mentella* in the continental slope region of this area is also considered one stock unit. Due to inadequate knowledge about the distribution (vertical and horizontal) of pelagic deep-sea *S.mentella* in the Irminger Sea and the lack of separation of oceanic and deep-sea *S.mentella* in the pelagic catches, the Working Group finds it impossible at this time to separate these two types and does therefore at present consider all pelagic *S.mentella* in the Irminger Sea as one stock unit. The Working Group therefore will deal with and assess the following stocks:

S. marinus Greenland-Iceland-Faroes stock.

S. mentella Greenland-Iceland-Faroes deep-sea stock.

S. mentella Irminger Sea oceanic stock.

7.2 Nominal Catches and Splitting of the Landings in Stocks

7.2.1 Nominal catches of Redfish by countries and areas

The total catch of redfish in 1995 (approximately 100,000 t) excluding the catch figures from the oceanic *S. mentella* fishery, was 20% less than in 1994 (125,000 t). This is mainly caused by a decrease in the German deep-sea *S.mentella* fishery in Sub-area XIV because of a redirection of effort to other fishery resources.

The preliminary reported landings of oceanic *S. mentella* in 1995 are about 124,000 t. Thus the total catch of redfish in the area amounts to about 220,000 t in 1995 compared to nearly 260,000 t in 1994.

In Division Va (Iceland), the total redfish landings reached 91,071 t including 1,543 t of oceanic *S. mentella*. Apart from the oceanic *S. mentella* landings the catches in Division Va have remained relatively stable since 1989 at 91,000–100,000 t (Tables 7.2.1–7.2.2).

In Division Vb (Faroes) (Tables 7.2.3–7.2.4) the largest redfish catch were taken in 1986 (21,000 t). Since then catches have decreased steadily to about 12,000 t in 1990 but increased again to about 15,000 and 16,000 t in 1991 and 1992, respectively. Since then catches have decreased to about 8-9,000 t in 1994-1995.

Landings from Sub-area VI have been of minor importance in recent years, but a steady increase in the UK redfish landings is reported (Tables 7.2.5–7.2.6). The catches have not been sampled, it is expected that they are probably *S.marinus*.

All landings from Sub-area XII are oceanic S.mentella which are described in chapter 10 (Tables 7.2.7-7.2.8).

The highest landings from Sub-area XIV were reported in 1986-1988, having reached 96,000 t. Landings dropped to about 25,000 t in 1989 before increasing to nearly 60,000 t in 1994. Provisional data for 1995 show, however, a decrease to about 34,000 t. This decline is mainly caused by a decrease in the German deep-sea *S.mentella* fishery due to redirected effort to other resources (Tables 7.2.9-7.2.10). Of the total landings from this area in 1995, about 97% were oceanic *S.mentella.*

7.2.2 Splitting of the catches

Since 1993, an attempt has been made to divide the redfish catches in Division Va into *S. marinus* and *S. mentella*, using both data from log-books and data collected by the staff of the Marine Research Institute. A new attempt was made this year for 1995, which separates the catches in stratum according to the ratio of *S. marinus/S.mentella* as observed in samples from the same stratum. Each stratum is defined by 15 min Lattitude and 30' Longitude.

The following data were used:

1. Samples from the fresh-fish trawlers taken by the Marine Research Institute (MRI) and the Icelandic Catch Supervision (ICS) personals.

2. Landing statistics from Germany.

3. Information on landed products from freezer trawlers.

4. Logbook data.

5. Landing statistic from the different fleets.

Splitting of catches from freezer trawlers:

In the freezer fleet, the products are usually labelled according to species. Reliable data on this basis are available from 1993 to 1995, and assuming that the species composition is the same in the split and unsplit catches, the total catches were split according to the products.

Splitting of the catches from the fresh fish trawlers:

i. For each year: The catches from each year were pooled into rectangles (15 min. Latitude by 30 min. Longitude) and scaled to the total unsplit catch of the two species for each rectangle. It is therefore assumed that the distribution of catches not reported in logbooks was the same as those in the reported catches. Catches taken by other gears were included (about 2% of total catch). All catches and hauls taken by the freezer trawlers were excluded as well as hauls taken in trips where the trawlers landed in Germany.

ii. For each stratum and each year: The samples taken were used to split the catches according to the average composition in the samples and raised to the total catches from that fleet. If no information on the species composition in strata for a year were available, the composition in ± 1 year, ± 2 years (max. 5 years) were used. If there were no observations in the period from 1988 to 1995, the splitting was done according to depth and the captain's experience. Only a small proportion of the catches were split using the last criteria.

The landings in Germany are split at the market and reported.

The results are given in the following text table:

Type of fleet	**% *S. marinus***	**% *S. mentella***
A. Freezer vessels	15.41	84.59
B. Landings in Germany	20.3	79.7
C. Landings in Iceland (excluding from freezer vessels).	71.3	28.7
Results	**46.4**	**53.6**

The splitting values (%) between *S. marinus* and deep sea *S. mentella* for the years 1992-1995 are given in the following text table:

	Results from 1992-1995 (%)	
Year	**S. marinus**	**S. mentella**
1992	54.00	46.00
1993	46.96	53.04
1994	40.40	59.60
1995	46.40	53.60

For other areas and divisions, catches were split according to information from different laboratories (Tables 7.2.11-7.11.12).

7.2.3 CPUE

As early as 1978, Magnússon and Magnússon (1978) indicated that the proportion of *S. marinus* and *S. mentella* is highly dependent on depth and stated that redfish catches in waters deeper than 500 m, were >80% *S. mentella*. Also, they noted that catch percentages of *S. mentella* in waters shallower than 450 m were less than 20% in the SW area where most of the catches were taken. The same conclusion was reached in studies of samples taken by the Marine Research Institute (MRI) and the Icelandic Catch Supervision (ICS) in the period 1988 - 1995. This would suggest that CPUE in redfish can be split into CPUE for *S. mentella* and *S. marinus*, by depth.

Therefore, the CPUE for the bottom trawl fleet for different depth intervals was calculated for the period 1986 to 1995.

The results are given in Figure 7.2.1. The CPUE indices are computed by simply aggregating tows where the percentage of redfish in each tow is above a certain level. This level corresponds to 10% (Figure 7.2.1). Knowing that *S. marinus* is rarely caught at depths deeper than 500 m, it is assumed that these results give a CPUE in *S. mentella*.

Similarly, it is assumed that for the redfish fishery at water depths shallower than 500 m, the series for calculated CPUE reflects a CPUE for *S. marinus*.

7.3 Juvenile Redfish

7.3.1 Recruitment indices

7.3.1.1 Icelandic 0-group survey

Indices for 0-group redfish in the Irminger Sea and at East Greenland are available from the Icelandic 0-group surveys which started in 1970 (Table 7.3.1). In 1972, 1973 and 1974 the indices were well above the overall average of 14.8 suggesting good year classes in those years. During the ten-year period 1975-1984 the indices were below average in all the years, particularly in 1976 and from 1978-1984. Values were high in 1985, 1987, 1990, 1991 and in 1995 the index was 13.9 near the average.

Although the indices in 1986 and 1989 were slightly below average the indices suggest generally strong year classes from 1985 to 1991 (with an average index of 19.8 for that period) following a period of poor ones (1975-1984, average index 5.9). In 1992-1994 the indices were below the overall average.

7.3.1.2 Icelandic Groundfish survey

The Icelandic groundfish survey, which covers the depths to the 500 m depth range, provides indices of the recruitment to the *S. marinus* stock. Age determinations are not available, but length distributions from the survey are given in Figure 7.3.1. The points in each plot represent the individual data points in terms of frequency. The solid lines represent smooth curves drawn through the scatterplot using a generalized additive model (GAM) with several degrees of freedom. Year classes can be seen in these plots and it is also seen that the recruitment to the *S. marinus* stock is quite variable, but there is no indication of any recruitment failure in recent years. The length distributions also illustrate the diminishing number of large fish in the latest years and the recruitment of probably two year-classes (1985 and 1987) to the fishable stock. The survey conducted in March 1996 shows an increase in numbers of fish in almost all length groups in relation to the results obtained in 1994 and 1995.

7.3.1.3 German Groundfish Survey

Abundance, biomass indices and length compositions have been derived using annual groundfish surveys covering shelf areas and the continental slope off West and East Greenland down to 400m depth. Surveys commenced in 1982 and were primarily designed for the assessment of cod. A description is given in chapter 5.1.1 and more detailed in the 1993 Report of the North Western Working Group (Anon, 1993/Assess:18). Juvenile redfish (<17 cm) were classified as *Sebastes spp.* due to difficult species identification.

Tables 7.3.2 and 7.3.3 describe the trends in survey abundance and biomass for juvenile redfish (<17 cm) broken down by stratum at West and East Greenland. Respective values are shown in Figures 7.3.2 and 7.3.3. Small and unspecified redfish are very abundant and were distributed both off West and East Greenland. A lack of these size groups during the years 1982-84 might be caused by irregular recording of catches. Since 1985, both abundance and biomass indices vary without a clear trend. In 1985, 1993 and 1995 small redfish redfish were more abundant, in the entire survey area off East Greenland.

Length distributions are illustrated in Figures 7.3.4 and 7.3.5 aggregated for West and East Greenland. They reveal that juveniles off East Greenland are bigger than those off West Greenland. Peaks at 6.5, 10.5-12.5 and 15.5-16.5 cm re-occur frequently and might indicate year classes.

7.3.1.4 Greenland Trawl Survey

Juvenile redfish are caught both off West and East Greenland during the Greenland trawl survey, which commenced in 1992 and is directed towards shrimp. The survey design covers the depth range 0-600 m. The data from 1992 were recalculated to compensate to a change in the cod end mesh size made in 1993 from 44 mm to 20 mm. In 1992, there are two different indices for biomass and abundance because of including or rejecting one single outstanding catch. If this outstanding catch is excluded from the 1992-survey the biomass index off East Greenland has fluctuated between 33,000 t in 1992 to 81,000 t and 49,000 t in 1993-1994 followed by an increase to 141,000 t in 1995 (Figure 7.3.6). In the same period, the abundance indices are 725 millions in 1992, 1.7 billion and 1.4 billion fish in 1993-1994 and 3.0 billion in 1995.

The length frequencies from all catches off East Greenland reveals that the size group of 12 cm dominated the catches in 1992. In 1993 and 1994, distinct modes were found at 15 cm and 10 cm respectively. In 1995 a distinct mode was seen at 20 cm.

7.3.2 Discards of redfish in East and West Greenland

An offshore shrimp fishery with small meshed trawls (44 mm) began in the early seventies at the west coast of Greenland and expanded to the east coast in the beginning of the eighties, mainly at the shallower part of "Dohrn Bank". The shrimp fishery at both West and East Greenland has small redfish as a by-catch and it can be concluded that the area for shrimp fishery is also a part of the nursery area for redfish

Survey data from the Greenland Trawl Survey collected in important shrimp fishing areas on West Greenland as well as data from the commercial shrimp fishery has been analysed in order to estimate the amount of redfish by-catch (WD no. 18).

Based on an annual shrimp catch about 50,000 t at West Greenland, the total bycatch of redfish is estimated to approximately 100 million individuals or 3,100 t. Redfish from 6 to about 20 cm are predominating in the by-catch.

Further investigations on this matter is continued in 1996 at East and West Greenland.

7.3.3 Regulations of small redfish at East and West Greenland

Present regulations concerning by-catch in the Greenland shrimp fishery permits a by-catch maximum of 10 % of the total catch per each haul by weight. In 1994 a new arrangement with observers on board the vessels was implemented to strengthen the enforcement of the regulations and improve the reliability of the log-books.

The redfish box was created in 1981 as recommended by ACFM to protect that part of the nursery area of redfish (*S. marinus* and *S. mentella*) against the directed cod and redfish trawl fishery

Trial fisheries for shrimp have frequently been carried out in the redfish box in the most recent years, and for 1995 a general dispensation has been issued for part of the area. The Greenland Home Rule Government had questioned the relevance of the redfish box, since fishermen often claims, that the by-catches of small redfish are much smaller inside than outside the redfish box. Length frequencies from 1992-94 collected during the Greenland trawl survey reveals that small redfish are indeed caught inside the redfish box, but that the biomass and abundance seems to be highly variable from year to year (Anon, 1995/G:1). As the survey data is collected outside the main shrimp fishing season (January-April) further data is needed to answer this question satisfactory.

Bearing in mind the declining fishery and biomass of *S. mentella* and especially *S. marinus*, and increased interest of fishing redfish, concern must be expressed on the discard of small redfish of both species where ever it takes place.

The Working Group considered the following means of protections:

- Legislate the use of a "fish grid" as is the case in the Barents Sea and in Icelandic waters.
- Temporary closure of areas when the by-catch of small fish exceeds a defined level as enforced at Iceland and in the Barents Sea;

7.4 Age-based production model

An age-based production model, similar to that used in 1995 (EXCEL spreadsheet format) was updated for the *S. marinus* stock in ICES Division Va and the oceanic *S. mentella* stock in the Irminger Sea consistent with that indicated in the Report from the Methods Working Group (Anon,.1995/Assess:15, chapter 3.4). For the latter stock, a similar approach has been followed in the last four annual assessments (Anon, 1993/Assess:18).

The model calculates population numbers at age N_{ay} at the beginning of year y as well as the fishing mortality F_{ay} The basic stock equations are given by

$$N_{a+1,y+1}=N_{ay}\exp(-Z_{ay}),$$

where $Z_{ay}=F_{ay}+M$ gives the total mortality rate.

R_y denotes the recruitment in year y, so that for the first age group, a=0, $N_{0y}=R_y$. If it is assumed that the population at the start of exploitation is a virgin stock which has had constant recruitment, R_0, for a number of years, then the stock size in the initial year is given by

$$N_{a,0}=R_0\exp(-aM)$$

where a year class of age a is assumed to have been originally of constant size R_0, but subsequently reduced by a constant natural mortality for a number of years.

In order to relate landings in tonnes to an overall average fishing mortality, a selection pattern needs to be assumed or estimated. For the sake of parsimony, a simple model for the selection pattern is taken as length based, with the relative selection at a length of *l* given with

$S^C_l = 1/(1+\exp(-K^C*(l-L^C_{50})))$

In this equation L^C_{50} denotes the length at 50% selection. Naturally, K^C and L^C_{50} are unknown parameters in this equation and need to be estimated.

Given this selection pattern and length at age the fishing mortality at age is given by

$F_{ay}=F_y S_{la}$

where l_a is the length at age a.

Similarly, a survey selection pattern (S^S_l)

$S^S_l = 1/(1+\exp(-K^S*(l-L^S_{50})))$

can be defined in order to link the total numbers at age to the numbers observed in the survey.

The basic assumption made is that the initial stock size (occurring in 1977) for *S. marinus* and in 1982 for oceanic *S. mentella* was considered an equilibrium stock composed of age groups from a constant number of recruits. For given values of annual recruitment, R_y, fishing mortality rate in each year, F_y, natural mortality, M, and selection parameters, K^C and L^C_{50}, it is clear that a complete stock projection can be made for all years. Adding the length-weight relationship allows for the prediction of landings in each of the years. Given the landings, the fishing mortality in each year is determined. Projections of the stock size are then possible for any given value of the parameters (i.e., natural mortality, constant recruitment, fishing selection and growth) based on the usual VPA catch equations and the given catches taken. The concept of the model is that the projection of the fishable stock from the initial years onwards should either match independent acoustic estimates or an index series from a groundfish survey. The model should further match the given annual catches (by calculating the fishing moralities necessary to produce the catches) and the length distributions of these. Iterations were then made with different constant recruitment levels to model the best fit (minimizing sum-of-squares). By setting a selection pattern for the surveys it was possible to estimate both a survey biomass and a fishable biomass. The natural mortality was in all cases set at a constant 0.05.

The results for various harvesting strategies for each stock are shown in chapters 8 and 10.

8 *SEBASTES MARINUS*

8.1 Landings and Trends in the Fisheries

The total catch of *S. marinus* in Divisions Va and Vb and in the Sub-areas VI and XIV has decreased from about 130,000 t in 1982 to about 43,000 t in 1994 (Table 8.1.1). This decline of about 68% over this period has been continuous with few exceptions. The catches in 1995 were about 45,000 t. Considering the last years development, the catches have decreased from about 67,000 t in 1990 to about 45,000 t in 1995 or about 40%. The relative highest decline in 1995 occurred in area XIV where less than 100 t were caught compared to 1,400 t in 1994 (Table 8.1.1).

The largest *S. marinus* catches has been taken in Division Va, where the catches have declined from about 63,000 t in 1990 to approximately 39,000 t in 1994 or with about 39% during this 5 year period. The decline in the catch in 1994 was at least partly due to area closures imposed on the fishery by Iceland in order to reduce the catches of *S. marinus*. The catches in 1995 increased again to approximately 42,000 t despite the area closures. The length distribution in the Icelandic landing in 1989-1995 along with measurements at sea from the commercial trawler fleet are shown in Figure 8.1.1.

About 90-95% of the total redfish catches in area Va in recent years have been taken by bottom trawlers (both fresh fish and freezer) targeting on redfish. The remainder is taken by different gear and partly as a bycatch in the shrimp fishery.

In Division Vb, the catches were highest in 1985 approximating 9,000 t and declined steadily to about 2,400 t in 1990. They have since then remained at that level of 2,100-2,600 t except in 1992 when the catch was about 3,400 t (Table 8.1.1). Most of the redfish (both *S. marinus* and *S. mentella*) catches in the sub-area have been taken by large bottom trawlers with more than 50% of their catches during the last 10 years having been redfish. The length distribution from the Faroes catches is shown in Figure 8.1.2

In Sub-area VI, the catches in the period from 1978-1994 were highest in 1987, at almost 600 t, but declined, then, to a level of 100 t from 1988-1994. In 1995 the catches increased to over 600 t which are the highest catches in the whole period from 1978 (Table 8.1.1). The major proportion of the catches have been taken by trawlers.

In Sub-area XIV, the catches have shown relatively greater decrease than in the other Divisions and Sub-areas. Thus the catches dropped from almost 31,000 t in 1982 to 5,000 t in 1984 (an 84% decrease). In the period 1984 to 1988, they varied between 1,200-5,000 t. In 1989 they were only 685 t (only 2.2% of the catches in 1982). The catches remained at this low level for two years, then they increased again to 3,900 t in 1990. In the period from 1991-1994 the catches were between 1,100–1,700 t but in 1995 the catches were less than 100 t, the lowest on record (Table 8.1.1.).

In 1995, there was no directed fishery for *S. marinus* nor deep sea *S. mentella* and so most of the catches were taken as bycatch in the shrimp fishery. In former years most of the catches were taken by large bottom trawlers, targeting on redfish and cod.

8.2 Assessment

8.2.1 Trends in CPUE and survey indices

Figure 8.2.1 shows the Icelandic groundfish survey abundance index for *S. marinus* and the CPUE index from the trawler fleet. The survey index is a biomass index computed by using an almost knife-edge length-based fishable stock ogive (0 on 31 cm, 1 on 33 cm). For each station, the biomass index is computed by using the selection ogive and computing the total biomass at the station. The index is then averaged within statistical squares and finally across squares within years (see chapter 3.3.1, on groundfish survey design).

The index from the groundfish survey of the fishable stock indicate a strong increase in the fishable biomass in 1996 (65% above that of 1995). Since there is an increase in almost all length groups (Figure 8.2.2), this could indicate a variation in catchability in the survey in 1996., The length distribution from the survey shows a peak in the length distribution about 32 cm, which is in accordance with the peak in 1993 when there was a peak at about 28 cm indicating a growth of about 2 cm annually. The high survey index in 1996 could therefore be related both to an increase in catchability and increasing recruitment to the fishable stock. The results from the trawler fleet shows an increase in CPUE of about 5% compared to that of 1994.

The results both from the survey and from the fleet indicate an increase, although the peak in the survey index is much higher than in the CPUE data.

In summary, the Icelandic groundfish survey as well as the CPUE data seems to indicate a considerable decline in fishable biomass of *S. marinus* in the period from 1986-1994. The stock shows some indications of recovery in 1995/96. However, the stock is still at a very low level.

Abundance, biomass indices and length composition of *S. marinus* at Greenland have been derived by using data derived form the German annual groundfish surveys covering shelf areas and the continental slope off West and East Greenland down to 400 m depth. Surveys commenced in 1982 and were primarily designed for the assessment of cod. A description is given in chapter 5.1.1 and more detailed in the 1993 Report of the North Western Working Group (Anon, 1993/Assess:18). Only redfish (>=17 cm) were separated to *Sebastes marinus* L. and included in the calculations.

For the period 1982-95, survey abundance and biomass indices are listed in Tables 8.2.2 and 8.2.3 by stratum, West and East Greenland, aggregated to total and accompanying confidence intervals, and illustrated in Figures 8.2.3 and 8.2.4. Values in 1984, 1992 and 1994 are indicated as incorrect due to incomplete sampling off East Greenland. Ignoring these years, total figures show a declining trend from 680,000 million to 325 million individuals and 440,000 t to 140,000 t during 1982-1985. Since 1986, an almost continuous reduction in survey biomass from 300,000 t to 11,000 t in 1995 was observed, which is the minimum of the time series among years with complete survey coverage. Apart from the year 1990 which has the maximum value amounting to 780 million fish caused by the occurrence of juveniles (<25 cm), there is the same decreasing trend regarding the survey abundance.

During 1987-1995, abundance estimates decreased from 610 million to 43 million.

It can be taken from Figures 8.2.5 and 8.2.6 that this species was mainly distributed off East Greenland, while the minor abundance and biomass indices off West Greenland decreased almost to zero. It should be underlined that the enormous variation of catch per tow data resulted in high confidence intervals, ranging between 40% and 60% of the stratified mean in most of the years.

The length frequencies are illustrated for West and East Greenland and aggregated to total in Figures 8.2.5 and 8.2.6, respectively (WD no. 10). They reveal pronounced year and area effects. Usually, the few individuals off West Greenland showed a peak around 30 cm while fish lengths off East Greenland varied over a wide range. Since 1984, juveniles (<30 cm) contributed important and increasing parts to the stock. Peaks at lengths of 20.5, 25.5, 28.5, 29.5 and 30.5 cm between the successive years 1985-89 and at lengths of 22.5, 25.5 cm between the successive years 1990-91 might indicate the annual growth increments of single cohorts.

8.2.2 State of the stock and catch projections

Input data from Division Va for computing TAC values related to different reductions in real effort, as used earlier by the Working Group are given in following text table:

Year		Catch Va	Effort
1985	3857	67312	17
1986	4424	67772	15
1987	4335	69212	16
1988	3083	80472	26
1989	3512	51825	15
1990	3268	63156	19
1991	2004	49678	25
1992	1795	51464	29
1993	1508	45890	30
1994	1629	38669	24
1995	1557	41513	27
1996	2546		
Average 85-90			
	3747	av.86-89	18.0

The groundfish survey indices (*U*) may be assumed to be related to overall biomass (*B*) by a simple multiplicative relationship ($U=kB$). If catches in time, t, are assumed to be proportional to stock size and effort ($Y=cEB$), then it follows that catch over survey index is proportional to effort ($Y/U=aE$) and this allows a one-year prediction of catch assuming a *status-quo* effort level.

The time series of survey indices, catches and deduced effort indices is given above. Since the survey index from the last groundfish survey is probably an outlier and can hardly reflect the true changes in the fishable stock, it is not appropriate to calculate a TAC based on that data point.
A possible alternative would be to use the CPUE data to predict the catch for the next quota year, using *status - quo* effort. The results would then be as follows:

Year	CPUE	Catch Va	Effort
1988	647	80472	124
1989	689	51825	75
1990	602	63156	105
1991	504	49677	99
1992	509	51464	101
1993	469	45890	98
1994	469	38669	82
1995	491	41513	85

These data seems to not indicate any increase in the effort. That is probably due to equipment improvement in the last years and also expanding of the fishing ground during the first years of the period. However, the present state of exploitation seems not to be sustainable. ACFM has also advised a reduction in effort towards the 1986-1990 level.

Although the effort measurements using the CPUE data does not reflect the same trend as from the survey data, due to the outlier in the 1996 survey, the effort measurements calculated from the fishery was used to project the *status - quo effort in* 1997. It was assumed that catch per unit effort will be same in 1996-1997 as in 1995 and the catches in 1996 to be same as in 1995. By using this approach, the catches in 1997, using constant effort would be approximate 42,000 t. By reducing the effort in steps of e.g. 25% annually, the catches in 1997 would be 31,000 t. Approximately same results are obtained by projecting the survey data from 1995, as was done for the CPUE data.

8.2.3 8.2.3 Stock trajectories for *Sebastes marinus* using the age-based production model

The input parameters, fixed or estimated, for the model are derived in Section 7.4 and listed in Table 8.2.4 The parameters taken as known *a priori* were: (1) the length-weight relationship – data from the Icelandic groundfish survey, (2) the growth parameters in the von Bertalanffy model, (3) the natural mortality and the selection pattern in the survey. Then the unknown parameters were: (1) the selection pattern in the fishery and (2) the average recruitment.

The unknown parameters were then estimated by: (1) minimizing the difference between the abundance indices from the Icelandic groundfish survey on the fishable stock from 1985-96 and the estimated fishable stock from the model and (2) the difference in the observed cumulative length distribution in the catches, from 1987-95, and those predicted by the model. Figure 8.2.10. shows (a) indices on the fishable stock and their deviations from the survey indices, (b) catches and fishing moralities, and finally, (c) the cumulative plots of length distributions.

An alternative approach is to use the O-group survey indices as an direct measurement on number of 1 year old fish and scale it with a constant. The indices from the Icelandic O-group survey are correlated with the recruitment indices from the Icelandic groundfish survey ($r^2 = 0.60$-0.68 dependent on which time lag was used between recruitment and the O-group index (Magnusson and Johannesson, Anon.1995/G:39)). In this case, the same assumptions are made as in Table 8.2.4, and the recruitment multiplier constant and the selection pattern for the fishery were estimated.

The catch prognosis in Figure 8.2.7 and 8.2.8 (1996-2001) are simply derived by assuming a catch of 35,000 t in 1996 and setting the average fishing mortality for 1997-2001 equal to the average from 1982 to 1988.

The main difference between these two runs is basically the difference in the recruitment part. Using the O-group data for recruitment the stock shows a higher rate of recovery since the O-group indices in the last 10 years have been relatively high, compared to the overall average in the period from 1976. Using the O-group indices for recruitment also suggests higher catches in the period from 1997 to 2001 while using a constant F. Using the estimated average recruitment (Figure 8.2.7), the stock is predicted to remain at a low level, from 1997 and onwards giving low catches.

8.2.4 MBAL

The fishable stock of *S. marinus* is at a very low level, and the catches in last years have been low despite of increased effort, especially in Division Va, but recruitment seems not to have failed in Division Va.

The Working Group agreed that it is difficult to define any MBAL for the stock based on available information.

8.2.5 Management considerations

Based on the Icelandic groundfish survey information and the CPUE data, the *S. marinus* stock seems to be at a low level and the fishable biomass appears to have decreased considerably from 1986 to 1995 from analysis of, however, recruitment failure does not seem to have occurred (Table and Figure 7.3.1).

Also from the age-based model, the *S. marinus* stock in Va seems to be at a low level and the fishable biomass may have decreased to about 35% of the 1985-level, or about 20% of the 1977-level.

It is advised that effort be reduced from the present level since this level does not seem sustainable. Survey indices from the last Icelandic groundfish survey showed an improvement on the previous ones but this improvement is most likely an outlier since there is an increase in all length groups, except one. Nevertheless, the survey does indicate increased recruitment to the fishable stock and the CPUE from the Icelandic trawler fleet has increased slightly compared to the last two years and the length distributions from catches show some signs of incoming recruitment to the fishable stock.

Although there are some indications of incoming recruitment, it is important that this recruitment be used to build the fishable stock up from its present low level. If the stock size is to increase, it is likely that effort will have to be reduced from the present high levels. It is likely that true reductions in real effort will only be attained if the effort is reduced by a considerable amount. Since the effort seems to have more than doubled in recent years, without considerable gains in catches, it would seem that there is little gain in remaining at current effort levels. It is quite likely that similar catches could be obtained in the longer term by decreasing the current effort.

It may be feasible to initiate effort reduction e.g. by imposing an initial 25% reduction and then following up with further reductions if no significant improvement is seen in the Icelandic groundfish survey and in the CPUE data.

Since *S.marinus* in Sub-areas V and XIV is treated as a one unit stock, it is suggested by the Working Group that some specific advice should be given for Division Vb and Sub-area XIV.

The results from the German groundfish surveys in Sub-area XIV are alarming concerning *S. marinus*. It is therefore urgent to protect the juvenile fish which are presently observed in large quantities at E- Greenland.

Since recommendations have been advanced to reduce the effort in Va and XIV, it is the opinion of the Working Group that there will be no gain in increasing the effort in Vb.

9 DEEP-SEA *SEBASTES MENTELLA*

9.1 Landings and Trends in the Fisheries

The total annual catches of deep-sea *S. mentella* in Divisions Va and Vb and Sub-areas VI and XIV varied considerably in the 1980s mainly from 30,000 to 60,000 t.

In 1990 the catch was 44,000 t, and reached 67,000 t in 1991, decreased slightly in 1992 (62,000 t) but increased to about 83,000 t in 1994. In 1995 the catches decreased again to approximately 55,000 t. In summary, the average annual catch in the period from 1991-1995 (69,000 t) increased substantially from the average in the 1980s (42,000 t) and the year 1990 (44,000 t) (Table 9.1.1).

In Division Va, the total catch in 1995 was about 48,000 t, decreasing from the record high caches in 1994 of 57,000 t. In the 1980s the catches varied from 10,000-40,000 t, but were averaging about 21,000 t during that period. The catches doubled from 1990-1994 i.e. from 28,000 t to 57,000 t. This increase in the catch coincides with the introduction of large pelagic trawls used by a part of the Icelandic fleet during autumn and early winter months. Length distributions from the landings of the Icelandic fleet in 1989-1995 along with measurements at sea from the commercial trawler fleet are shown in Figure 9.1.1.

About 90-95% of the total redfish catches in area Va in recent years have been taken by bottom trawlers (both fresh fish and freezer) and the remainder is taken by other gear and partly as a bycatch in the shrimp fishery.

In Division Vb annual catches of deep-sea *S. mentella* varied from 5,000-8,000 t until 1984. Then catches increased rapidly to about 15,000 t in 1986. The catches declined again to 9,000 t in 1990. They increased to about 13,000 t 1991. Since then they have remained low at almost half the 1991 catch, a reduction of about 43% (6,000 t in 1995) (Table 9.1.1). The length distribution from the Faroese catches is shown in Figure 9.1.2.

In Sub-area VI the annual catches were highest in 1980 (1,000 t), but have decreased to 80, 90 and 5 t in 1993, 1994 and 1995 respectively (Table 9.1.1).

In Sub-area XIV, the annual catches have varied considerably. In the beginning of the 1980s the landings were between 10,000-15,000t, but then decreased to the level of 6,000 t in 1987-1992 and increased to 19,000 t in 1994. At that time the fleet were mainly fishing very small redfish. The catches in 1995 are the lowest on record, at only 1,000 t, due to effort reduction (Table 9.1.1).

9.2 Assessment

9.2.1 Trends in CPUE and survey indices

CPUE for deep-sea *S. mentella* in division Va is based on tows taken below 500 m depth and where total catches of redfish are more than 10% of the total catch in each tow. In the period from 1986 - 1989 the CPUE was stable. Since 1989, there has been a strong declining trend in CPUE (Figure 9.2.1), except in 1995 where CPUE increased by 5% from 1994 . The decline in the period from 1989 shows a reduction from a stable CPUE level of about 950 before 1990 to the current level of about 500, which is a reduction of about 45% (Table 9.2.1).
It should be noted that these data reflect only a part of the stock, i.e. Division Va, and only in the demersal trawl fishery. During the same period, the landings have increased from about 20,000 t to an average of over 50,000 t in last the two years. This may be taken as a strong indication that the stock in this area cannot sustain the present level of exploitation.

Since 1991, considerable amounts of *S. mentella* have been taken in pelagic trawls on mating grounds mainly in the area east of the Reykjanes Ridge. The CPUE from this fishery (Figure 9.2.2) shows considerable decline, even though fishing technology has improved during the last years.

Abundance, biomass estimates and length structures of *S. mentella* at Greenland have been derived using data derived form the German annual groundfish surveys covering shelf areas and the continental slope off West and East Greenland down to 400 m depth. Surveys commenced in 1982 and were primarily designed for the assessment of cod. A description is given in chapter 5.1.1 and more detailed in the 1993 Report of the North Western Working Group (Anon, 1993/Assess:18.). Only redfish (>=17 cm) were separated to deep sea *Sebastes mentella* Travin and included in the calculations.

Survey abundance and biomass indices are presented in Tables 9.2.2 and 9.2.3, broken down by stratum at West and East Greenland, and illustrated in Figures 9.2.3 and 9.2.4. An increasing trend is evident for both abundance and biomass indices. In 1991, 1993 and 1995, when the survey area was completely covered, this species was found to be very abundant with 970 million and 1,400 million and 2,500 million individuals and 290,000, 230,000, and 375,000 tons respectively. During the early eighties, the abundance varied among 90-170 million fish, while the minimum and maximum biomass amounted 34,000 t and 65,000 t. Comparing the proportions between West and East Greenland, deep sea redfish was almost exclusively distributed off East Greenland. West Greenland shares are negligible and vary without a clear trend. The high confidence intervals indicate a low precision of these estimates.

Length disaggregated abundance is shown for West, East Greenland and total in Figures 9.2.5 and 9.2.6. Since 1985, juveniles (<25 cm) contribute significant portions and have dominated the stock structure since 1989. In

1991 and 1993, most of the beaked redfish were smaller than 20 cm or varied between 25-27 cm. Growth indications for single cohorts between successive years are hardly derivable from these length distributions, the only occurring in 1990-91 with pronounced peaks at 21.5-23.5 cm and 25.5-26.5 cm, respectively. In 1993 and 1995, pronounced peaks were determined at 18 and 21-22 cm, respectively.

Only small amounts of *S. mentella* are caught in the Icelandic groundfish survey, and it was considered not to reflect any changes in the stock situation.

9.2.2 State of the stock and catch projections

It should be noted that in the last few years the CPUE has decreased drastically, catches have increased and fishing effort has increased by a factor of 3 since 1989-1990.

It is possible to compute effort as well as a TAC corresponding to different reductions in effort for deep sea *S. mentella* by a similar method as described in section 8.2.1, although for the deep-sea *S. mentella,* a CPUE index is used as the survey index. The time series of the CPUE index, catches in area Va and deduced effort index are given in Table 9.2.1.

9.3 MBAL

The fishable stock seems to be at a very low level, and knowledge about recruitment is scarce. Therefore, it is difficult to define any MBAL limit for the stock.

9.4 Management Considerations

The stock seemed stable during 1989-1990 and it would be necessary to reduce the current fishing effort by about 57% to reach the effort created during this period of relative stability. The reduction could be done by 25% per year which, assuming that the CPUE in 1996/1997 will be the same as in 1995, would correspond to catches of 35,000 t for the 1996/1997 fishing season.

According to German survey data, there is a large depletion of the adult stock (over 30 cm) in Sub-area XIV. The fishery in earlier years targeting on small fish did not continue in 1995. The working group points out that exploiting the juvenile redfish will neither lead to stock recovery nor improve catches in future.

Regarding Division Vb the catches of deep-sea *S. mentella* have decreased in recent years although the effort has remained at approximately the same level. Although little information exist on the part of the stock in Division Vb, a reduction in fishing effort is recommended.

An age based production model could also be used for this stock using length distributions from catches and a CPUE data as an tuning series in absence of any survey data on the fishable stock. Since the input data necessary to run the model were not available for the group, it was not possible to run the model during the meeting.

10 OCEANIC *SEBASTES MENTELLA*,

10.1 Fishery on oceanic *S.mentella*

10.1.1 Historical development of the fishery.

The fishery on oceanic S. *mentella* started in 1982 by the Russian fleet. Bulgaria, former GDR and Poland joined Russia from 1984. The international catches during the first period increased from 60,000-70,000 t to 105,107 t in 1986. Since 1987 the total landings decreased and reached a minimum in 1991 of 24,956 t. The main reason for this decrease was a reduction in fishing effort, especially by Russia. From 1989 the number of countries, participating in the oceanic S. *mentella* fishery increased. As a consequence, the total catches also increased and reached the highest level to date in 1994 of 139,562 tonnes (Tables 10.1.1-10.1.2).

In 1982-1992 the fishery was carried out during April-August. In 1993-1994 the fishing season was prolonged considerably, and in 1995 the fishing season was from March to December. The fleets participating in this fishery have improved and developed new fishing technology, and most trawlers are now using big pelagic trawls ("Gloria"-type with different (80-120 meters) vertical openings), and are working at all depths (100-800 m).

10.1.2 Brief description of the various fleets in 1995.

The fleets fishing for oceanic *S.mentella* are different. and it was impossible for the Working Group to get a complete picture of all vessel types, gears etc. Up to 70 trawlers at a time participated in the fishery in 1995 at the same time.

The Russian fleet, which in 1995 was composed from 2 to 41 factory trawlers depending on the season, and consisted of seven different factory trawler types. The Icelandic trawlers, in 1995 about 20 vessels, were almost all factory trawlers. The 3 Norwegian trawlers were all factory trawlers. Spain, which took part in this fishery for the first time in 1995, participated with 4 vessels. The German fleet composed 7 factory and 2 roundfish trawlers. The Faroes fleet composed 1 factory and 3-4 freshfish trawlers. Information about the other fleets (see Table 10.1.2) was not available.

10.1.3 Landings and Trends in the Fishery on Oceanic S. *mentella*

Provisional data for 1995 show a total catch of 123,846 t (Table 10.1.1-10.1.2). In 1995, catches have been reported from 15 countries. The catch statistics for 1994 and 1995 should, however, be considered incomplete. Reportings from Bulgaria, Lithuania and Ukraine are lacking in one or both of the years. Assuming similar catches for these countries as in 1993 the total landings in 1994 and 1995 are likely to be at least 145,000 and 130,000 t, respectively.

The landing statistics reported by Iceland and Norway account for discards, while the other countries report the quantity landed. However, there may be other uncertainties connected to the fishery . The factors used for converting the weight of "Japanese-cut" and ordinary head-cut redfish or fillets into round weight may cause errors in the statistics if these factors are wrong and/or differ between countries.

From the beginning of the fishery in 1982 catches were reported from both Sub-areas XII and XIV. Most of the catches were taken in Sub-area XII (40,000-60,000 t) until 1985 when the greater part of the catches were reported from Sub-area XIV. In 1994-1995 the landings from Sub-area XII are again in majority with 80,000-85,000 t each year (Table 10.1.1).

The landings from Division Va has been around 2,000 t since the fishery started here in 1992, except in 1994 when more than 15,000 t were caught in this area (Table 10.1.1). It should also be noted that Canada has reported to have landed 602 tonnes from NAFO area 1F.

In Table 10.1.3 the CPUE for Russian and Norwegian fleets are given, but were not used for assessment purposes because of changes in gears, fishing pattern etc. Patchiness and variations in the extension of fish concentrations were also reported. This will affect CPUE, and it was therefore impossible for the Working Group to draw any conclusions from these observations.

Length distributions of oceanic *S. mentella* from German, Icelandic and Spanish landings were reported for 1995 and are given in Figure 10.1.1. The weighted (by catch) length distribution was used as input to the stock production model.

10.2 Assessment

10.2.1 Acoustic assessment

Results from a new acoustic survey was available for the Working Group. This survey was conducted by Russia by one research vessel from 24 June to 30 July 1995 to cover the area in international waters and within the Greenland EEZ down to a depth of 500 m (W.D. No. 19). The survey design (Fig. 10.2.1.B) was in accordance with the recommendations of the ICES Study Group on Redfish Stocks (Anon. 1994/G:4). The stock size in the area covered was calculated to be about 2.48 mill. tonnes, with an abundance of $4.1*10^9$ specimens (Table 10.2.1). The biomass estimate is 11.7 % higher than that in 1994 and 3.1 % lower than that in 1993. The 1995 redfish distribution is shown on Fig. 10.3.3.

It was not possible to cover the total redfish distributional area as only one Russian research vessel took part in the survey. It is believed, however, that the main area of the stock's distribution down to 500 m depth was covered. The Working Group therefore agreed upon adopting the results from the 1995 Russian survey into the assessment. The 1991-1995 acoustic surveys were all included in the stock production model to evaluate the stock. The Working Group has previously decided not to include the years prior to 1991 due to insufficient area coverage, improper design of the survey tracks, and improvement of the acoustic survey technique over time.

Settings of the acoustic instruments and the target strength parameters will have impact on the correct level of the estimate (can lead to either over- or underestimate). This may cause a bias in the estimates when different vessels from different countries are not all intercalibrated. However, assuming that the acoustic equipment has been acceptably intercalibrated among the vessels within and between years, the main biases in the field are believed to be differences in the ability to scrutinize the deepest part of the 500 m water column, exclusion of the scattering layer, and day-night differences in the behaviour of the fish, which will be reflected in the target strength (TS) measurements and computed biomass (Reynisson *et al.* 1995). An average TS between day and night has therefore been used.

The acoustic surveys have measured the oceanic *S.mentella* stock to be at the same level during the last five years (2.2 - 2.6 mill. t). This implies that the catches during these years can not yet be seen to have affected the fishable stock size, but it remains an open question how the fishery may have affected the recruitment to the stock, i.e., young oceanic redfish that grow up outside the Irminger Sea.

The oceanic redfish geographic distributional pattern in June-July has appeared very similar from year to year. The surveys have neither shown any significant changes in the mean length, individual weight or sex ratio of oceanic redfish.

Pelagic *S. mentella* living mainly deeper than 500 meters in the Irminger Sea, which according to Icelandic scientists mainly belong to the deep-sea *S. mentella* and not the oceanic type (e.g., due to different colour, length at first maturity) has not yet been assessed acoustically.

Stock trajectories for oceanic *S. mentella* are fully dependent on the best available acoustic estimate. The acoustic design and analysis procedure of the acoustic surveys have been according to Simmonds *et al.* (1992) and conducted by countries having long experience in this measuring technique. Although improvements are to be expected, the Working Group considers the acoustic estimates to be reliable taking into account difficulties mentioned above. Especially in periods with great increase in fishing effort from year to year, it is necessary to frequently conduct these acoustic surveys. This is especially important now, also since more experience about the capability of the rather new stock production model to monitor the stock is needed.

10.2.2 Ichthyoplankton assessment

The regular Russian ichthyoplankton survey of the oceanic redfish stock was conducted from 18 April to 17 May 1995. The standard techniques to calculate redfish abundance and estimate biomass were used (Shibanov and Melnikov, 1994). The redfish larvae were collected using a "Bongo" sampler with an opening of 60 cm diameter. The samples were collected using oblique tows fishing in the 0-50 m layer. The area covered and station positions are presented in Fig. 10.2.1.A.

The commercial redfish stock was estimated at 2.95 mill. tonnes with an abundance of $3.6*10^9$ specimens. (Table 10.2.2.). The estimated results relates well with the results from the 1993 icththyoplankton survey (Table 10.2.3.). The Working Group did not use the estmate in the stock production model. However, no effects of catches on the stock can be seen from this alternative method either.

10.3 Some new biological information concerning the oceanic redfish distribution

In accordance with requests from ACFM and NEAFC to the North-Western Working Group, new information about redfish migration patterns, collected during the Russian ichthyoplankton and trawl-acoustic surveys is presented.

There is a hypothesis about existence of **two types of redfish** in the Irminger Sea.

In 1995 the distribution of redfish extruded larvae (April-May) and fry that started their active feeding (June-July) were observed (Fig. 10.3.1.). Extrusion of larvae in the Irminger Sea started in mid-April in the southeastern area and was completed by the end of the second ten-day period of May on the western slopes of the Reykjanes Ridge. The larvae were widely distributed over an area of 126.700 sq. miles. The larval density reached 45 specimens/sq. m in some locations, situated generally along the Reykjanes Ridge.

In June-July 1995 a northward drift of fry concentrations was registered. It is obvious that the general direction of redfish larvae/fry drift was in the same direction as the surface currents. In the northern part of the area surveyed a westward drift was registered , which is consistent with the direction of the Irminger current. It is quite likely that the fry later drifted in a southern direction within the Greenland EEZ following the water masses of the Irminger Current. In this case the most probable location of young oceanic redfish settling will be on the shelf and slopes of West Greenland and, perhaps, off Baffin Island.

It is obvious that redfish larvae which are extruded in the same places and at the same time will mix. It has not been possible for the ichthyoplankton survey to distinguish between larvae extruded by the two hypothetic pelagic redfish types. A concentration of redfish fry at 60°30'N, 32°00'W is presented in Fig. 10.3.1.B.

Outlines of adult redfish distribution were obtained both from the hydroacoustic observations during the ichthyoplankton and trawl-acoustic surveys (Fig. 10.3.2. and 10.3.3.). In April-May the adult redfish was mainly distributed in the international waters of the Irminger Sea. In June-July the redfish aggregations moved in a western direction so, that 66 % of the redfish stock was distributed within the East Greenland EEZ. Redfish were distributed in a south-west to north-east direction and were found mainly along the frontal zone between the Irminger Current and the relative cold water masses of the central Irminger Sea.

10.4 Stock and catch trajectories for oceanic *Sebastes mentella*

The input parameters, fixed or estimated, to the model are listed in Table 10.4.1. All fixed parameters were the same as those used by last year's Working Group. The length-weight relationship was taken from the 1994 acoustic survey results. Von Bertalanffy parameters were estimated to give the best fit (EXCEL Solver) to Norwegian otolith readings of oceanic *S.mentella* presented to last year's Working Group. The same selection pattern was assumed for the fishery and the survey. The other parameters were estimated (by EXCEL Solver) as to minimise (1) the discrepancy between the observed catch length distributions in 1994 and 1995 (Fig. 10.1.1) and those predicted by the model, and (2) the difference between the acoustic biomass estimates and those estimated by the model for the same years. The results from the age-based production model are given in Figures 10.4.1 - 10.4.4. The age-length distribution generated by the model also resembled previous age-length keys presented to the Working Group. The fishing mortalities on the fully recruited age groups, i.e., above age 20, are at present estimated to be about 0.06.

The stock production model estimates the virgin biomass in 1982 to have been 2.93 mill. tonnes. The model shows that if the cumulative catch in the next five year period will be e.g., 750,000 t, the fishable stock will be reduced by approx. 500,000 t. The modelling thus shows that the stock is only capable of approx. 50,000 t production per year.

It was the opinion of the Working Group that it was difficult to rely on the prognosis from the stock production model due to the following:

i) The acoustic estimate, which is considered to be an absolute measure of the fishable stock, covers only the pelagic redfish shallower than 500 metres. The input historic catches to the model, however, represent the total catches taken from the whole water column, also deeper than 500 metres.

ii) The 1995 acoustic survey estimated the fishable stock (of which approximately 95% is mature) to be 2.48 mill. t, which do not imply any stock decrease compared with the previous surveys, although the 1993-1995 catches have been as high as 113,000 - 140,000 t each year. Although the cumulative catches in 1993-1995 (i.e. 377,000 t) have only been slightly higher than the variation in the acoustic estimates seems to be (e.g. the difference between the 1994 and 1995 acoustic estimates is 291,000 t) the rapid decline in the fishable biomass towards 2001, according to the model, may be difficult to rely on.

Nevertheless, different scenarios from the stock production model are presented below:

Scenario 1

Projections of spawning stock biomass (about 95% of the fishable biomass is mature) and catches have been made up to 2010. Based on the 1996 quota agreement in NEAFC, the catch for 1996 has been set to 150,000 t. If it is a goal not to let the biomass in 2010 become less than 50% of the virgin biomass in 1982, and the quota each year is set to a certain percentage of the spawning stock biomass, then the quota should not be set higher than approximately 5 % of this biomass in the beginning of each year (see text table below). This scenario will give quotas from about 102,000 t in 1997 down to 73,000 t in 2010. In the short term (until 2001), the stock will be reduced to 58% of the 1982-level when fishing 5 % of the standing fishable biomass annually, or down to 52 % and 46 % if the annually catches are taken as 7.5% or 10%, respectively, of the fishable biomass measured at the beginning of each year.

Scenario 1: (Figure 10.4.2)
Final stock biomass as percentage of the estimated virginal stock biomass.

	Catch as percentage of fishable biomass		
Year	5%	7.5%	10%
2001	58	52	46
2010	49	39	30

Scenario 2

Stock and catch scenarios were also made when having constant catches within each 5-year period based on a certain percentage (5-10%) of the fishable biomass in the beginning of the 5-year period. In the text table below the consequences (as stock size in year 2001 and 2010 as percentage of virgin biomass in 1982) are shown for the different catch scenarios.

Scenario 2: (Figure 10.4.3)
Final stock biomass as percentage of the estimated virginal stock biomass.

	Catch as percentage of fishable biomass		
Year	5%	7.5%	10%
2001	57	50	43
2010	48	36	26

Scenario 3

A scenario is also presented with a constant catch of 100,000 t, 125,000 t or 150,000 t each year the next five years (i.e., 1997-2001), and a catch in later years set to 5% of the fishable biomass in the beginning of each 5-year period. This scenario was requested for by NEAFC. The results are shown in the text-table below.

Scenario 3: (Figure 10.4.4)
Final stock biomass as percentage of the estimated virginal stock biomass.

	Constant catch in 1997-2001		
Year	100,000 t	125,000 t	150,000 t
2001	57	54	51
2010	49	47	45

A run was also made to take account of the mixture of a possible deep-sea *S.mentella* type in the three most recent year's catches. The 1993-1995 catches of oceanic *S.mentella* were reduced to 65% according to Icelandic samples (W.D. no. 15). In summary it could be said that the catch and stock development will be similar to the above scenarios, but the decrease will be about five years delayed.

Another run was made with catches of 150,000 t per year until 2010. This will give a stock in 2010 of 23% of virgin biomass, and the estimated fishing mortality will increase from the present 0.06 to 0.25 in 2010.

These predictions clearly relate to the generic evaluation of management strategies, which are sometimes considered in more general settings (Anon. 1995/Assess:15). Such approaches need to be considered in more detail in the future, with an emphasis on quantifying uncertainty in such a fashion as to allow tabulation of e.g. medium-term catches vs. risk of depletion. This is particularly the case for Oceanic *S. mentella.* In order to complete such a task, the two working groups ideally need some guidance on appropriate target levels and criteria for evaluating strategies.

Some generic goals should be set, e.g. on a long-term target level for the stock, possible aversion to catch reduction and on interannual variation, in order to reduce the number of possibilities for evaluation. In the absence of other criteria, the present meeting has emphasised harvesting strategies which lead the Oceanic-type *S. mentella* towards a level close to half of the virgin biomass, in accordance with the NEAFC request to "obtain sustainable yields". Clearly little can be said on where MSY is for this stock, but a procedure which maintains a stock close to 50% of its virgin size certainly constitutes a sustainable harvesting strategy. This is also stated in ACFM's latest advice, i.e., that a SSB above or close to 50% of virgin biomass is very likely to be sustainable.

All three scenarios show a gradual decline in the spawning stock over the simulation period, and an equilibrium SSB is not reached. However, the model simulations have shown that the harvesting strategy closest to this goal will be in the coming five-year period sooner or later to set the catch to about 5% of the fishable stock.

10.5 Management considerations

Due to inadequate knowledge about deep-sea *S.mentella* caught pelagic in the Irminger Sea, it is the opinion of the Working Group until such knowledge is available to continue managing all pelagic redfish in the Irminger Sea as one stock unit, hitherto grouped as oceanic *S.mentella*, and separated from the adult continental stocks.

The Working Group found it difficult to rely on the prognosis from the stock production model. The acoustic surveys do not cover the entire water column from where the fishery is going on, and the fishery does not seem too have affected the stock size yet. Better prognosis and stock evaluation should, however, be possible to make after the acoustic survey in June-July 1996.

The main strategy when setting the catch-levels for the oceanic *S. mentella* stock in the future should be to obtain sustainable yields. In order to do that, and in view of the uncertainties concerning the stock dynamics, the fishable biomass should never be reduced below 50% of the virgin biomass in 1982.

The scenarios given show that the stock will come very close to this "critical" level already in 2001 if the annual catches will be 150,000 t in the next five years (scenario 3). Scenarios 1 and 2 show that if any of these strategies for quota recommendations should be adopted, approaching the 5% catch-level could be recommended. Dependent upon how to decrease from the present catch level, this will in the years after 2001 imply a catch level at about 80,000 t. Better prognosis should be possible to give after the 1996 acoustic survey. The results from the stock production model also indicate a yearly production in the stock of approx. 50,000 t. This implies a production only 1/3 of the present catch level.

The age-based production model used for this stock has revealed some stock dynamics which are quite different from e.g., gadoid stocks. The strong decline observed even though the fishing mortality is quite low is something one should be aware of when evaluating the fishing mortalities, which although they are low compared to other fish stocks, may have reached a critical level for a long-lived species such as redfish.

Although stock trajectories are made taking into account different catch levels, the behaviour of the stock to the recent increase in fishing effort is unknown. The Working Group therefore see the need for the international acoustic survey which will be conducted in June-July 1996. Future time scaling of monitoring the stock by surveys is therefore dependent on the results from the 1996 survey and the development of the fishery.

It should be underlined that since no reliable information is available on the recruitment processes for this stock, it will at present be impossible to detect reduction in the recruitment before the fish enter the fishable part of the stock at an age of at least 10-15 years. The stock could therefore suffer from recruitment failure in many years before it is possible to observe it. In order to gain important knowledge on the location of the nursery areas for this stock and of the recruitment to the Irminger Sea, a joint international synoptic trawl survey for 0-group and/or juvenile redfish covering the entire distribution area would be necessary.

The ichthyoplankton surveys do provide some information about the spawning stock. Although it is not possible to identify to which redfish type the larvae belong, it should be further investigated if these surveys can provide a larval index useful for management.

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Table 2.1.1. Catches of COD in Vb by various faroese fleet categories. Tonnes gutted weight.

Year	*Open boats*	*Longliners < 100 GRT*	*Singletrawl < 400 HP*	*Gill nett*	*Jiggers*	*Singletrawl 400-1000HP*	*Singletrawl > 1000 HP*	*Pairtrawl < 1000 HP*	*Pairtrawl > 1000 HP*	*Longliners > 100 GRT*	*Industrial trawlers*	*Others*	*Total*
1985	5650	9667	2506	291	1522	3049	4354	5393	2223	3133	54	202	38044
1986	2946	4708	1643	443	921	2049	2840	10132	4793	1700	141	391	32706
1987	2151	3232	1393	283	639	1543	1794	6361	3273	2586	112	30	23408
1988	579	3055	1114	568	1657	1652	1510	6065	3455	3201	137	35	23025
1989	923	6019	1213	692	1932	1203	1157	2278	1729	3840	148	12	21147
1990	471	4252	582	201	1000	442	568	863	1259	2440	79	27	12184
1991	335	2478	574	160	629	277	371	663	1038	1394	45	8	7971
1992	136	1360	361	1	382	123	193	634	1119	708	258	21	5296
1993	109	815	803	0	455	219	178	717	1141	696	40	23	5194
1994	240	1086	956	58	1500	235	447	651	1942	1128	45	7	8295
1995	733	3112	1137	55	4407	714	865	1164	2204	3341	11	1	17744

Table 2.1.2. Catches of HADDOCK in Vb by various faroese fleet categories. Tonnes gutted weight.

Year	*Open boats*	*Longliners < 100 GRT*	*Singletrawl < 400 HP*	*Gill nett*	*Jiggers*	*Singletrawl 400-1000HP*	*Singletrawl > 1000 HP*	*Pairtrawl < 1000 HP*	*Pairtrawl > 1000 HP*	*Longliners > 100 GRT*	*Industrial trawlers*	*Others*	*Total*
1985	903	5299	196	18	86	780	1055	2546	832	1816	15	28	13575
1986	951	5039	250	4	62	354	664	2654	1313	1535	87	56	12967
1987	1520	5418	313	3	47	625	288	2340	1251	1796	204	29	13834
1988	197	5227	167	2	50	430	259	1205	914	2076	161	13	10700
1989	450	7433	138	2	176	409	213	862	749	2257	180	5	12876
1990	248	6141	76	1	132	294	192	534	800	1815	68	18	10319
1991	210	4213	116	0	40	95	126	495	799	1321	52	5	7473
1992	79	1892	64	0	13	30	45	439	576	917	41	8	4104
1993	27	787	261	0	6	101	37	424	713	818	98	4	3275
1994	34	630	290	0	4	85	121	363	1045	913	93	3	3582
1995	46	1009	295	0	16	207	91	371	695	1654	11	0	4397

Table 2.1.3. Catches of SAITHE in Vb by various faroese fleet categories. Tonnes gutted weight.

Year	Open boats	Longliners < 100 GRT	Singletrawl < 400 HP	Gill nett	Jiggers	Singletrawl 400-1000HP	Singletrawl > 1000 HP	Pairtrawl < 1000 HP	Pairtrawl > 1000 HP	Longliners > 100 GRT	Industrial trawlers	Others	Total
1985	89	38	23	13	982	2509	12930	10822	10805	28	60	79	38377
1986	107	67	31	54	1296	1004	9872	9921	13173	21	254	330	36132
1987	244	52	116	157	1985	1458	7289	8134	15790	37	408	1	35700
1988	173	101	40	113	2576	2660	8257	7748	17266	31	501	21	39587
1989	352	55	133	90	3723	2144	7118	9440	16513	60	504	5	40136
1990	315	132	110	122	4032	2096	10742	13127	23442	101	495	8	54721
1991	298	55	78	281	4784	585	6791	12978	22584	64	404	7	48910
1992	123	121	18	0	3300	135	2253	7677	17486	37	320	1	31472
1993	168	56	57	0	2697	146	1879	6234	17639	29	203	3	29111
1994	139	112	44	2	3655	315	1995	5408	17240	63	202	0	29175
1995	50	19	90	5	2579	216	2406	4289	14776	73	19		24519

Table 2.1.4. Fishing effort (days) by various faroese fleet categories in Vb.

Year	Open boats	Longliners < 100 GRT	Singletrawl < 400 HP	Gill nett	Jiggers	Singletrawl 400-1000HP	Singletrawl > 1000 HP	Pairtrawl < 1000 HP	Pairtrawl > 1000 HP	Longliners > 100 GRT
1985		7558	2171	108	3348	2077	5565	5389	3193	2973
1986		6692	1509	123	2745	1221	5402	6573	4433	2176
1987		6728	1297	201	2973	1531	4389	6314	5546	2915
1988		8753	1261	234	8072	2204	4964	6026	6034	3203
1989		12804	1445	208	10670	1993	4939	5175	5127	3369
1990		14543	1159	157	9611	1853	4020	5444	7491	3521
1991		14801	1141	183	10332	1038	4005	5828	7875	3573
1992		10599	1150	181	10128	495	4174	3985	7243	2892
1993		7497	2045	561	8056	1008	3577	2851	6335	2046
1994		7625	2029	1833	13410	677	3825	2120	6227	2925
1995		9742	1985	2052	18744	1342	4317	2594	6752	3959

Table 2.1.5. Effort (days) used by various fleet categories at Faroes 1985-1995. At the right the average of 1990-1995 and the number of fishing days allocated in the proposal.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Avg90-95		Proposal
Longliners < 100 GRT														
and jiggers	10906	9437	9701	16825	23474	24154	25133	20727	15553	21035	28486	22187		20380
Single trawlers <	2171	1509	1297	1261	1445	1159	1141	1150	2045	2029	1985	1670	*)	1170
Pairtrawlers	8582	11006	11860	12060	10302	12935	13703	11228	9186	8347	9346	10362		8225
Longliners > 100	2973	2176	2915	3203	3369	3521	3573	2892	2046	2925	3959	3079		3040
Single trawl 400-	No effort limitiations. Cod and haddock catches management by bycatch percentages													
Single trawl > 10	No effort limitiations. Cod and haddock catches management by bycatch percentages													

*) Includes effort used inside 12 nautical miles zone.

**) Only for fishery outside 12 n.miles. Will be allocated ca. 800 days for fishing inside 12 n. miles. with max 30% of cod and max 10% of haddock.

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Table 2.2.1. Faroe Plateau (Sub-division Vb1) COD. Nominal catches (tonnes) by countries, 1986-1995, as officially reported to ICES.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 *)
Denmark	8	30	10	-	-	-	-	-	-	-
Faroe Island	34,492	21,303	22,272	20,535	12,232	8,203	5,938	5,744	8,724 *)	19,128
France [1)]	4	17	17	-	-	-	318 [3)]	1)		
Germany	8	12	5	7	24	16	12	+	2 [3)]	
Norway	83	21	163	285	124	89	39	61	36 *)	38
UK (Engl. a	-	8	-	-	-	1	79	186	56	
UK (Scotlan	-	-	-	-	-	-	-	-		641 [3)]
Total	34,595	21,391	22,467	20,827	12,380	8,309	6,386	5,992	8,818	19,807

*) Preliminary

[1)] Quantity unknown 1989-1991 and 1994.

[2)] Catches included in Sub-division Vb2

[3)] Reported as Vb.

Table 2.2.2. Nominal catch (tonnes) of COD in sub-division Vb1 (Faroe Plateau) 1986-1995, as used in the assessment.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 *)
Officially rep	34,595	21,391	22,467	20,827	12,380	8,309	6,386	5,992	8,818	19,807
Faroese catches in IIA within Faroe area jurisdiction			715	1,229	1,090	351	154			
Expected misreporting/discard										3330
French catches as reported to Faroese authorities				12	17					
Total used i	34,595	21,391	23,182	22,068	13,487	8,660	6,540	5,992	8,818	23,137

*) Preliminary

Table 2.2.3. The Faroese catches (nominal weight) of Faroe Plateau cod 1985-1995 in Vb1 by percent for different fleet categories.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Open boats	16	9	10	3	4	4	4	3	2	3	4
Longliners < 100 GRT	27	15	15	14	29	36	32	26	16	13	18
Singletrawl < 400 HP	7	5	6	5	6	5	7	7	15	10	6
Tangle nett	1	1	1	3	3	1	2	0	0	1	0
Jiggers	4	3	3	8	9	8	8	7	9	19	25
Singletrawl 400-1000HP	8	6	7	7	6	4	3	2	4	3	4
Singletrawl > 1000 HP	11	8	8	7	6	4	5	4	4	5	5
Pairtrawl < 1000 HP	12	30	26	25	11	7	8	12	14	8	6
Pairtrawl > 1000 HP	6	15	14	16	8	10	13	21	22	24	12
Longliners > 100 GRT	7	5	10	13	18	20	17	13	13	14	18
Industrial trawlers	0	0	1	1	1	1	1	5	1	1	0
Others	1	1	0	0	0	0	0	0	0	0	0
Total Faroese catches, t	39,422	34,492	21,303	22,987	21,764	13,322	8,554	6,092	5,744	8,724	22,458

Table 2.2.4

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

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

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	3093,	4424,	4110,	2033,	852,
3,	2686,	2500,	3958,	3021,	3230,
4,	1331,	1255,	1280,	2300,	2564,
5,	1066,	855,	662,	630,	1416,
6,	232,	481,	284,	350,	363,
7,	372,	93,	204,	158,	155,
8,	78,	94,	48,	79,	48,
9,	29,	22,	30,	41,	63,
+gp,	0,	0,	0,	0,	0,
TOTALNUM,	8887,	9724,	10576,	8612,	8691,
TONSLAND,	25500,	23200,	23100,	24000,	24856,
SOPCOF %,	121,	112,	106,	114,	103,

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	1337,	1609,	1529,	878,	402,	328,	875,	723,	2161,	2584,
3,	970,	2690,	3322,	3106,	1163,	757,	1176,	3124,	1266,	5689,
4,	2080,	860,	2663,	3300,	2172,	821,	810,	1590,	1811,	2157,
5,	1339,	1706,	945,	1538,	1685,	1287,	596,	707,	934,	2211,
6,	606,	847,	1226,	477,	752,	1451,	1021,	384,	563,	813,
7,	197,	309,	452,	713,	244,	510,	596,	312,	452,	295,
8,	104,	64,	105,	203,	300,	114,	154,	227,	149,	190,
9,	33,	27,	11,	92,	44,	179,	25,	120,	141,	118,
+gp,	0,	0,	0,	0,	0,	0,	0,	97,	91,	150,
TOTALNUM,	6666,	8112,	10253,	10307,	6762,	5447,	5253,	7284,	7568,	14207,
TONSLAND,	21027,	25174,	30279,	35670,	29037,	26151,	20437,	22381,	24581,	36775,
SOPCOF %,	103,	107,	101,	110,	120,	114,	109,	101,	106,	94,

Table 2.2.4 (Continued)

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

At 6-May-96 22:22:31

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	1497,	425,	555,	575,	1129,	646,	1139,	2149,	4396,	998,
3,	4158,	3282,	1219,	1732,	2263,	4137,	1965,	5771,	5234,	9484,
4,	3799,	6844,	2643,	1673,	1461,	1981,	3073,	2760,	3487,	3795,
5,	1380,	3718,	3216,	1601,	895,	947,	1286,	2746,	1461,	1669,
6,	1427,	788,	1041,	1906,	807,	582,	471,	1204,	912,	770,
7,	617,	1160,	268,	493,	832,	487,	314,	510,	314,	872,
8,	273,	239,	201,	134,	339,	527,	169,	157,	82,	309,
9,	120,	134,	66,	87,	42,	123,	254,	104,	34,	65,
+gp,	186,	9,	56,	38,	18,	55,	122,	102,	66,	80,
TOTALNUM,	13457,	16599,	9265,	8239,	7786,	9485,	8793,	15503,	15986,	18042,
TONSLAND,	39799,	34927,	26585,	23112,	20513,	22963,	21489,	38133,	36979,	39484,
SOPCOF %,	93,	93,	100,	98,	106,	104,	100,	97,	97,	95,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	210,	257,	509,	2237,	243,	190,	209,	118,	559,	2625,
3,	3586,	1362,	2122,	2151,	2849,	446,	465,	787,	768,	2727,
4,	8462,	2611,	1945,	2187,	1481,	2130,	476,	591,	1035,	2016,
5,	2373,	3083,	1484,	1121,	852,	616,	932,	218,	519,	1016,
6,	907,	812,	2178,	1026,	404,	300,	300,	323,	122,	467,
7,	236,	224,	492,	997,	294,	141,	135,	94,	172,	118,
8,	147,	68,	168,	220,	291,	92,	55,	32,	38,	176,
9,	47,	69,	33,	61,	50,	52,	30,	22,	22,	44,
+gp,	38,	26,	25,	9,	26,	24,	35,	25,	16,	49,
TOTALNUM,	16006,	8512,	8956,	10009,	6490,	3991,	2637,	2210,	3251,	9238,
TONSLAND,	34595,	21391,	23182,	22068,	13487,	8660,	6540,	5992,	8818,	23137,
SOPCOF %,	96,	96,	101,	98,	99,	106,	102,	102,	101,	101,

Table 2.2.5

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

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Table 2 Catch weights at age (kg)

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	1.0600,	1.0600,	1.0600,	1.0600,	1.0600,
3,	1.8900,	1.8900,	1.8900,	1.8900,	1.8900,
4,	2.9200,	2.9200,	2.9200,	2.9200,	2.9200,
5,	4.0700,	4.0700,	4.0700,	4.0700,	4.0700,
6,	5.3000,	5.3000,	5.3000,	5.3000,	5.3000,
7,	6.5800,	6.5800,	6.5800,	6.5800,	6.5800,
8,	7.8500,	7.8500,	7.8500,	7.8500,	7.8500,
9,	9.0800,	9.0800,	9.0800,	9.0800,	9.0800,
+gp,	10.2700,	10.2700,	10.2700,	10.2700,	10.2700,
SOPCOFAC,	1.2066,	1.1231,	1.0613,	1.1411,	1.0292,

Table 2 Catch weights at age (kg)

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	1.0600,	1.0600,	1.0600,	1.0600,	1.0600,	1.0600,	1.0600,	1.0600,	1.0600,	1.0600,
3,	1.8900,	1.8900,	1.8900,	1.8900,	1.8900,	1.8900,	1.8900,	1.8900,	1.8900,	1.8900,
4,	2.9200,	2.9200,	2.9200,	2.9200,	2.9200,	2.9200,	2.9200,	2.9200,	2.9200,	2.9200,
5,	4.0700,	4.0700,	4.0700,	4.0700,	4.0700,	4.0700,	4.0700,	4.0700,	4.0700,	4.0700,
6,	5.3000,	5.3000,	5.3000,	5.3000,	5.3000,	5.3000,	5.3000,	5.3000,	5.3000,	5.3000,
7,	6.5800,	6.5800,	6.5800,	6.5800,	6.5800,	6.5800,	6.5800,	6.5800,	6.5800,	6.5800,
8,	7.8500,	7.8500,	7.8500,	7.8500,	7.8500,	7.8500,	7.8500,	7.8500,	7.8500,	7.8500,
9,	9.0800,	9.0800,	9.0800,	9.0800,	9.0800,	9.0800,	9.0800,	9.0800,	9.0800,	9.0800,
+gp,	10.2700,	10.2700,	10.2700,	10.2700,	10.2700,	10.2700,	10.2700,	10.2700,	10.2700,	10.2700,
SOPCOFAC,	1.0308,	1.0706,	1.0121,	1.1028,	1.2014,	1.1380,	1.0923,	1.0106,	1.0634,	.9395,

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

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Table 2 Catch weights at age (kg)

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	1.0600,	.6800,	1.1120,	.8970,	.9270,	1.0800,	1.2800,	1.3380,	1.1950,	.9050,
3,	1.8900,	1.1700,	1.3850,	1.6820,	1.4320,	1.4700,	1.4130,	1.9500,	1.8880,	1.6580,
4,	2.9200,	1.8710,	2.1400,	2.2110,	2.2200,	2.1800,	2.1380,	2.4030,	2.9800,	2.6260,
5,	4.0700,	2.6670,	3.1250,	3.0520,	3.1050,	3.2100,	3.1070,	3.1070,	3.6790,	3.4000,
6,	5.3000,	3.5880,	4.3630,	3.6420,	3.5390,	3.7000,	4.0120,	4.1100,	4.4700,	3.7520,
7,	6.5800,	4.7680,	5.9270,	4.7190,	4.3920,	4.2400,	5.4420,	5.0200,	5.4880,	4.2200,
8,	7.8500,	5.9180,	6.3480,	7.2720,	6.1000,	4.4300,	5.5630,	5.6010,	6.4660,	4.7390,
9,	9.0800,	5.4480,	8.7150,	8.3680,	7.6030,	6.6900,	5.2160,	8.0130,	6.6280,	6.5110,
+gp,	10.2700,	6.0030,	12.2990,	13.0420,	9.6680,	10.0000,	6.7070,	8.0310,	10.9810,	10.9810,
SOPCOFAC,	.9273,	.9337,	.9964,	.9843,	1.0584,	1.0408,	1.0003,	.9695,	.9685,	.9491,

Table 2 Catch weights at age (kg)

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	1.0990,	1.0930,	1.0610,	1.0100,	.9450,	.7790,	.9890,	1.1550,	1.1940,	1.2180,
3,	1.4590,	1.5170,	1.7490,	1.5970,	1.3000,	1.2710,	1.3640,	1.7040,	1.8430,	1.9860,
4,	2.0460,	2.1600,	2.3000,	2.2010,	1.9590,	1.5700,	1.7790,	2.4210,	2.6130,	2.6220,
5,	2.9360,	2.7660,	2.9140,	2.9340,	2.5310,	2.5240,	2.3120,	3.1320,	3.6540,	3.9250,
6,	3.7860,	3.9080,	3.1090,	3.4680,	3.2730,	3.1850,	3.4770,	3.7230,	4.5840,	5.1800,
7,	4.8990,	5.4610,	3.9760,	3.7500,	4.6520,	4.0860,	4.5450,	4.9710,	4.9760,	6.0790,
8,	5.8930,	6.3410,	4.8960,	4.6820,	4.7580,	5.6560,	6.2750,	6.1590,	7.1460,	6.2410,
9,	9.6990,	8.5090,	7.0870,	6.1400,	6.7040,	5.9730,	7.6190,	7.6140,	8.5640,	7.7820,
+gp,	8.8150,	9.8110,	8.2870,	9.1560,	8.6890,	8.1470,	9.7250,	9.5870,	8.7960,	8.6270,
SOPCOFAC,	.9612,	.9642,	1.0061,	.9773,	.9897,	1.0597,	1.0198,	1.0217,	1.0136,	1.0109,

Table 2.2.6

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

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Table 5 Proportion mature at age

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	.1700,	.1700,	.1700,	.1700,	.1700,
3,	.6400,	.6400,	.6400,	.6400,	.6400,
4,	.8700,	.8700,	.8700,	.8700,	.8700,
5,	.9500,	.9500,	.9500,	.9500,	.9500,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,
3,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,
4,	.8700,	.8700,	.8700,	.8700,	.8700,	.8700,	.8700,	.8700,	.8700,	.8700,
5,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

At 6-May-96 22:22:31

Table 5 Proportion mature at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.6300,	.4000,	.0000,
3,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.7100,	.9600,	.5000,
4,	.8700,	.8700,	.8700,	.8700,	.8700,	.8700,	.8700,	.9300,	.9800,	.9600,
5,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9400,	.9700,	.9600,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	.0000,	.0000,	.0600,	.0500,	.0000,	.0000,	.0600,	.2500,	.7200,	.2100,
3,	.3800,	.6700,	.7200,	.5400,	.6800,	.7200,	.5000,	.7300,	.8900,	.5300,
4,	.9300,	.9100,	.9000,	.9800,	.9000,	.8600,	.8200,	.7800,	.9800,	.5500,
5,	1.0000,	1.0000,	.9700,	1.0000,	.9900,	1.0000,	.9800,	.9100,	.9900,	.7400,
6,	1.0000,	1.0000,	1.0000,	1.0000,	.9600,	1.0000,	1.0000,	.9900,	1.0000,	.9700,
7,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	1.0000,	1.0000,	1.0000,	.9800,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.2.7

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

RVXSA: Faroe Plateau RV survey shifted backwards to Dec. prev. year (Catch: Number)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1982	1	471	2592	1784	1441	528	146	51	8
1983	1	1085	2184	1619	508	329	131	1	1
1984	1	416	4296	1546	621	131	157	60	1
1985	1	91	2669	9423	2649	1113	545	352	107
1986	1	127	1539	3448	4595	722	91	115	10
1987	1	197	1265	1662	1284	1427	275	72	18
1988	1	445	602	1006	824	405	661	66	9
1989	1	262	638	1522	1378	436	545	370	62
1990	1	254	352	1222	315	150	51	12	23
1991	1	148	210	472	1810	394	126	65	13
1992	1	41	448	232	163	329	118	44	12
1993	1	472	374	1374	783	211	305	32	1
1994	1	767	977	2089	2913	2754	755	904	127
1995	1	291	5293	6885	3741	2804	814	154	316

Table 2.2.8

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

FLT45: Longliners < 100 GRT (jan-dec) (Catch: Thousands)

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	7530	3110	799	375	181	282	73	17
1986	6622	646	1239	352	148	43	26	6
1987	6669	223	427	528	130	29	11	11
1988	8690	532	236	173	273	67	23	5
1989	12774	931	672	303	270	216	34	4
1990	14440	1302	481	317	119	86	85	14
1991	14780	255	984	185	79	28	15	10
1992	10523	198	164	230	50	22	9	6
1993	7326	178	85	28	53	11	5	3
1994	7443	166	140	47	12	16	3	2
1995	9582	475	169	110	58	16	24	5

Table 2.2.9

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

FLT44: Single trawlers < 400 HP (jan-dec) (Catch: Thousands)

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	1987	1120	257	82	33	27	11	1
1986	1477	398	466	68	16	4	3	1
1987	1259	266	295	214	28	4	1	1
1988	1196	188	144	71	91	14	4	0
1989	1376	221	175	66	49	57	11	4
1990	1144	274	141	29	10	6	4	0
1991	1106	41	197	54	22	8	4	2
1992	1148	33	27	59	22	9	4	1
1993	1977	169	90	31	42	10	4	3
1994	1600	73	101	54	10	15	3	1
1995	1924	153	175	89	33	6	9	3

Table 2.2.10

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

FLT32: Single trawlers 400-1000 HP (Catch: Thousands)

Year	Fishing effort	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	1969	339	118	57	41	13	2
1986	1133	658	141	38	9	6	2
1987	1463	257	245	36	10	3	3
1988	2175	142	113	165	38	11	2
1989	1952	156	58	51	59	11	4
1990	1853	55	19	15	10	10	2
1991	1013	52	27	15	8	3	3
1992	465	10	18	6	3	1	1
1993	963	39	11	11	3	1	1
1994	636	18	15	4	5	1	1
1995	1302	70	47	22	5	5	1

Table 2.2.11

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

FLT33: Single trawlers > 1000 HP (Catch: Thousands)

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	5296	706	520	230	91	62	25	9
1986	5232	258	813	206	62	17	10	5
1987	4181	41	154	275	92	27	6	7
1988	4481	105	92	98	152	47	13	4
1989	4572	44	90	82	75	75	18	5
1990	3601	120	63	36	17	12	12	2
1991	3644	8	51	28	16	9	6	2
1992	3580	15	15	29	10	4	2	1
1993	3547	9	16	7	10	4	1	1
1994	3500	20	28	34	9	12	3	1
1995	3789	44	74	54	27	6	7	2

Table 2.2.12

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

FLT19: PAIR TRAWLERS 400-1000 HP

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	4906	61	802	424	201	94	120	43	12
1986	5953	20	848	2667	747	265	54	37	15
1987	5575	46	383	755	927	221	54	16	21
1988	5736	52	558	698	467	663	108	31	4
1989	4987	49	139	265	148	122	114	30	8
1990	5273	1	77	92	68	35	28	24	4
1991	5626	0	13	92	53	29	15	11	6
1992	3832	2	16	33	97	38	17	6	3
1993	2771	4	52	60	26	38	15	4	3
1994	1962	17	42	44	50	15	19	4	3
1995	2388	26	62	109	72	34	8	8	2

Table 2.2.13

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

FLT20: PAIR TRAWLERS > 1000 HP

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	3064	14	370	218	98	39	47	17	6
1986	4336	17	267	1001	388	166	44	27	8
1987	5420	7	117	319	484	173	46	10	8
1988	5973	9	217	263	247	377	91	34	6
1989	5111	10	73	152	119	104	99	25	7
1990	7424	2	139	149	92	47	29	29	5
1991	7673	1	21	134	82	45	25	17	8
1992	6853	2	29	55	158	64	29	12	5
1993	5953	4	79	106	48	64	24	7	5
1994	5302	28	91	123	151	43	53	12	8
1995	6069	42	115	191	142	71	16	19	6

Table 2.2.14

17:23 Tuesday, May 7, 1996

COD-FARP: Cod in the Faroe Plateau (Fishing Area Vb1)

FLT35: Longliners > 100 GRT (Catch: Thousands)

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	2740	468	231	124	69	103	39	9
1986	2085	95	300	128	67	20	14	4
1987	2444	25	132	232	117	56	21	18
1988	2831	191	183	173	229	69	35	10
1989	3220	306	290	163	192	189	54	16
1990	3367	344	179	133	88	77	77	14
1991	3442	47	289	98	52	30	23	13
1992	2829	47	47	89	33	16	8	5
1993	1754	78	76	26	47	12	6	3
1994	2334	134	67	42	13	24	9	5
1995	3648	384	221	152	90	28	59	15

Table 2.2.15. Faroe Plateau cod: Results of ADAPT calibrations with the research vessel survey index of stock size alone by 5 year periods to investigate changes in the availability of cod to the survey. The 5 year periods correspond to the catch at age used while the survey index for the year following the last year of catch at age data in each period was included in the calibration. The last period, 1991 to 1995, is strikingly different from the other periods, suggesting that the series cannot be treated as a consistent continuous time series of stock size.

	83 to 87	84 to 88	85 to 89	86 to 90	87 to 91	88 to 92	89 to 93	90 to 94	91 to 95
k2	7966	5919	6118	4256	3324	2154	2722	5378	171099
k3	831	711	858	734	1006	874	979	1846	35596
k4	501	378	370	240	351	360	386	503	9957
k5	563	368	309	193	237	260	238	324	5802
k6	692	472	414	237	304	303	291	297	5519
k7	745	417	362	201	324	267	242	275	6708
k8	755	367	335	205	333	380	378	368	10415
k9	1578	375	514	366	520	447	491	362	9779

Table 2.2.16

Lowestoft VPA Version 3.1

6-May-96 22:21:22

Extended Survivors Analysis

Cod FaroePlateau Vb1 (run: XSAAK09/X09)

CPUE data from file /users/fish/ifad/ifapwork/nwwg/cod_farp/FLEET.X09

Catch data for 35 years. 1961 to 1995. Ages 2 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT32: Single trawle,	1985,	1995,	4,	9,	.000,	1.000
FLT35: Longliners > ,	1985,	1995,	3,	9,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 3

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 3

Catchability independent of age for ages >= 6

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 15 iterations

Regression weights

.751,	.820,	.877,	.921,	.954,	.976,	.990,	.997,	1.000,	1.000

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
2,	.025,	.029,	.067,	.192,	.091,	.041,	.032,	.014,	.031,	.079
3,	.353,	.223,	.348,	.446,	.399,	.241,	.135,	.164,	.120,	.208
4,	.619,	.472,	.570,	.741,	.639,	.593,	.438,	.255,	.336,	.523
5,	.702,	.481,	.543,	.779,	.738,	.606,	.566,	.368,	.373,	.653
6,	.801,	.554,	.761,	.940,	.733,	.635,	.683,	.389,	.362,	.686
7,	.823,	.463,	.793,	1.015,	.789,	.618,	.668,	.470,	.370,	.725
8,	.569,	.597,	.775,	1.081,	.986,	.615,	.523,	.321,	.352,	.821
9,	.655,	.579,	.662,	.733,	.779,	.457,	.413,	.409,	.383,	.907

Table 2.2.16 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9
1986	9.45E+03	1.33E+04	2.03E+04	5.20E+03	1.82E+03	4.65E+02	3.74E+02	1.08E+02
1987	1.00E+04	7.54E+03	7.67E+03	8.93E+03	2.11E+03	6.68E+02	1.67E+02	1.73E+02
1988	8.64E+03	7.99E+03	4.94E+03	3.91E+03	4.52E+03	9.93E+02	3.44E+02	7.53E+01
1989	1.42E+04	6.61E+03	4.62E+03	2.29E+03	1.86E+03	1.73E+03	3.68E+02	1.30E+02
1990	3.08E+03	9.58E+03	3.47E+03	1.80E+03	8.59E+02	5.95E+02	5.13E+02	1.02E+02
1991	5.17E+03	2.30E+03	5.26E+03	1.50E+03	7.06E+02	3.38E+02	2.21E+02	1.57E+02
1992	7.27E+03	4.06E+03	1.48E+03	2.38E+03	6.70E+02	3.06E+02	1.49E+02	9.81E+01
1993	9.33E+03	5.76E+03	2.90E+03	7.83E+02	1.11E+03	2.77E+02	1.29E+02	7.24E+01
1994	2.02E+04	7.53E+03	4.00E+03	1.84E+03	4.44E+02	6.14E+02	1.42E+02	7.64E+01
1995	3.84E+04	1.61E+04	5.47E+03	2.34E+03	1.04E+03	2.53E+02	3.47E+02	8.15E+01

Estimated population abundance at 1st Jan 1996

	.00E+00	2.90E+04	1.07E+04	2.65E+03	9.98E+02	4.28E+02	1.00E+02	1.25E+02

Taper weighted geometric mean of the VPA populations:

	1.22E+04	8.72E+03	5.27E+03	2.70E+03	1.32E+03	6.06E+02	2.77E+02	1.16E+02

Standard error of the weighted Log(VPA populations) :

	.7537	.6836	.6384	.6438	.6602	.6557	.5703	.5091

Log catchability residuals.

Fleet : FLT32: Single trawle

Age	1985
3	No data for this fleet at this age
4	.22
5	.05
6	.42
7	.17
8	.18
9	-.37

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	.83	.54	.03	.37	-.37	-.26	.07	-.06	-.70	-.28
5	.58	.24	-.08	.00	-.85	.24	.13	-.07	-.19	.12
6	.27	-.30	.16	.05	-.43	.33	.26	-.49	-.19	.09
7	.20	-.47	.22	.30	-.45	.43	.34	-.37	-.29	.04
8	-.10	-.23	.03	.20	-.22	-.13	-.10	-.77	-.44	-.24
9	.08	-.27	-.20	.08	-.30	.14	.27	-.15	.20	-.36

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

Age	4	5	6	7	8	9
Mean Log q	-10.9058	-10.7995	-10.7092	-10.7092	-10.7092	-10.7092
S.E(Log q)	.4343	.3524	.3173	.3438	.3363	.2524

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	.75	1.708	10.29	.85	11	.29	-10.91
5	.83	1.203	10.28	.86	11	.28	-10.80
6	.94	.344	10.51	.83	11	.32	-10.71
7	.95	.274	10.49	.80	11	.35	-10.70
8	.74	2.398	9.51	.92	11	.17	-10.89
9	.93	.260	10.36	.64	11	.24	-10.78

Table 2.2.16 (Continued)

Fleet : FLT35: Longliners >

Age	1985
3	-.18
4	-.36
5	-.30
6	-.06
7	.42
8	.61
9	.46

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-.53	-1.51	.37	.95	.63	-.03	-.45	.20	.17	.06
4	-.43	-.50	.16	.64	.35	.37	-.05	.15	-.54	-.02
5	-.20	-.40	.01	.46	.43	.23	-.15	.12	-.54	.19
6	-.11	.03	-.12	.54	.40	.01	-.18	.02	-.65	.13
7	.05	.40	.21	.63	.66	.18	-.13	.08	-.36	.39
8	-.20	.87	.58	.95	.89	.34	-.16	.08	.12	.86
9	-.17	.67	.80	.63	.71	.05	-.26	.01	.17	.98

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

Age	3	4	5	6	7	8	9
Mean Log q	-11.7949	-11.0475	-10.7265	-10.3695	-10.3695	-10.3695	-10.3695
S.E(Log q)	.6437	.3945	.3356	.3193	.3958	.6402	.5785

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.02	-.046	11.84	.53	11	.69	-11.79
4	1.28	-1.111	11.76	.67	11	.50	-11.05
5	1.30	-1.440	11.61	.74	11	.41	-10.73
6	.86	1.035	9.90	.87	11	.27	-10.37
7	.84	1.239	9.52	.88	11	.26	-10.15
8	.68	1.931	8.51	.82	11	.26	-9.92
9	1.01	-.021	10.06	.32	11	.46	-10.01

Terminal year survivor and F summaries :

Age 2 Catchability dependent on age and year class strength

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT32: Single trawle	1.	.000	.000	.00	0	.000	.000
FLT35: Longliners >	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	8725.	.68				.349	.241
F shrinkage mean	55235.	.50				.651	.042

Weighted prediction :

Survivors, at end of year	Int s.e	Ext s.e	N	Var Ratio	F
29033.	.40	10.31	2	25.556	.079

Table 2.2.16 (Continued)

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT32: Single trawle,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT35: Longliners > ,	11303.,	.675,	.000,	.00,	1,	.308,	.197
F shrinkage mean ,	10417.,	.50,,,,				.692,	.213

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
10682.,	.40,	.07,	2,	.168,	.208

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT32: Single trawle,	1997.,	.456,	.000,	.00,	1,	.249,	.649
FLT35: Longliners > ,	2718.,	.353,	.082,	.23,	2,	.402,	.513
F shrinkage mean ,	3161.,	.50,,,,				.349,	.456

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2654.,	.25,	.12,	4,	.473,	.523

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT32: Single trawle,	864.,	.291,	.379,	1.31,	2,	.336,	.725
FLT35: Longliners > ,	962.,	.254,	.238,	.94,	3,	.424,	.671
F shrinkage mean ,	1301.,	.50,,,,				.240,	.534

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
998.,	.19,	.16,	6,	.849,	.653

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT32: Single trawle,	421.,	.224,	.090,	.40,	3,	.385,	.695
FLT35: Longliners > ,	389.,	.207,	.183,	.88,	4,	.431,	.735
F shrinkage mean ,	556.,	.50,,,,				.184,	.565

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
428.,	.15,	.10,	8,	.645,	.686

Table 2.2.16 (Continued)

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT32: Single trawle,	95.,	.199,	.060,	.30,	4,	.418,	.752
FLT35: Longliners > ,	93.,	.196,	.218,	1.12,	5,	.401,	.764
F shrinkage mean ,	133.,	.50,,,,				.182,	.588

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
100.,	.15,	.11,	10,	.733,	.725

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT32: Single trawle,	96.,	.187,	.081,	.43,	5,	.471,	.980
FLT35: Longliners > ,	132.,	.204,	.187,	.92,	6,	.316,	.793
F shrinkage mean ,	210.,	.50,,,,				.212,	.564

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
125.,	.15,	.13,	12,	.837,	.821

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT32: Single trawle,	20.,	.178,	.094,	.53,	6,	.537,	1.100
FLT35: Longliners > ,	37.,	.231,	.177,	.77,	7,	.235,	.736
F shrinkage mean ,	40.,	.50,,,,				.229,	.688

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
27.,	.16,	.12,	14,	.764,	.907

Table 2.2.17

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

At 6-May-96 22:22:31

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	.3346,	.2701,	.2534,	.1086,	.1209,
3,	.5141,	.4982,	.4138,	.2997,	.2518,
4,	.4986,	.4838,	.5172,	.4523,	.4498,
5,	.5737,	.7076,	.5124,	.5229,	.5622,
6,	.4863,	.5569,	.5405,	.5659,	.6604,
7,	.9566,	.3662,	.4879,	.6677,	.5305,
8,	.8116,	.6826,	.3269,	.3531,	.4345,
9,	.6715,	.5641,	.4806,	.5164,	.5318,
+gp,	.6715,	.5641,	.4806,	.5164,	.5318,
FBAR 3- 7,	.6059,	.5226,	.4944,	.5017,	.4909,

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	.0829,	.0789,	.1010,	.1099,	.0530,	.0309,	.0464,	.0657,	.0816,	.0775,
3,	.1969,	.2389,	.2318,	.3063,	.2081,	.1337,	.1476,	.2322,	.1568,	.3194,
4,	.2552,	.2687,	.3949,	.3806,	.3654,	.2225,	.2070,	.3048,	.2046,	.4360,
5,	.4499,	.3442,	.5339,	.4180,	.3409,	.3845,	.2497,	.2813,	.2953,	.4134,
6,	.5016,	.5779,	.4472,	.5709,	.3709,	.5572,	.6058,	.2526,	.3797,	.4544,
7,	.9680,	.5203,	.7132,	.5118,	.6559,	.4651,	.4686,	.3722,	.5330,	.3504,
8,	.8520,	1.0438,	.3331,	.8457,	.4208,	.7528,	.2464,	.3259,	.3052,	.4485,
9,	.6106,	.5556,	.4882,	.5499,	.4339,	.4801,	.3578,	.3092,	.3457,	.4235,
+gp,	.6106,	.5556,	.4882,	.5499,	.4339,	.4801,	.3578,	.3092,	.3457,	.4235,
FBAR 3- 7,	.4743,	.3900,	.4642,	.4375,	.3882,	.3526,	.3358,	.2886,	.3139,	.3947,

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

At 6-May-96 22:22:31

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	.0933,	.0481,	.0589,	.0432,	.0545,	.0523,	.0584,	.0991,	.1070,	.0656,
3,	.1723,	.3037,	.1897,	.2631,	.2387,	.2885,	.2224,	.4651,	.3709,	.3533,
4,	.3665,	.4750,	.4292,	.4310,	.3713,	.3400,	.3615,	.5573,	.5744,	.5070,
5,	.5569,	.7534,	.4291,	.5052,	.4339,	.4399,	.3872,	.6449,	.6584,	.6046,
6,	.5167,	.7335,	.4852,	.4909,	.5186,	.5647,	.4090,	.7780,	.4579,	.9157,
7,	.7620,	1.1140,	.5971,	.4483,	.4124,	.6952,	.6935,	1.1035,	.4700,	1.1340,
8,	.6430,	.7778,	.5676,	.6908,	.6444,	.5023,	.5544,	.9444,	.5036,	1.2769,
9,	.5739,	.7784,	.5056,	.5173,	.4797,	.5125,	.4848,	.8139,	.5372,	1.0048,
+gp,	.5739,	.7784,	.5056,	.5173,	.4797,	.5125,	.4848,	.8139,	.5372,	1.0048,
FBAR 3- 7,	.4749,	.6759,	.4261,	.4277,	.3950,	.4657,	.4147,	.7098,	.5063,	.7029,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	.0249,	.0287,	.0673,	.1917,	.0912,	.0415,	.0323,	.0141,	.0310,	.0786,
3,	.3530,	.2225,	.3476,	.4455,	.3986,	.2408,	.1353,	.1637,	.1196,	.2078,
4,	.6194,	.4723,	.5704,	.7406,	.6388,	.5928,	.4383,	.2548,	.3365,	.5232,
5,	.7018,	.4808,	.5432,	.7794,	.7383,	.6056,	.5662,	.3678,	.3728,	.6531,
6,	.8014,	.5538,	.7608,	.9397,	.7330,	.6345,	.6834,	.3892,	.3622,	.6863,
7,	.8232,	.4631,	.7930,	1.0145,	.7890,	.6179,	.6676,	.4705,	.3703,	.7249,
8,	.5693,	.5973,	.7754,	1.0814,	.9855,	.6146,	.5232,	.3214,	.3519,	.8211,
9,	.6545,	.5793,	.6625,	.7331,	.7786,	.4565,	.4126,	.4093,	.3832,	.9075,
+gp,	.6545,	.5793,	.6625,	.7331,	.7786,	.4565,	.4126,	.4093,	.3832,	.9075,
FBAR 3- 7,	.6598,	.4385,	.6030,	.7840,	.6595,	.5383,	.4982,	.3292,	.3123,	.5591,

Table 2.2.18

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

At 6-May-96 22:22:31

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	12019,	20654,	20290,	21834,	8269,
3,	7385,	7042,	12907,	12893,	16037,
4,	3747,	3616,	3503,	6986,	7823,
5,	2699,	1863,	1825,	1710,	3639,
6,	666,	1245,	752,	895,	830,
7,	668,	335,	584,	358,	416,
8,	155,	210,	190,	294,	151,
9,	66,	56,	87,	112,	169,
+gp,	0,	0,	0,	0,	0,
TOTAL,	27403,	35021,	40138,	45083,	37332,

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	18566,	23451,	17582,	9325,	8608,	11928,	21320,	12572,	30478,	38313,
3,	5999,	13990,	17744,	13012,	6840,	6684,	9469,	16663,	9639,	22998,
4,	10207,	4034,	9020,	11522,	7843,	4548,	4788,	6688,	10816,	6746,
5,	4085,	6475,	2525,	4976,	6447,	4456,	2981,	3187,	4037,	7217,
6,	1698,	2133,	3757,	1212,	2682,	3754,	2483,	1901,	1969,	2460,
7,	351,	842,	980,	1967,	561,	1515,	1760,	1109,	1209,	1103,
8,	200,	109,	410,	393,	965,	238,	779,	902,	626,	581,
9,	80,	70,	31,	240,	138,	519,	92,	499,	533,	378,
+gp,	0,	0,	0,	0,	0,	0,	0,	400,	342,	476,
TOTAL,	41186,	51104,	52049,	42646,	34085,	33642,	43672,	43923,	59650,	80272,

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

At 6-May-96 22:22:31

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	18571,	9993,	10718,	15023,	23534,	14017,	22205,	25172,	47876,	17379,
3,	29030,	13850,	7797,	8273,	11780,	18246,	10891,	17150,	18665,	35220,
4,	13682,	20005,	8370,	5281,	5206,	7597,	11195,	7139,	8819,	10546,
5,	3572,	7764,	10186,	4461,	2810,	2941,	4427,	6386,	3348,	4065,
6,	3908,	1676,	2993,	5430,	2204,	1491,	1551,	2461,	2743,	1419,
7,	1279,	1908,	659,	1508,	2721,	1074,	694,	843,	925,	1421,
8,	636,	489,	513,	297,	789,	1475,	439,	284,	229,	474,
9,	304,	274,	184,	238,	122,	339,	731,	206,	90,	113,
+gp,	466,	18,	154,	103,	52,	150,	348,	199,	174,	137,
TOTAL,	71447,	55978,	41574,	40614,	49217,	47329,	52481,	59841,	82870,	70773,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE											
2,	9447,	10040,	8639,	14171,	3082,	5170,	7266,	9326,	20235,	38362,	0,
3,	13326,	7545,	7988,	6612,	9578,	2303,	4061,	5760,	7529,	16061,	29033,
4,	20254,	7665,	4945,	4620,	3467,	5264,	1482,	2904,	4003,	5469,	10682,
5,	5200,	8926,	3913,	2289,	1804,	1499,	2382,	783,	1843,	2341,	2654,
6,	1818,	2110,	4518,	1861,	859,	706,	670,	1107,	444,	1039,	998,
7,	465,	668,	993,	1729,	595,	338,	306,	277,	614,	253,	428,
8,	374,	167,	344,	368,	513,	221,	149,	129,	142,	347,	100,
9,	108,	173,	75,	130,	102,	157,	98,	72,	76,	82,	125,
+gp,	86,	65,	56,	19,	52,	72,	113,	82,	55,	89,	56,
TOTAL,	51079,	37360,	31472,	31798,	20053,	15730,	16528,	20440,	34941,	64043,	44076,

Table 2.2.19

Run title : Cod FaroePlateau Vb1 (run: XSAAK09/X09)

At 6-May-96 22:22:31

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1961,	12019,	58355,	40784,	25500,	.6252,	.6059,
1962,	20654,	64307,	39592,	23200,	.5860,	.5226,
1963,	20290,	73668,	45333,	23100,	.5096,	.4944,
1964,	21834,	85299,	54316,	24000,	.4419,	.5017,
1965,	8269,	86578,	64681,	24856,	.3843,	.4909,
1966,	18566,	91054,	65933,	21027,	.3189,	.4743,
1967,	23451,	107766,	74766,	25174,	.3367,	.3900,
1968,	17582,	118650,	87170,	30279,	.3474,	.4642,
1969,	9325,	113005,	90562,	35670,	.3939,	.4375,
1970,	8608,	97929,	81413,	29037,	.3567,	.3882,
1971,	11928,	93140,	75465,	26151,	.3465,	.3526,
1972,	21320,	98305,	70681,	20437,	.2891,	.3358,
1973,	12572,	110419,	84832,	22381,	.2638,	.2886,
1974,	30478,	130197,	91896,	24581,	.2675,	.3139,
1975,	38313,	166326,	112941,	36775,	.3256,	.3947,
1976,	18571,	170699,	128687,	39799,	.3093,	.4749,
1977,	9993,	100741,	83366,	34927,	.4190,	.6759,
1978,	10718,	96180,	78479,	26585,	.3388,	.4261,
1979,	15023,	85069,	66676,	23112,	.3466,	.4277,
1980,	23534,	84954,	58836,	20513,	.3486,	.3950,
1981,	14017,	88333,	63487,	22963,	.3617,	.4657,
1982,	22205,	100084,	67154,	21489,	.3200,	.4147,
1983,	25172,	123312,	98760,	38133,	.3861,	.7098,
1984,	47876,	152377,	115745,	36979,	.3195,	.5063,
1985,	17379,	131443,	84857,	39484,	.4653,	.7029,
1986,	9447,	99709,	74372,	34595,	.4652,	.6598,
1987,	10040,	78730,	62489,	21391,	.3423,	.4385,
1988,	8639,	66594,	52587,	23182,	.4408,	.6030,
1989,	14171,	57384,	38726,	22068,	.5698,	.7840,
1990,	3082,	35885,	28095,	13487,	.4800,	.6595,
1991,	5170,	25405,	19400,	8660,	.4464,	.5383,
1992,	7266,	27378,	17268,	6540,	.3787,	.4982,
1993,	9326,	37693,	25156,	5992,	.2382,	.3292,
1994,	20235,	62473,	53844,	8818,	.1638,	.3123,
1995,	38362,	112645,	51737,	23137,	.4472,	.5591,
Arith. Mean ,	17298,	92345,	67145,	24686,	.3823,	.4867,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.2.20

Faroe Plateau cod; Groundfish surveys and 0-group survey data.

4 15 2

'yclass'	'vpa'	'gfage2'	'gfage3'	'gfage4'	'0-group'
1981	25172	476	21847	1546	-11
1982	47876	1085	4296	9423	6842
1983	17377	416	2669	3448	3389
1984	9447	91	1539	1662	775
1985	10037	127	1265	1006	851
1986	8639	197	602	1522	432
1987	14171	445	638	1222	5718
1988	3082	262	352	472	3800
1989	5170	254	210	232	78
1990	7266	148	448	1374	523
1991	9629	41	374	2089	17
1992	20235	472	977	6885	120
1993	-11	767	5293	-11	1193
1994	-11	2917	-11	-11	664
1995	-11	-11	-11	-11	59

Table 2.2.21

Analysis by RCT3 ver3.1 of data from file :

Faroe Plateau cod; Groundfish surveys and 0-group survey data.

Data for 4 surveys over 14 years : 1982 - 1995

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1989

	I-----------Regression----------				I-----------Prediction---------					
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
gfage2	1.55	.66	1.08	.409	7	5.54	9.24	1.378	.079
gfage3	1.09	1.66	.55	.729	7	5.35	7.50	.872	.197
gfage4	.93	2.46	.34	.878	7	5.45	7.51	.551	.494
0-grou	2.03	-6.07	2.29	.134	7	4.37	2.79	4.400	.008
						VPA Mean =	9.35	.820	.223

Yearclass = 1990

	I-----------Regression----------				I-----------Prediction---------					
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
gfage2	1.76	-.63	1.16	.363	8	5.00	8.19	1.488	.056
gfage3	.94	2.84	.54	.722	8	6.11	8.57	.692	.261
gfage4	.80	3.51	.42	.811	8	7.23	9.28	.521	.460
0-grou	1.08	1.51	1.58	.235	8	6.26	8.25	1.995	.031
						VPA Mean =	9.24	.807	.192

Table 2.2.21 (Continued)

Yearclass = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I				I-----------Prediction---------I				
gfage2	1.72	-.33	1.08	.361	9	3.74	6.12	1.705	.041
gfage3	.92	3.02	.51	.717	9	5.93	8.47	.639	.289
gfage4	.82	3.34	.42	.786	9	7.64	9.59	.517	.442
0-grou	1.04	1.83	1.45	.239	9	2.89	4.84	2.434	.020
						VPA Mean =	9.19	.755	.208

Yearclass = 1992

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I				I-----------Prediction---------I				
gfage2	1.77	-.24	1.51	.198	10	6.16	10.66	1.874	.036
gfage3	.92	3.09	.54	.661	10	6.89	9.43	.640	.308
gfage4	.82	3.29	.42	.757	10	8.84	10.52	.576	.380
0-grou	1.05	2.25	2.05	.117	10	4.80	7.28	2.551	.019
						VPA Mean =	9.17	.702	.256

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression----------I				I-----------Prediction---------I				
gfage2	1.86	-.71	1.60	.177	10	6.64	11.64	2.146	.054
gfage3	.92	3.07	.54	.652	10	8.57	11.00	.799	.390
gfage4									
0-grou	1.08	2.04	2.16	.106	10	7.09	9.73	2.593	.037
						VPA Mean =	9.16	.693	.519

Table 2.2.21 (Continued)

Yearclass = 1994

I-----------Regression----------I						I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
gfage2	1.99	-1.36	1.73	.152	10	7.98	14.48	3.037	.046
gfage3									
gfage4									
0-grou	1.13	1.75	2.31	.092	10	6.50	9.12	2.786	.054
					VPA Mean =		9.14	.683	.900

Yearclass = 1995

I-----------Regression----------I						I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
gfage2									
gfage3									
gfage4									
0-grou	1.21	1.33	2.52	.076	10	4.09	6.26	3.343	.039
					VPA Mean =		9.11	.670	.961

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	3034	8.02	.39	.48	1.51	5173	8.55
1990	8069	9.00	.35	.19	.30	7594	8.94
1991	7671	8.95	.34	.48	1.95	9626	9.17
1992	17710	9.78	.36	.35	.97		
1993	22744	10.03	.50	.55	1.22		
1994	11829	9.38	.65	.79	1.48		
1995	8123	9.00	.66	.55	.70		

Table 2.2.22

Cod in the Faroe Plateau (Fishing Area Vb1)

Prediction with management option table: Input data

Year: 1996								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	15893.000	0.2000	0.0400	0.0000	0.0000	1.218	0.0580	1.218
3	17025.000	0.2000	0.4400	0.0000	0.0000	1.986	0.2290	1.986
4	10682.000	0.2000	0.7500	0.0000	0.0000	2.622	0.5190	2.622
5	2654.000	0.2000	0.8700	0.0000	0.0000	3.925	0.6490	3.925
6	998.000	0.2000	0.9400	0.0000	0.0000	5.180	0.6700	5.180
7	428.000	0.2000	1.0000	0.0000	0.0000	6.079	0.7290	6.079
8	100.000	0.2000	1.0000	0.0000	0.0000	6.241	0.6960	6.241
9	125.000	0.2000	1.0000	0.0000	0.0000	7.782	0.7920	7.782
10+	56.000	0.2000	1.0000	0.0000	0.0000	8.627	0.7920	8.627
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	9673.000	0.2000	0.3233	0.0000	0.0000	1.206	0.0580	1.206
3	.	0.2000	0.6200	0.0000	0.0000	1.915	0.2290	1.915
4	.	0.2000	0.7600	0.0000	0.0000	2.618	0.5190	2.618
5	.	0.2000	0.8667	0.0000	0.0000	3.790	0.6490	3.790
6	.	0.2000	0.9700	0.0000	0.0000	4.882	0.6700	4.882
7	.	0.2000	0.9933	0.0000	0.0000	5.528	0.7290	5.528
8	.	0.2000	1.0000	0.0000	0.0000	6.694	0.6960	6.694
9	.	0.2000	1.0000	0.0000	0.0000	8.173	0.7920	8.173
10+	.	0.2000	1.0000	0.0000	0.0000	8.712	0.7920	8.712
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	9708.000	0.2000	0.3233	0.0000	0.0000	1.206	0.0580	1.206
3	.	0.2000	0.6200	0.0000	0.0000	1.915	0.2290	1.915
4	.	0.2000	0.7600	0.0000	0.0000	2.618	0.5190	2.618
5	.	0.2000	0.8667	0.0000	0.0000	3.790	0.6490	3.790
6	.	0.2000	0.9700	0.0000	0.0000	4.882	0.6700	4.882
7	.	0.2000	0.9933	0.0000	0.0000	5.528	0.7290	5.528
8	.	0.2000	1.0000	0.0000	0.0000	6.694	0.6960	6.694
9	.	0.2000	1.0000	0.0000	0.0000	8.173	0.7920	8.173
10+	.	0.2000	1.0000	0.0000	0.0000	8.712	0.7920	8.712
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANAK02
Date and time: 20MAY96:14:57

Table 2.2.23

Cod in the Faroe Plateau (Fishing Area Vb1)

14:38 Monday, May 20, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.5592	101446	55262	26775	0.0000	0.0000	93833	67227	0	117728	92481
.	.	.	.	.	0.1000	0.0559	.	67227	3606	113368	88571
.	.	.	.	.	0.2000	0.1118	.	67227	7028	109235	84870
.	.	.	.	.	0.3000	0.1678	.	67227	10276	105316	81366
.	.	.	.	.	0.4000	0.2237	.	67227	13361	101599	78048
.	.	.	.	.	0.5000	0.2796	.	67227	16291	98072	74905
.	.	.	.	.	0.6000	0.3355	.	67227	19075	94725	71926
.	.	.	.	.	0.7000	0.3914	.	67227	21721	91548	69104
.	.	.	.	.	0.8000	0.4474	.	67227	24236	88531	66428
.	.	.	.	.	0.9000	0.5033	.	67227	26628	85665	63891
.	.	.	.	.	1.0000	0.5592	.	67227	28904	82942	61485
.	.	.	.	.	1.1000	0.6151	.	67227	31070	80354	59202
.	.	.	.	.	1.2000	0.6710	.	67227	33132	77894	57035
.	.	.	.	.	1.3000	0.7270	.	67227	35096	75555	54979
.	.	.	.	.	1.4000	0.7829	.	67227	36967	73329	53026
.	.	.	.	.	1.5000	0.8388	.	67227	38749	71211	51172
.	.	.	.	.	1.6000	0.8947	.	67227	40449	69195	49410
.	.	.	.	.	1.7000	0.9506	.	67227	42070	67275	47735
.	.	.	.	.	1.8000	1.0066	.	67227	43616	65446	46143
.	.	.	.	.	1.9000	1.0625	.	67227	45092	63704	44629
.	.	.	.	.	2.0000	1.1184	.	67227	46501	62043	43189
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANAK02
Date and time : 20MAY96:14:57
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1996 : F factors

Table 2.2.24

Cod in the Faroe Plateau (Fishing Area Vb1)

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.8950	0.5005	101446	55262	24511	0.0000	0.0000	96513	69523	0	120574	95139
.	.	.	.	.	0.1000	0.0559	.	69523	3749	116049	91073
.	.	.	.	.	0.2000	0.1118	.	69523	7305	111761	87225
.	.	.	.	.	0.3000	0.1678	.	69523	10680	107696	83583
.	.	.	.	.	0.4000	0.2237	.	69523	13884	103841	80135
.	.	.	.	.	0.5000	0.2796	.	69523	16926	100185	76870
.	.	.	.	.	0.6000	0.3355	.	69523	19816	96717	73777
.	.	.	.	.	0.7000	0.3914	.	69523	22561	93426	70847
.	.	.	.	.	0.8000	0.4474	.	69523	25170	90301	68070
.	.	.	.	.	0.9000	0.5033	.	69523	27651	87335	65438
.	.	.	.	.	1.0000	0.5592	.	69523	30010	84517	62943
.	.	.	.	.	1.1000	0.6151	.	69523	32255	81840	60576
.	.	.	.	.	1.2000	0.6710	.	69523	34391	79296	58330
.	.	.	.	.	1.3000	0.7270	.	69523	36424	76877	56200
.	.	.	.	.	1.4000	0.7829	.	69523	38361	74577	54177
.	.	.	.	.	1.5000	0.8388	.	69523	40206	72389	52257
.	.	.	.	.	1.6000	0.8947	.	69523	41964	70307	50433
.	.	.	.	.	1.7000	0.9506	.	69523	43640	68325	48701
.	.	.	.	.	1.8000	1.0066	.	69523	45238	66438	47054
.	.	.	.	.	1.9000	1.0625	.	69523	46764	64641	45489
.	.	.	.	.	2.0000	1.1184	.	69523	48219	62928	44001
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANAK04
Date and time : 20MAY96:15:15
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1996 : F factors

Table 2.2.25

Cod in the Faroe Plateau (Fishing Area Vb1)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	1.000	0.2000	0.1729	0.0000	0.0000	1.071	0.1010	1.071
3	.	0.2000	0.6407	0.0000	0.0000	1.593	0.3150	1.593
4	.	0.2000	0.8736	0.0000	0.0000	2.254	0.4930	2.254
5	.	0.2000	0.9514	0.0000	0.0000	3.079	0.5840	3.079
6	.	0.2000	0.9900	0.0000	0.0000	3.849	0.6590	3.849
7	.	0.2000	0.9971	0.0000	0.0000	4.825	0.7440	4.825
8	.	0.2000	1.0000	0.0000	0.0000	5.809	0.7190	5.809
9	.	0.2000	1.0000	0.0000	0.0000	7.413	0.6430	7.413
10+	.	0.2000	1.0000	0.0000	0.0000	9.519	0.6430	9.519
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDAK02
Date and time: 20MAY96:15:18

Table 2.2.26

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Cod in the Faroe Plateau (Fishing Area Vb1)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	23260.277	4.278	21610.350	4.278	21610.350
0.0500	0.0280	0.104	505.413	4.997	19199.376	3.764	17561.150	3.764	17561.150
0.1000	0.0559	0.183	827.879	4.603	16263.967	3.375	14637.044	3.375	14637.044
0.1500	0.0839	0.246	1037.852	4.295	14068.564	3.070	12452.569	3.070	12452.569
0.2000	0.1118	0.296	1176.169	4.045	12381.345	2.826	10775.921	2.826	10775.921
0.2500	0.1398	0.337	1267.631	3.840	11055.260	2.624	9460.066	2.624	9460.066
0.3000	0.1677	0.372	1327.849	3.667	9993.028	2.456	8407.744	2.456	8407.744
0.3500	0.1957	0.402	1366.921	3.519	9128.072	2.312	7552.392	2.312	7552.392
0.4000	0.2236	0.428	1391.526	3.391	8413.530	2.188	6847.162	2.188	6847.162
0.4500	0.2515	0.451	1406.160	3.279	7815.629	2.080	6258.296	2.080	6258.296
0.5000	0.2795	0.471	1413.890	3.180	7309.534	1.985	5760.971	1.985	5760.971
0.5500	0.3074	0.489	1416.834	3.092	6876.660	1.900	5336.617	1.900	5336.617
0.6000	0.3354	0.505	1416.467	3.012	6502.885	1.824	4971.120	1.824	4971.120
0.6500	0.3634	0.520	1413.823	2.940	6177.330	1.756	4653.614	1.756	4653.614
0.7000	0.3913	0.533	1409.632	2.875	5891.511	1.694	4375.625	1.694	4375.625
0.7500	0.4193	0.545	1404.410	2.815	5638.738	1.638	4130.473	1.638	4130.473
0.8000	0.4472	0.557	1398.524	2.759	5413.683	1.586	3912.838	1.586	3912.838
0.8500	0.4752	0.567	1392.233	2.708	5212.061	1.538	3718.443	1.538	3718.443
0.9000	0.5031	0.577	1385.721	2.661	5030.397	1.494	3543.824	1.494	3543.824
0.9500	0.5311	0.586	1379.119	2.617	4865.851	1.453	3386.145	1.453	3386.145
1.0000	0.5590	0.594	1372.516	2.575	4716.081	1.415	3243.074	1.415	3243.074
1.0500	0.5870	0.602	1365.977	2.537	4579.146	1.379	3112.676	1.379	3112.676
1.1000	0.6149	0.610	1359.543	2.500	4453.423	1.346	2993.334	1.346	2993.334
1.1500	0.6429	0.617	1353.244	2.466	4337.549	1.314	2883.692	1.314	2883.692
1.2000	0.6708	0.624	1347.097	2.434	4230.371	1.285	2782.602	1.285	2782.602
1.2500	0.6988	0.630	1341.113	2.403	4130.907	1.257	2689.088	1.257	2689.088
1.3000	0.7267	0.636	1335.298	2.374	4038.319	1.231	2602.316	1.231	2602.316
1.3500	0.7547	0.642	1329.652	2.346	3951.885	1.206	2521.570	1.206	2521.570
1.4000	0.7826	0.647	1324.175	2.320	3870.981	1.182	2446.231	1.182	2446.231
1.4500	0.8106	0.652	1318.865	2.295	3795.066	1.160	2375.762	1.160	2375.762
1.5000	0.8385	0.657	1313.717	2.271	3723.668	1.138	2309.696	1.138	2309.696
1.5500	0.8665	0.662	1308.726	2.248	3656.373	1.118	2247.623	1.118	2247.623
1.6000	0.8944	0.667	1303.887	2.226	3592.818	1.099	2189.182	1.099	2189.182
1.6500	0.9224	0.671	1299.195	2.205	3532.682	1.080	2134.057	1.080	2134.057
1.7000	0.9503	0.675	1294.645	2.185	3475.679	1.062	2081.967	1.062	2081.967
1.7500	0.9783	0.679	1290.230	2.166	3421.557	1.045	2032.661	1.045	2032.661
1.8000	1.0062	0.683	1285.946	2.147	3370.089	1.029	1985.916	1.029	1985.916
1.8500	1.0342	0.687	1281.787	2.129	3321.073	1.013	1941.533	1.013	1941.533
1.9000	1.0621	0.691	1277.748	2.112	3274.327	0.998	1899.333	0.998	1899.333
1.9500	1.0901	0.694	1273.825	2.095	3229.686	0.984	1859.155	0.984	1859.155
2.0000	1.1180	0.698	1270.012	2.079	3187.004	0.970	1820.853	0.970	1820.853
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDAK02
Date and time : 20MAY96:15:18
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.2683
F-max factor : 0.5677
F-0.1 reference F : 0.1500
F-max reference F : 0.3173
Recruitment : Single recruit

Table 2.3.1. Faroe Bank (Sub-division Vb2) COD. Nominal catches (tonnes) by countries, 1986-1995, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 *)
Faroe Islands	1,836	3,409	2,960	1,270	289	297	122	264	717 *)	569
Norway	6	23	94	128	72	38	32	2 *)	8 *)	105
UK (Engl. and Wales)	-	-	-	-	-	-	+	1	1	2)
UK (Scotland) 1)	63	47	37	14	207	90	172	118	227	2)
Total	1,905	3,479	3,091	1,412	568	425	326	385	953	674

*) Provisional data

1) Includes Vb1

2) Included in Vb1 /UK

Table 2.3.2: Faroe Bank Cod: results of the fitting of Schaefer general production model.

Year	Landings	Obs. CPUE	Pred. CPUE	Biomass
1983	2 367	45	246.6	9294
1984	2 216	218	211.7	7977
1985	2 961	173	190.1	7164
1986	1 905	159	152.4	5743
1987	3479	151	144.9	5462
1988	3091	103	95.6	3602
1989	1 412	37	50.4	1899
1990	568	24	36.4	1373
1991	425	47	39.3	1481
1992	326	61	47.1	1776
1993	385	62	60.8	2290
1994	953	67	77.8	2932
1995	674	88	85.0	3202
1996				3823

Table 2.4.1 Faroe Plateau (Sub-division Vb1) HADDOCK. Nominal catches (tonnes) by countries 1981-1994, as officially reported to ICES, and the total Working Group estimate.

Country	1982	1983	1984	1985	1986	1987	1988
Denmark	-	-	-	-	1	8	4
Faroe Islands	10,319	11,898	11,418	13,597	13,359	13,954	10,867
France[1]	2	2	20	23	8	22	14
Germany	1	+	+	+	1	1	-
Norway	12	12	10	21	22	13	54
UK (Engl. and Wales)	-	-	-	-	-	2	-
UK (Scotland)[3]	1	-	-	-	-	-	-
United Kingdom							
Total	10,335	11,912	11,448	13,641	13,391	14,000	10,939
Working Group estimate[4,5]	11,937	12,894	12,378	15,143	14,477	14,882	12,178

Country	1989	1990	1991	1992	1993	1994	1995
Denmark	-	-	-	-	-	-	-
Faroe Islands	13,506	11,106	8,074	4,629	3,622	3,675	4,566
France[1]	-	-	-	164	-	-	-
Germany	+	+	+	-	-	-	5
Norway	111	94	125	71 [2]	29 [2]	22	28
UK (Engl. and Wales)	-	7	-	71	80	-	-
UK (Scotland)[3]	-	-	-	-	-	-	-
United Kingdom						200 [6]	55
Total	13,617	11,207	8,199	4,935	3,731	3,897	
Working Group estimate[4,5]	14,325	11,726	8,429	5,476	3,814	4,251	4,987

1) Including catches from Sub-division Vb2. Quantity unknown 1989-1991, 1993 and1995.

2) Provisional data

3)From 1983 catches included in Sub-division Vb2.

4) Includes catches from Sub-division Vb2 and Division IIa in Faroese waters.

5)Includes French catches from Division Vb, as reported to the Faroese coastal guard service

6) Reported as Division Vb.

Table 2.4.2 Faroe Bank (Sub-division Vb2) HADDOCK. Nominal catches (tonnes) by countries, 1981-1995, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988
Faroe Islands	1,533	967	925	1,474	1,050	832	1,160
France[1]	-	-	-	-	-	-	-
Norway	1	2	5	3	10	5	43
UK (Engl. and Wales)	-	-	-	-	-	-	-
UK (Scotland)[3]	48	13	+	25	26	45	15
Total	1,582	982	930	3,462	1,086	882	1,218

Country	1989	1990	1991	1992	1993	1994	1995
Faroe Islands	659	325	217	338	185	353	313
France[1]	-	-	-	-	-		
Norway	16	97	4	23	8	1	20
UK (Engl. and Wales)	-	-	-	+	+	... [1]	...
UK (Scotland)[3]	30	725	287	852	102	... [1]	...
Total	705	1,147	508	1,213	295		

1) Catches included in Sub-division Vb1.

2) Provisional data

3)Since 1983 includes also catches taken in Sub-division Vb1 (see Table 2.4.1)

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Table 2.4.3 Total Faroese landings of haddock from Division Vb and the contribution (%) by each fleet category (metier).
In the column to the right are the average haddock percentages of the total landings of all species by each fleet categ

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Haddock %
Open boats	7	7	11	2	3	2	3	2	1	1	1	22
Longliners < 100GRT	39	39	39	49	58	60	56	46	24	18	23	46
Longliners > 100GRT	13	12	13	19	18	18	18	22	25	25	38	23
Otterboard trawlers < 400HP	1	2	2	2	1	1	2	2	8	8	7	11
Otter board trawlers 400-999HP	6	3	5	4	3	3	1	1	3	2	5	11
Otterboard trawlers > 1000HP	8	5	2	2	2	2	2	1	1	3	2	1
Pairtrawlers < 1000HP	19	20	17	11	7	5	7	11	13	10	8	8
Pairtrawlers > 1000HP	6	10	9	9	6	8	11	14	22	29	16	4
Nets	0	0	0	0	0	0	0	0	0	0	0	0
Jigging	1	0	0	0	1	1	1	0	0	0	0	2
Industry trawlers	0	1	1	2	1	1	1	1	3	3	0	12
Other gears	0	0	0	0	0	0	0	0	0	0	0	9
Total catch, tonnes ungutted	13575	12967	13834	10700	12876	10319	7473	4104	3275	3582	4395	

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Table 2.4.4

Haddock in ICES Division Vb 1995
Catch at age in numbers by fleet category

Age	Vb1 Open Boats	Vb1 LLiners < 100GRT	Vb1 LLiners > 100GRT	Vb1 OB. trawl. < 400HP	Vb1 OB. trawl. 400-999H	Vb1 OB. trawl. > 1000HP	Vb1 Pair trawl < 1000HP	Vb1 Pair trawl > 1000HP	Vb1 Others	Vb2 All Fleets	Vb Foreign Trawlers	Vb Foreign LLiners	Vb Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	21	470	274	1	1	0	2	3	6	24	0	8	810
3	6	133	156	11	29	4	24	46	5	35	2	5	456
4	2	45	66	9	16	5	20	43	3	23	3	2	237
5	1	40	82	9	10	4	16	33	2	26	2	2	227
6	1	26	55	6	4	2	8	18	2	9	1	2	133
7	2	53	103	19	17	7	25	50	3	11	4	3	298
8	2	51	108	19	12	6	23	46	2	17	4	3	293
9	2	41	79	24	13	7	25	51	2	14	4	2	264
10	1	13	10	11	7	3	9	17	2	3	2	0	78
11	1	16	20	9	6	5	15	32	2	6	3	1	115
12	0	8	14	6	3	2	8	16	0	6	1	0	65
13	0	5	2	5	2	2	5	10	0	2	1	0	34
14	0	1	0	1	0	0	0	0	0	0	0	0	2
15	0	0	1	0	0	0	0	1	0	2	0	0	4
Total no.	39	902	970	130	120	47	180	366	26	178	29	29	3016
Catch, t.	42	1007	1418	290	206	87	347	681	38	280	54	43	4493

Notes: Numbers in 1000'
Catch, gutted weight in tonnes
Others includes netters, jiggers, other small categories and catches not otherwise accounted for
LLiners = Longliners OB.trawl. = Otterboard trawlers Pair Trawl. = Pair trawlers

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Table 2.4.5

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

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

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	7932,	9631,	13552,	2284,	1368,
3,	7330,	13977,	8907,	7457,	4286,
4,	5134,	5233,	7403,	3899,	5133,
5,	1937,	2361,	2242,	2360,	1443,
6,	1305,	1407,	1539,	1120,	1209,
7,	838,	868,	860,	728,	673,
8,	236,	270,	257,	198,	1345,
9,	59,	72,	75,	49,	43,
+gp,	0,	0,	0,	0,	0,
TOTALNUM,	24771,	33819,	34835,	18095,	15500,
TONSLAND,	20831,	27151,	27571,	19490,	18479,
SOPCOF %,	89,	90,	90,	101,	94,

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	1081,	1425,	5881,	2384,	1728,	717,	750,	3300,	5633,	7337,
3,	3304,	2405,	4097,	7539,	4855,	4393,	3744,	8388,	2899,	7952,
4,	4804,	2599,	2812,	4567,	6581,	4727,	4179,	1236,	3970,	2097,
5,	2710,	1785,	1524,	1565,	1624,	3267,	2706,	2786,	451,	1371,
6,	1112,	1426,	1526,	1485,	1383,	1292,	1171,	916,	976,	247,
7,	740,	631,	923,	1224,	1099,	864,	696,	1051,	466,	352,
8,	180,	197,	230,	378,	326,	222,	180,	150,	535,	237,
9,	54,	52,	68,	114,	68,	147,	113,	68,	68,	419,
+gp,	0,	0,	0,	0,	0,	0,	0,	11,	147,	187,
TOTALNUM,	13985,	10520,	17061,	19256,	17664,	15629,	13539,	17906,	15145,	20199,
TONSLAND,	18766,	13381,	17852,	23272,	21361,	19393,	16485,	17969,	14763,	20715,
SOPCOF %,	109,	102,	103,	108,	103,	99,	98,	98,	97,	117,

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	4396,	255,	32,	1,	143,	74,	539,	441,	1195,	985,
3,	7858,	4039,	1022,	1161,	58,	455,	934,	1969,	1561,	4553,
4,	6798,	5168,	4248,	1754,	3724,	202,	784,	383,	2462,	2196,
5,	1251,	4918,	4054,	3341,	2583,	2586,	298,	422,	147,	1242,
6,	1189,	2128,	1841,	1850,	2496,	1354,	2182,	93,	234,	169,
7,	298,	946,	717,	772,	1568,	1559,	973,	1444,	42,	91,
8,	720,	443,	635,	212,	660,	608,	1166,	740,	861,	61,
9,	258,	731,	243,	155,	99,	177,	1283,	947,	388,	503,
+gp,	318,	855,	312,	74,	86,	36,	214,	795,	968,	973,
TOTALNUM,	23086,	19483,	13104,	9320,	11417,	7051,	8373,	7234,	7858,	10773,
TONSLAND,	26211,	25553,	19200,	12424,	15016,	12233,	11937,	12894,	12378,	15143,
SOPCOF %,	107,	98,	99,	104,	100,	109,	92,	106,	106,	106,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	230,	283,	655,	63,	105,	77,	40,	113,	277,	810,
3,	2549,	1718,	444,	1518,	1275,	1044,	154,	298,	191,	456,
4,	4452,	3565,	2463,	658,	1921,	1774,	776,	274,	307,	237,
5,	1522,	2972,	3036,	2787,	768,	1248,	1120,	554,	153,	227,
6,	738,	1114,	2140,	2554,	1737,	651,	959,	538,	423,	133,
7,	39,	529,	475,	1976,	1909,	1101,	335,	474,	427,	298,
8,	130,	83,	151,	541,	885,	698,	373,	131,	383,	293,
9,	71,	48,	18,	133,	270,	317,	401,	201,	125,	264,
+gp,	712,	334,	128,	81,	108,	32,	162,	185,	301,	298,
TOTALNUM,	10443,	10646,	9510,	10311,	8978,	6942,	4320,	2768,	2587,	3016,
TONSLAND,	14477,	14882,	12178,	14325,	11726,	8429,	5446,	4026,	4252,	4987,
SOPCOF %,	101,	102,	97,	100,	102,	106,	105,	104,	100,	103,

Table 2.4.6

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

Table 2 Catch weights at age (kg)

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	.4700,	.4700,	.4700,	.4700,	.4700,
3,	.7300,	.7300,	.7300,	.7300,	.7300,
4,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,
7,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,
8,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,
9,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,
+gp,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,
SOPCOFAC,	.8938,	.9011,	.8964,	1.0131,	.9401,

Table 2 Catch weights at age (kg)

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,
3,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,
4,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,
7,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,
8,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,
9,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,
+gp,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,
SOPCOFAC,	1.0920,	1.0166,	1.0278,	1.0835,	1.0274,	.9874,	.9795,	.9772,	.9711,	1.1712,

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

Table 2 Catch weights at age (kg)

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	.4700,	.3110,	.3570,	.3570,	.6430,	.4520,	.7000,	.4700,	.6810,	.5280,
3,	.7300,	.6330,	.7900,	.6720,	.7130,	.7250,	.8960,	.7400,	1.0110,	.8590,
4,	1.1300,	1.0440,	1.0350,	.8940,	.9410,	.9570,	1.1500,	1.0100,	1.2550,	1.3910,
5,	1.5500,	1.4260,	1.3980,	1.1560,	1.1570,	1.2370,	1.4440,	1.3200,	1.8120,	1.7770,
6,	1.9700,	1.8520,	1.8700,	1.5900,	1.4930,	1.6510,	1.4980,	1.6600,	2.0610,	2.3260,
7,	2.4100,	2.2410,	2.3500,	2.0700,	1.7390,	2.0530,	1.8290,	2.0500,	2.0590,	2.4400,
8,	2.7600,	2.2050,	2.5970,	2.5250,	2.0950,	2.4060,	1.8870,	2.2600,	2.1370,	2.4010,
9,	3.0700,	2.5700,	3.0140,	2.6960,	2.4650,	2.7250,	1.9610,	2.5400,	2.3680,	2.5320,
+gp,	3.5500,	2.5910,	2.9200,	3.5190,	3.3100,	3.2500,	2.8560,	3.0400,	2.6860,	2.6860,
SOPCOFAC,	1.0746,	.9762,	.9947,	1.0385,	1.0017,	1.0870,	.9238,	1.0554,	1.0602,	1.0559,

Table 2 Catch weights at age (kg)

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	.6080,	.6050,	.5010,	.5800,	.4380,	.5470,	.5250,	.7550,	.7540,	.6660,
3,	.8870,	.8310,	.7810,	.7790,	.6990,	.6930,	.7240,	.9820,	1.1030,	1.0540,
4,	1.1750,	1.1260,	.9740,	.9230,	.9390,	.8840,	.8170,	1.0270,	1.2540,	1.4890,
5,	1.6310,	1.4620,	1.3630,	1.2070,	1.2040,	1.0860,	1.0380,	1.1920,	1.4650,	1.7790,
6,	1.9840,	1.9410,	1.6800,	1.5640,	1.3840,	1.2760,	1.2490,	1.3780,	1.5930,	1.9400,
7,	2.5190,	2.1730,	1.9750,	1.7460,	1.5640,	1.4770,	1.4300,	1.6430,	1.8040,	2.1820,
8,	2.5830,	2.3470,	2.3440,	2.0860,	1.8180,	1.5740,	1.5640,	1.7960,	2.0490,	2.3570,
9,	2.5700,	3.1180,	2.2480,	2.4240,	2.1680,	1.9300,	1.6330,	1.9710,	2.2250,	2.4900,
+gp,	2.9220,	2.9330,	3.2950,	2.5140,	2.3350,	2.1530,	2.1260,	2.2400,	2.4230,	2.6780,
SOPCOFAC,	1.0141,	1.0197,	.9695,	1.0025,	1.0195,	1.0635,	1.0496,	1.0361,	.9969,	1.0323,

Table 2.4.7

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

Table 5 Proportion mature at age

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	.0600,	.0600,	.0600,	.0600,	.0600,
3,	.4800,	.4800,	.4800,	.4800,	.4800,
4,	.9100,	.9100,	.9100,	.9100,	.9100,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,
3,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,
4,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

Table 5 Proportion mature at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0700,	.0800,	.0800,	.0300,
3,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.5200,	.6200,	.7600,	.6200,
4,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.8800,	.8900,	.9800,	.9600,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	.0300,	.0500,	.0500,	.0200,	.0800,	.1600,	.1800,	.1500,	.1200,	.1000,
3,	.4300,	.3200,	.2400,	.2200,	.3700,	.5800,	.6500,	.5300,	.5000,	.5500,
4,	.9500,	.9100,	.8900,	.8700,	.9000,	.9300,	.9100,	.9000,	.9200,	.9700,
5,	.9900,	.9800,	.9800,	.9900,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.4.8

```
Haddock in the Faroe Grounds (Fishing Area Vb) (run name: XSAJAK01)
105
LL95A: Longliners < 100GRT, revised in 1995 (Catch: Thousands) (Effort: Unknown)
1985 1995
1 1 0.00 1.00
3 9
    7558   2542    787    306     65     23     30    120
    6692   1435   1747    530    256     12     51     15
    6728   1027   1819   1118    331    155     20     12
    8753    311   1557   1405    768    138     40      5
   12804   1042    433   1676   1361   1015    313     74
   14543    993   1141    428    955   1005    457    155
   14801    733   1165    615    281    560    385    170
   10599    103    419    480    282     65    154    181
    7497     92     80    152    112     64     22     46
    7625     47     50     25     55     57     51     18
    9574    133     45     40     26     53     51     41
LL95B: Longliners > 100GRT, revised in 1995 (Catch: Thousands) (Effort: Unknown)
1985 1995
1 1 0.00 1.00
4 6
    2973    300    188     40
    2176    584    203    124
    2915    168    323    220
    3203    200    470    504
    3369     79    421    492
    3521    316    146    312
    3573    260    223    127
    2892     92    216    188
    2046     55    124    134
    2925     92     43     98
    3517     66     82     55
MH96A: Magnus Heinason Groundfish Survey tricked 96 to 95end (Catch: Number) (Effort: Unknown)
1985 1995
1 1 0.99 1.00
2 5
   100   46.5   21.7    4.2    0.8
   100   26.4   16.7    8.7    1.5
   100   11.8   21.2   10.7    3.8
   100  113.0    8.5   23.2   31.2
   100   64.0   23.9    2.5    7.7
   100   13.4    9.8    3.9    1.5
   100    8.5   15.5    6.8    5.1
   100    9.9    6.2    6.3    4.7
   100    3.1    4.0    2.0    3.6
   100   10.1    2.9    2.5    0.8
   100  137.1    6.1    0.9    0.7
OB95A: Otter board trawlers 400-999 HP, revised in 1995 (Catch: Thousands) (Effort: Unknown)
1988 1995
1 1 0.00 1.00
5 7
    2204    118     86     19
    1993     91     92     56
    1853     25     52     48
    1038     15     10     12
     495      8      4      2
    1008     24     14     12
     677      3      6      6
    1199     10      4     17
PT95A: Pair trawlers > 1000HP, revised in 1995 (Catch: Thousands) (Effort: Unknown)
1988 1995
1 1 0.00 1.00
5 7
    6034    251    194     55
    5127    162    156     39
    7491     57    156    184
    7875    181    104    131
    7243    107    150     52
    6335     82    111    122
    6227     32    133    128
    5052     33     18     50
```

Table 2.4.9

```
Lowestoft VPA Version 3.1

   2-May-96  18:35:14

Extended Survivors Analysis

Haddock Faroes Vb (run: XSAJAK01/X01)

CPUE data from file /users/fish/ifad/ifapwork/nwwg/had_faro/FLEET.X01

Catch data for  35 years. 1961 to 1995. Ages  2 to  10.

     Fleet,             First, Last, First, Last, Alpha,  Beta
                   ,     year, year,  age ,  age
LL95A: Longliners < ,    1985, 1995,   3,      9,   .000,  1.000
LL95B: Longliners > ,    1985, 1995,   4,      6,   .000,  1.000
MH96A: Magnus Heinas,    1985, 1995,   2,      5,   .990,  1.000
OB95A: Otter board t,    1988, 1995,   5,      7,   .000,  1.000
PT95A: Pair trawlers,    1988, 1995,   5,      7,   .000,  1.000


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years


Catchability analysis :

     Catchability dependent on stock size for ages <    3

        Regression type = C
        Minimum of   5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  3


     Catchability independent of age for ages >=    6


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning converged after   58 iterations




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


Fishing mortalities
   Age,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995

     2,  .010,  .038,  .044,  .005,  .012,  .031,  .012,  .066,  .074,  .037
     3,  .095,  .097,  .078,  .136,  .132,  .155,  .080,  .117,  .151,  .167
     4,  .246,  .188,  .196,  .159,  .254,  .273,  .165,  .201,  .169,  .284
     5,  .252,  .258,  .242,  .355,  .281,  .261,  .278,  .170,  .164,  .182
     6,  .321,  .296,  .299,  .330,  .392,  .409,  .329,  .208,  .189,  .210
     7,  .157,  .403,  .198,  .500,  .441,  .464,  .383,  .268,  .254,  .197
     8,  .423,  .581,  .190,  .364,  .438,  .284,  .280,  .252,  .361,  .277
     9,  .289,  .271,  .234,  .255,  .311,  .275,  .262,  .239,  .406,  .456
```

Table 2.4.9 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9
1986	2.54E+04	3.10E+04	2.26E+04	7.54E+03	2.97E+03	2.97E+02	4.17E+02	3.13E+02
1987	8.31E+03	2.06E+04	2.30E+04	1.45E+04	4.80E+03	1.76E+03	2.08E+02	2.24E+02
1988	1.69E+04	6.55E+03	1.53E+04	1.56E+04	9.15E+03	2.92E+03	9.65E+02	9.54E+01
1989	1.40E+04	1.32E+04	4.96E+03	1.03E+04	1.01E+04	5.55E+03	1.96E+03	6.53E+02
1990	9.96E+03	1.14E+04	9.45E+03	3.46E+03	5.92E+03	5.92E+03	2.76E+03	1.12E+03
1991	2.78E+03	8.06E+03	8.20E+03	6.00E+03	2.14E+03	3.28E+03	3.12E+03	1.46E+03
1992	3.69E+03	2.20E+03	5.65E+03	5.11E+03	3.78E+03	1.16E+03	1.69E+03	1.92E+03
1993	1.96E+03	2.99E+03	1.67E+03	3.92E+03	3.17E+03	2.23E+03	6.50E+02	1.04E+03
1994	4.31E+03	1.51E+03	2.18E+03	1.12E+03	2.71E+03	2.11E+03	1.40E+03	4.14E+02
1995	2.49E+04	3.28E+03	1.06E+03	1.50E+03	7.75E+02	1.84E+03	1.34E+03	7.96E+02

Estimated population abundance at 1st Jan 1996

, .00E+00, 1.97E+04, 2.27E+03, 6.53E+02, 1.03E+03, 5.14E+02, 1.24E+03, 8.31E+02,

Taper weighted geometric mean of the VPA populations:

, 9.44E+03, 7.12E+03, 5.65E+03, 4.40E+03, 3.13E+03, 2.18E+03, 1.36E+03, 8.28E+02,

Standard error of the weighted Log(VPA populations) :

, 1.0045, 1.0144, 1.0475, .9675, .9546, .9236, .9278, 1.0344,

Log catchability residuals.

Fleet : LL95A: Longliners <

Age	1985
2	No data for this fleet at this age
3	.64
4	.21
5	.18
6	.79
7	-.45
8	.11
9	-.06

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2	No data for this fleet at this age									
3	.21	.28	-.04	.11	.08	.12	-.25	-.30	-.29	-.25
4	.47	.46	.45	-.10	.14	.30	-.07	-.14	-.91	-.47
5	.41	.50	.38	.64	.21	.00	.25	-.34	-.91	-.96
6	.56	.32	.25	.37	.44	.22	-.04	-.50	-1.08	-.79
7	-.28	.61	-.37	.74	.51	.51	-.31	-.68	-.76	-.95
8	.95	.78	-.50	.55	.49	.11	.14	-.52	-.41	-.64
9	-.04	.06	-.25	.15	.25	.05	.16	-.26	-.22	-.25

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

Age	3	4	5	6	7	8	9
Mean Log q	-11.9473	-11.6225	-11.6535	-11.5692	-11.5692	-11.5692	-11.5692
S.E(Log q)	.2802	.4401	.5605	.5979	.6405	.5578	.1981

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	.80	7.051	11.33	.99	11	.09	-11.95
4	.74	4.614	10.85	.97	11	.18	-11.62
5	.63	5.982	10.48	.97	11	.16	-11.65
6	.85	.760	11.04	.76	11	.52	-11.57
7	.75	1.462	10.67	.81	11	.44	-11.71
8	1.15	-.573	12.19	.64	11	.66	-11.51
9	.93	1.130	11.25	.97	11	.18	-11.61

Table 2.4.9 (Continued)

Fleet : LL95B: Longliners >

Age	1985
2	No data for this fleet at this age
3	No data for this fleet at this age
4	.06
5	.07
6	.41
7	No data for this fleet at this age
8	No data for this fleet at this age
9	No data for this fleet at this age

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	.38	-1.21	-.72	-.58	.16	.10	-.41	.66	.54	.79
5	.02	-.46	-.26	.04	.00	-.15	.20	.20	.04	.21
6	.12	-.09	.00	-.15	-.09	.02	.02	.15	-.38	.12
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	4	5	6
Mean Log q	-11.5033	-11.1013	-10.7358
S.E(Log q)	.6361	.2075	.1944

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	1.70	-2.612	13.48	.64	11	.84	-11.50
5	1.18	-2.318	11.58	.95	11	.20	-11.10
6	1.14	-1.859	11.11	.96	11	.20	-10.74

Table 2.4.9 (Continued)

Fleet : MH96A: Magnus Heinas

Age	1985
2	-.76
3	-.68
4	-.69
5	-1.22
6	No data for this fleet at this age
7	No data for this fleet at this age
8	No data for this fleet at this age
9	No data for this fleet at this age

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2	-.89	-.50	.93	.54	-.59	.28	.12	-.30	.04	.71
3	-.96	-.32	-.10	.29	-.46	.37	.67	-.03	.37	.35
4	-.62	-.49	.70	-.43	-.54	.18	.37	.48	.40	.21
5	-1.07	-.78	1.23	.36	-.26	.40	.49	.38	.13	-.29
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	3	4	5
Mean Log q	-10.8734	-11.4073	-11.6119
S.E(Log q)	.4971	.5044	.7077

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	.94	.258	10.32	.73	11	.64	-10.39

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.58	-3.471	12.06	.82	11	.53	-10.87
4	1.32	-1.642	12.28	.77	11	.61	-11.41
5	.91	.360	11.32	.65	11	.67	-11.61

Table 2.4.9 (Continued)

Fleet : OB95A: Otter board t

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	99.99	99.99	-.15	.16	.00	-.49	-.21	.39	-.03	.31
6	99.99	99.99	.09	.18	.24	.20	-.59	.08	-.22	.06
7	99.99	99.99	-.32	.35	.18	-.02	-.08	.30	.06	.64
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	5	6	7
Mean Log q	-12.2253	-12.2182	-12.2182
S.E(Log q)	.2910	.2807	.3333

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
5	1.11	-.788	12.67	.89	8	.33	-12.23
6	.96	.295	12.06	.91	8	.29	-12.22
7	.96	.193	11.90	.79	8	.31	-12.07

Fleet : PT95A: Pair trawlers

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	99.99	99.99	-.21	-.02	-.39	.16	-.11	-.03	.30	.25
6	99.99	99.99	-.31	-.44	-.26	.31	.15	.11	.45	-.08
7	99.99	99.99	-.47	-1.16	-.08	.14	.29	.58	.69	.07
8	No data for this fleet at this age									
9	No data for this fleet at this age									

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

Age	5	6	7
Mean Log q	-12.4128	-12.0136	-12.0136
S.E(Log q)	.2358	.3139	.5930

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
5	1.18	-1.684	13.15	.94	8	.25	-12.41
6	1.26	-1.557	13.01	.86	8	.36	-12.01
7	3.09	-1.947	20.50	.13	8	1.54	-11.99

Table 2.4.9 (Continued)

Terminal year survivor and F summaries :

Age 2 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	1.,	.000,	.000,	.00,	0,	.000,	.000
LL95B: Longliners > ,	1.,	.000,	.000,	.00,	0,	.000,	.000
MH96A: Magnus Heinas,	40148.,	.744,	.000,	.00,	1,	.259,	.018
OB95A: Otter board t,	1.,	.000,	.000,	.00,	0,	.000,	.000
PT95A: Pair trawlers,	1.,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean ,	7119.,	1.01,,,,				.145,	.098
F shrinkage mean ,	18456.,	.50,,,,				.596,	.039

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
19667.,	.38,	.63,	3,	1.639,	.037

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	1775.,	.300,	.000,	.00,	1,	.516,	.209
LL95B: Longliners > ,	1.,	.000,	.000,	.00,	0,	.000,	.000
MH96A: Magnus Heinas,	2881.,	.414,	.147,	.36,	2,	.264,	.134
OB95A: Otter board t,	1.,	.000,	.000,	.00,	0,	.000,	.000
PT95A: Pair trawlers,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	3039.,	.50,,,,				.220,	.127

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2270.,	.22,	.16,	4,	.733,	.167

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	461.,	.252,	.086,	.34,	2,	.475,	.382
LL95B: Longliners > ,	1445.,	.667,	.000,	.00,	1,	.075,	.138
MH96A: Magnus Heinas,	783.,	.334,	.165,	.49,	3,	.273,	.242
OB95A: Otter board t,	1.,	.000,	.000,	.00,	0,	.000,	.000
PT95A: Pair trawlers,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	901.,	.50,,,,				.177,	.213

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
653.,	.18,	.16,	7,	.886,	.284

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	572.,	.233,	.221,	.95,	3,	.238,	.307
LL95B: Longliners > ,	1330.,	.274,	.115,	.42,	2,	.204,	.144
MH96A: Magnus Heinas,	1118.,	.301,	.146,	.49,	4,	.144,	.169
OB95A: Otter board t,	1396.,	.309,	.000,	.00,	1,	.164,	.137
PT95A: Pair trawlers,	1319.,	.300,	.000,	.00,	1,	.174,	.145
F shrinkage mean ,	787.,	.50,,,,				.075,	.232

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1026.,	.12,	.12,	12,	1.003,	.182

Table 2.4.9 (Continued)

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	337.,	.221,	.175,	.79,	4,	.173,	.305
LL95B: Longliners > ,	583.,	.203,	.108,	.53,	3,	.250,	.188
MH96A: Magnus Heinas,	793.,	.302,	.117,	.39,	4,	.086,	.141
OB95A: Otter board t,	524.,	.216,	.047,	.22,	2,	.226,	.207
PT95A: Pair trawlers,	577.,	.224,	.190,	.85,	2,	.208,	.189
F shrinkage mean ,	335.,	.50,,,,				.056,	.307

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
514.,	.10,	.08,	16,	.805,	.210

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	901.,	.214,	.239,	1.11,	5,	.169,	.262
LL95B: Longliners > ,	1080.,	.204,	.204,	1.00,	3,	.212,	.223
MH96A: Magnus Heinas,	1520.,	.303,	.208,	.68,	4,	.072,	.163
OB95A: Otter board t,	1570.,	.186,	.264,	1.42,	3,	.284,	.158
PT95A: Pair trawlers,	1488.,	.212,	.161,	.76,	3,	.206,	.167
F shrinkage mean ,	614.,	.50,,,,				.057,	.364

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1235.,	.10,	.10,	19,	1.081,	.197

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	663.,	.218,	.186,	.85,	6,	.192,	.336
LL95B: Longliners > ,	979.,	.206,	.021,	.10,	3,	.198,	.240
MH96A: Magnus Heinas,	935.,	.310,	.230,	.74,	4,	.058,	.250
OB95A: Otter board t,	825.,	.188,	.088,	.47,	3,	.275,	.279
PT95A: Pair trawlers,	924.,	.214,	.190,	.88,	3,	.195,	.252
F shrinkage mean ,	690.,	.50,,,,				.080,	.325

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
831.,	.10,	.07,	20,	.665,	.277

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	333.,	.198,	.081,	.41,	7,	.348,	.541
LL95B: Longliners > ,	396.,	.207,	.067,	.33,	3,	.144,	.472
MH96A: Magnus Heinas,	465.,	.317,	.296,	.93,	4,	.042,	.414
OB95A: Otter board t,	328.,	.190,	.291,	1.53,	3,	.208,	.548
PT95A: Pair trawlers,	519.,	.217,	.112,	.52,	3,	.144,	.379
F shrinkage mean ,	918.,	.50,,,,				.114,	.231

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
413.,	.11,	.10,	21,	.890,	.456

Table 2.4.10

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	.1875,	.3232,	.3801,	.0876,	.0691,
3,	.4162,	.5866,	.5639,	.3722,	.2354,
4,	.4209,	.5980,	.7261,	.5193,	.4767,
5,	.4387,	.3480,	.5591,	.5369,	.3678,
6,	.5879,	.6706,	.4026,	.6107,	.5882,
7,	.9483,	1.0499,	1.2493,	.3375,	.9618,
8,	.8742,	.9736,	1.1139,	1.2027,	2.3618,
9,	.6600,	.7351,	.8185,	.6472,	.9618,
+gp,	.6600,	.7351,	.8185,	.6472,	.9618,
FBAR 3- 7,	.5624,	.6506,	.7002,	.4753,	.5260,

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	.0609,	.0641,	.1261,	.0860,	.0551,	.0526,	.0253,	.1670,	.1265,	.1219,
3,	.2370,	.1872,	.2646,	.2362,	.2527,	.1935,	.4220,	.4303,	.2170,	.2646,
4,	.4515,	.2970,	.3482,	.5319,	.3342,	.4185,	.2851,	.2379,	.3722,	.2409,
5,	.5006,	.2997,	.2846,	.3329,	.3638,	.2752,	.4515,	.3128,	.1275,	.2110,
6,	.5421,	.5406,	.4539,	.4974,	.5557,	.5557,	.1493,	.2691,	.1710,	.0953,
7,	.9128,	.6906,	.8366,	.8274,	.8736,	.8371,	.6713,	.1942,	.2130,	.0857,
8,	.7509,	.6634,	.5850,	1.0628,	.5427,	.4220,	.4054,	.2902,	.1431,	.1596,
9,	.6372,	.5021,	.5056,	.6564,	.5383,	.5057,	.3952,	.2622,	.2063,	.1591,
+gp,	.6372,	.5021,	.5056,	.6564,	.5383,	.5057,	.3952,	.2622,	.2063,	.1591,
FBAR 3- 7,	.5288,	.4030,	.4376,	.4852,	.4760,	.4560,	.3958,	.2889,	.2201,	.1795,

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

At 2-May-96 18:36:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	.0901,	.0107,	.0010,	.0004,	.0312,	.0237,	.0369,	.0247,	.0326,	.0284,
3,	.1859,	.1118,	.0541,	.0459,	.0278,	.1314,	.4612,	.1839,	.1145,	.1676,
4,	.3801,	.1793,	.1649,	.1239,	.2036,	.1276,	.3502,	.3474,	.3685,	.2338,
5,	.2212,	.5254,	.2084,	.1890,	.2707,	.2126,	.2814,	.3225,	.2166,	.3210,
6,	.2861,	.7226,	.3798,	.1383,	.2105,	.2220,	.2799,	.1323,	.2981,	.4149,
7,	.1595,	.3885,	.5729,	.2700,	.1667,	.1969,	.2461,	.3025,	.0812,	.1803,
8,	.2530,	.3768,	.4930,	.3275,	.3910,	.0898,	.2216,	.3000,	.2974,	.1626,
9,	.2614,	.4417,	.3661,	.2107,	.2498,	.1705,	.2774,	.2825,	.2537,	.2839,
+gp,	.2614,	.4417,	.3661,	.2107,	.2498,	.1705,	.2774,	.2825,	.2537,	.2839,
FBAR 3- 7,	.2466,	.3855,	.2760,	.1534,	.1759,	.1781,	.3238,	.2577,	.2158,	.2635,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
2,	.0100,	.0384,	.0439,	.0050,	.0117,	.0311,	.0120,	.0657,	.0737,	.0366,
3,	.0954,	.0966,	.0779,	.1357,	.1317,	.1546,	.0803,	.1168,	.1510,	.1670,
4,	.2458,	.1876,	.1956,	.1586,	.2545,	.2733,	.1646,	.2006,	.1694,	.2838,
5,	.2523,	.2577,	.2416,	.3547,	.2810,	.2613,	.2776,	.1696,	.1643,	.1824,
6,	.3212,	.2965,	.2991,	.3296,	.3917,	.4094,	.3288,	.2079,	.1892,	.2103,
7,	.1566,	.4028,	.1981,	.4996,	.4407,	.4640,	.3826,	.2679,	.2536,	.1975,
8,	.4226,	.5808,	.1899,	.3636,	.4377,	.2841,	.2801,	.2519,	.3613,	.2770,
9,	.2890,	.2708,	.2339,	.2548,	.3110,	.2748,	.2621,	.2393,	.4062,	.4563,
+gp,	.2890,	.2708,	.2339,	.2548,	.3110,	.2748,	.2621,	.2393,	.4062,	.4563,
FBAR 3- 7,	.2142,	.2482,	.2025,	.2956,	.2999,	.3125,	.2468,	.1926,	.1855,	.2082,

Table 2.4.11

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
2,	51279,	38537,	47363,	30111,	22646,
3,	23796,	34806,	22837,	26515,	22586,
4,	16517,	12850,	15850,	10638,	14961,
5,	6028,	8877,	5786,	6278,	5182,
6,	3245,	3182,	5132,	2708,	3005,
7,	1512,	1476,	1332,	2809,	1204,
8,	448,	480,	423,	313,	1641,
9,	135,	153,	148,	114,	77,
+gp,	0,	0,	0,	0,	0,
TOTAL,	102958,	100362,	98871,	79487,	71302,

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
2,	20208,	25359,	54870,	31981,	35616,	15473,	33211,	23710,	52401,	70632,
3,	17303,	15567,	19473,	39602,	24026,	27596,	12019,	26512,	16426,	37805,
4,	14614,	11177,	10569,	12236,	25602,	15278,	18619,	6453,	14116,	10826,
5,	7605,	7618,	6799,	6109,	5886,	15007,	8232,	11462,	4165,	7965,
6,	2937,	3774,	4622,	4188,	3585,	3349,	9330,	4291,	6864,	3002,
7,	1366,	1398,	1800,	2403,	2085,	1684,	1573,	6579,	2684,	4736,
8,	377,	449,	574,	638,	860,	713,	597,	658,	4436,	1776,
9,	127,	146,	189,	262,	181,	409,	383,	326,	403,	3148,
+gp,	0,	0,	0,	0,	0,	0,	0,	52,	867,	1399,
TOTAL,	64536,	65488,	98896,	97419,	97841,	79508,	83963,	80044,	102362,	141288,

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
2,	56389,	26484,	34934,	2859,	5147,	3494,	16422,	19959,	41152,	38893,
3,	51189,	42189,	21453,	28573,	2340,	4085,	2794,	12957,	15942,	32611,
4,	23757,	34800,	30887,	16639,	22343,	1863,	2933,	1442,	8827,	11640,
5,	6966,	13300,	23816,	21444,	12036,	14923,	1343,	1692,	834,	4999,
6,	5281,	4571,	6439,	15831,	14534,	7517,	9878,	830,	1003,	550,
7,	2234,	3248,	1817,	3606,	11287,	9641,	4929,	6113,	595,	610,
8,	3559,	1559,	1803,	839,	2254,	7822,	6483,	3155,	3698,	449,
9,	1240,	2263,	876,	902,	495,	1248,	5854,	4253,	1914,	2249,
+gp,	1519,	2623,	1116,	428,	428,	253,	970,	3547,	4747,	4323,
TOTAL,	152134,	131037,	123140,	91120,	70863,	50846,	51606,	53949,	78712,	96324,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE											
2,	25428,	8310,	16871,	14021,	9957,	2778,	3694,	1964,	4309,	24916,	0,
3,	30952,	20611,	6548,	13220,	11422,	8057,	2205,	2988,	1506,	3277,	19667,
4,	22580,	23035,	15320,	4959,	9450,	8198,	5652,	1666,	2177,	1060,	2270,
5,	7543,	14458,	15633,	10314,	3465,	5999,	5107,	3925,	1116,	1504,	653,
6,	2969,	4799,	9148,	10052,	5923,	2142,	3782,	3168,	2712,	775,	1026,
7,	297,	1763,	2921,	5554,	5919,	3278,	1164,	2229,	2107,	1838,	514,
8,	417,	208,	965,	1962,	2759,	3119,	1687,	650,	1396,	1338,	1235,
9,	313,	224,	95,	653,	1116,	1458,	1922,	1044,	414,	796,	831,
+gp,	3115,	1547,	674,	396,	444,	146,	772,	955,	988,	891,	875,
TOTAL,	93613,	74954,	68176,	61131,	50455,	35174,	25985,	18589,	16724,	36396,	27073,

Table 2.4.12

Run title : Haddock Faroes Vb (run: XSAJAK01/X01)

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Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1961,	51279,	81164,	47797,	20831,	.4358,	.5624,
1962,	38537,	83420,	51875,	27151,	.5234,	.6506,
1963,	47363,	80753,	49547,	27571,	.5565,	.7002,
1964,	30111,	68578,	44128,	19490,	.4417,	.4753,
1965,	22646,	65656,	45556,	18479,	.4056,	.5260,
1966,	20208,	60937,	43955,	18766,	.4269,	.5288,
1967,	25359,	60212,	41962,	13381,	.3189,	.4030,
1968,	54870,	78094,	45385,	17852,	.3933,	.4376,
1969,	31981,	83843,	53436,	23272,	.4355,	.4852,
1970,	35616,	87348,	59889,	21361,	.3567,	.4760,
1971,	15473,	81821,	62956,	19393,	.3080,	.4560,
1972,	33211,	83175,	62046,	16485,	.2657,	.3958,
1973,	23710,	82868,	61673,	17969,	.2914,	.2889,
1974,	52401,	95576,	64754,	14763,	.2280,	.2201,
1975,	70632,	122233,	75576,	20715,	.2741,	.1795,
1976,	56388,	136322,	89562,	26211,	.2927,	.2466,
1977,	26484,	122033,	97133,	25553,	.2631,	.3855,
1978,	34934,	121574,	98161,	19200,	.1956,	.2760,
1979,	2859,	98577,	86295,	12424,	.1440,	.1534,
1980,	5147,	88613,	82742,	15016,	.1815,	.1759,
1981,	3494,	80030,	76845,	12233,	.1592,	.1781,
1982,	16422,	69607,	57310,	11937,	.2083,	.3238,
1983,	19959,	65285,	52851,	12894,	.2440,	.2577,
1984,	41152,	85209,	55337,	12378,	.2237,	.2158,
1985,	38893,	94774,	63562,	15143,	.2382,	.2635,
1986,	25428,	99369,	67274,	14477,	.2152,	.2142,
1987,	8310,	88098,	68918,	14882,	.2159,	.2482,
1988,	16871,	75632,	61649,	12178,	.1975,	.2025,
1989,	14021,	67546,	50824,	14325,	.2819,	.2956,
1990,	9957,	51317,	41388,	11726,	.2833,	.2999,
1991,	2778,	36477,	32348,	8429,	.2606,	.3125,
1992,	3694,	27261,	24697,	5446,	.2205,	.2468,
1993,	1964,	24199,	21388,	4026,	.1882,	.1926,
1994,	4309,	23571,	19663,	4252,	.2162,	.1855,
1995,	24916,	37340,	20803,	4987,	.2397,	.2082,
Arith. Mean ,	26039,	77386,	56551,	15863,	.2895,	.3334,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.4.13

Faroe Haddock: VPA and groundfish survey data

3 11 2

'Yearclass'	'VPAage2'	'Survage1'	'Survage2'	'Survage3'
1985	8310	23.6	11.8	11.8
1986	16871	40.6	88.1	113.0
1987	14021	40.5	146.6	64.0
1988	9957	43.8	43.1	13.4
1989	2778	6.1	16.5	8.5
1990	3694	4.0	26.9	9.9
1991	1964	6.2	9.2	3.1
1992	4309	28.1	21.3	10.1
1993	-11	186.3	252.6	137.1
1994	-11	486.9	244.2	-11
1995	-11	65.6	-11	-11

Table 2.4.14

Analysis by RCT3 ver3.1 of data from file :

rcte96.dat

Faroe Haddock: VPA and groundfish survey data

Data for 3 surveys over 11 years : 1985 - 1995

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1988

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Survl	1.25	4.99	.13	.938	3	3.80	9.75	.299	.236
Surv2	.32	8.17	.25	.809	3	3.79	9.36	.508	.082
Surv3	.32	8.20	.00	1.000	3	2.67	9.06	.006	.527
					VPA Mean =		9.44	.367	.156

Yearclass = 1989

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Survl	1.80	2.86	.47	.415	4	1.96	6.40	2.411	.004
Surv2	.35	8.00	.22	.762	4	2.86	9.00	.395	.155
Surv3	.30	8.32	.08	.964	4	2.25	9.00	.141	.605
					VPA Mean =		9.38	.321	.235

Yearclass = 1990

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Survl	.95	5.97	.26	.908	5	1.61	7.50	.518	.477
Surv2	.92	5.64	.75	.544	5	3.33	8.71	1.079	.110
Surv3	.79	6.49	.60	.652	5	2.39	8.39	.903	.157
					VPA Mean =		9.09	.707	.256

Table 2.4.14 (Continued)

Yearclass = 1991

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	.79	6.56	.31	.877	6	1.97	8.13	.442	.570
Surv2	1.07	5.01	.78	.521	6	2.32	7.50	1.210	.076
Surv3	.83	6.34	.55	.689	6	1.41	7.51	.881	.144
						VPA Mean =	8.94	.728	.210

Yearclass = 1992

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	.93	6.08	.39	.852	7	3.37	9.23	.502	.427
Surv2	1.04	5.11	.68	.650	7	3.10	8.35	.872	.141
Surv3	.82	6.39	.48	.787	7	2.41	8.36	.619	.280
						VPA Mean =	8.74	.842	.152

Yearclass = 1993

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	1.00	5.79	.52	.733	8	5.23	11.00	.865	.213
Surv2	1.04	5.12	.61	.663	8	5.54	10.88	.976	.167
Surv3	.82	6.39	.44	.793	8	4.93	10.42	.662	.364
						VPA Mean =	8.68	.790	.256

Yearclass = 1994

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	.99	5.79	.52	.730	8	6.19	11.95	1.066	.249
Surv2	1.04	5.12	.60	.670	8	5.50	10.83	.971	.300
Surv3									
						VPA Mean =	8.67	.791	.452

Table 2.4.14 (Continued)

Yearclass = 1995

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	.99	5.79	.53	.726	8	4.20	9.96	.751	.526
Surv2									
Surv3									
					VPA Mean =		8.65	.792	.474

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	11020	9.31	.15	.16	1.27	9958	9.21
1989	8735	9.08	.16	.14	.78	2778	7.93
1990	3557	8.18	.36	.40	1.22	3695	8.21
1991	3501	8.16	.33	.27	.66	1965	7.58
1992	6532	8.78	.33	.23	.50	4310	8.37
1993	26255	10.18	.40	.52	1.72		
1994	25154	10.13	.53	.98	3.42		
1995	11408	9.34	.55	.65	1.44		

Table 2.4.15	**Ranking of yearclass strengths from the final 1996 VPA(quartiles)**							
	1973	70.632						
	1974	56.388						
	1966	54.87						
"Good	1972	52.401	Geomean:	48.560				
yearclasses"	1961	47.363						
	1982	41.152						
	1983	38.893						
	1968	35.616						
			1976	34.934				
			1970	33.211				
			1967	31.981				
			1962	30.111				
			1975	26.484				
			1984	25.428				
		"Medium	1965	25.359	Geomean:	21.731		
		yearclasses"	1971	23.71				
			1963	22.646				
			1964	20.208				
			1981	19.959				
			1986	16.871				
			1980	16.422				
			1969	15.473				
			1987	14.021				
			1988	9.957				
					1985	8.31		
					1978	5.147		
					1992	4.309		
				"Poor	1990	3.694	Geomean:	3.725
				yearclasses"	1979	3.494		
					1977	2.859		
					1989	2.778		
					1991	1.964		
	SSB range	**"Good YC"**	**"Medium YC"**	**"Poor YC"**				
	< 40.000t	0	?	6				
	40.000-65.000t	25	31	9				
	>65.000t	3	16	9				
	Table 2.4.15	Probability of getting a certain Yearclass strength						
		(% of VPA-observations), based on SSB-R plot (Fig. 2.4.16).						
		(?: 9 % prob. of predicted YC's)						

Table 2.4.16

Haddock in the Faroe Grounds (Fishing Area Vb)

Prediction with management option table: Input data

Year: 1996								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	25154.000	0.2000	0.0100	0.0000	0.0000	0.725	0.0625	0.725
3	20438.000	0.2000	0.5500	0.0000	0.0000	0.990	0.1544	0.990
4	2270.000	0.2000	0.9700	0.0000	0.0000	1.383	0.2322	1.383
5	653.000	0.2000	1.0000	0.0000	0.0000	1.971	0.1834	1.971
6	1026.000	0.2000	1.0000	0.0000	0.0000	2.217	0.2157	2.217
7	514.000	0.2000	1.0000	0.0000	0.0000	2.448	0.2553	2.448
8	1235.000	0.2000	1.0000	0.0000	0.0000	2.662	0.3161	2.662
9	831.000	0.2000	1.0000	0.0000	0.0000	2.792	0.3913	2.792
10+	875.000	0.2000	1.0000	0.0000	0.0000	2.943	0.3913	2.943
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	11408.000	0.2000	0.0100	0.0000	0.0000	0.725	0.0625	0.725
3	.	0.2000	0.5500	0.0000	0.0000	0.990	0.1544	0.990
4	.	0.2000	0.9700	0.0000	0.0000	1.383	0.2322	1.383
5	.	0.2000	1.0000	0.0000	0.0000	1.971	0.1834	1.971
6	.	0.2000	1.0000	0.0000	0.0000	2.217	0.2157	2.217
7	.	0.2000	1.0000	0.0000	0.0000	2.448	0.2553	2.448
8	.	0.2000	1.0000	0.0000	0.0000	2.662	0.3161	2.662
9	.	0.2000	1.0000	0.0000	0.0000	2.792	0.3913	2.792
10+	.	0.2000	1.0000	0.0000	0.0000	2.943	0.3913	2.943
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	12512.000	0.2000	0.0100	0.0000	0.0000	0.725	0.0625	0.725
3	.	0.2000	0.5500	0.0000	0.0000	0.990	0.1544	0.990
4	.	0.2000	0.9700	0.0000	0.0000	1.383	0.2322	1.383
5	.	0.2000	1.0000	0.0000	0.0000	1.971	0.1834	1.971
6	.	0.2000	1.0000	0.0000	0.0000	2.217	0.2157	2.217
7	.	0.2000	1.0000	0.0000	0.0000	2.448	0.2553	2.448
8	.	0.2000	1.0000	0.0000	0.0000	2.662	0.3161	2.662
9	.	0.2000	1.0000	0.0000	0.0000	2.792	0.3913	2.792
10+	.	0.2000	1.0000	0.0000	0.0000	2.943	0.3913	2.943
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANJAK02
Date and time: 08MAY96:01:26

Table 2.4.17

01:25 Wednesday, May 8, 1996

Haddock in the Faroe Grounds (Fishing Area Vb)

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.2082	54613	27359	7338	0.0000	0.0000	58509	41107	0	73202	59404
.	.	.	.	.	0.1000	0.0208	.	41107	1023	71995	58232
.	.	.	.	.	0.2000	0.0416	.	41107	2024	70813	57086
.	.	.	.	.	0.3000	0.0625	.	41107	3002	69658	55966
.	.	.	.	.	0.4000	0.0833	.	41107	3960	68528	54871
.	.	.	.	.	0.5000	0.1041	.	41107	4896	67423	53801
.	.	.	.	.	0.6000	0.1249	.	41107	5812	66342	52754
.	.	.	.	.	0.7000	0.1457	.	41107	6708	65284	51731
.	.	.	.	.	0.8000	0.1666	.	41107	7585	64249	50729
.	.	.	.	.	0.9000	0.1874	.	41107	8443	63236	49751
.	.	.	.	.	1.0000	0.2082	.	41107	9283	62246	48793
.	.	.	.	.	1.1000	0.2290	.	41107	10105	61276	47857
.	.	.	.	.	1.2000	0.2498	.	41107	10909	60328	46941
.	.	.	.	.	1.3000	0.2707	.	41107	11697	59399	46045
.	.	.	.	.	1.4000	0.2915	.	41107	12467	58490	45168
.	.	.	.	.	1.5000	0.3123	.	41107	13222	57601	44311
.	.	.	.	.	1.6000	0.3331	.	41107	13960	56731	43472
.	.	.	.	.	1.7000	0.3539	.	41107	14684	55878	42651
.	.	.	.	.	1.8000	0.3748	.	41107	15392	55044	41848
.	.	.	.	.	1.9000	0.3956	.	41107	16085	54227	41062
.	.	.	.	.	2.0000	0.4164	.	41107	16764	53428	40293
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANJAK02
Date and time : 08MAY96:01:26
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1996 : F factors

Table 2.4.18

13:27 Monday, May 6, 1996

Haddock in the Faroe Grounds (Fishing Area Vb)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	1.000	0.2000	0.0900	0.0000	0.0000	0.551	0.0692	0.551
3	.	0.2000	0.4900	0.0000	0.0000	0.820	0.2148	0.820
4	.	0.2000	0.9200	0.0000	0.0000	1.068	0.3220	1.068
5	.	0.2000	1.0000	0.0000	0.0000	1.377	0.3218	1.377
6	.	0.2000	1.0000	0.0000	0.0000	1.684	0.3707	1.684
7	.	0.2000	1.0000	0.0000	0.0000	1.965	0.4375	1.965
8	.	0.2000	1.0000	0.0000	0.0000	2.160	0.4853	2.160
9	.	0.2000	1.0000	0.0000	0.0000	2.403	0.4014	2.403
10+	.	0.2000	1.0000	0.0000	0.0000	2.762	0.4014	2.762
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDJAK01
Date and time: 06MAY96:15:37

Table 2.4.19

13:27 Monday, May 6, 1

Haddock in the Faroe Grounds (Fishing Area Vb)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	8492.978	4.135	7591.902	4.135	7591.902
0.0500	0.0167	0.068	121.474	5.176	7661.598	3.797	6762.513	3.797	6762.513
0.1000	0.0333	0.125	216.261	4.892	6980.282	3.515	6083.171	3.515	6083.171
0.1500	0.0500	0.174	291.216	4.651	6413.223	3.276	5518.072	3.276	5518.072
0.2000	0.0667	0.216	351.151	4.444	5934.978	3.071	5041.771	3.071	5041.771
0.2500	0.0833	0.252	399.527	4.264	5526.995	2.893	4635.717	2.893	4635.717
0.3000	0.1000	0.284	438.890	4.105	5175.444	2.737	4286.081	2.737	4286.081
0.3500	0.1167	0.312	471.139	3.965	4869.818	2.599	3982.355	2.599	3982.355
0.4000	0.1333	0.337	497.717	3.840	4602.005	2.476	3716.427	2.476	3716.427
0.4500	0.1500	0.360	519.734	3.727	4365.646	2.365	3481.940	2.365	3481.940
0.5000	0.1667	0.381	538.052	3.625	4155.696	2.265	3273.847	2.265	3273.847
0.5500	0.1833	0.399	553.350	3.532	3968.104	2.174	3088.098	2.174	3088.098
0.6000	0.2000	0.417	566.166	3.447	3799.585	2.091	2921.407	2.091	2921.407
0.6500	0.2167	0.432	576.928	3.369	3647.448	2.015	2771.086	2.015	2771.086
0.7000	0.2334	0.447	585.985	3.297	3509.473	1.945	2634.914	1.945	2634.914
0.7500	0.2500	0.460	593.618	3.231	3383.813	1.881	2511.042	1.881	2511.042
0.8000	0.2667	0.473	600.055	3.169	3268.920	1.821	2397.924	1.821	2397.924
0.8500	0.2834	0.485	605.484	3.111	3163.487	1.765	2294.254	1.765	2294.254
0.9000	0.3000	0.496	610.063	3.057	3066.407	1.713	2198.924	1.713	2198.924
0.9500	0.3167	0.506	613.919	3.006	2976.735	1.664	2110.988	1.664	2110.988
1.0000	0.3334	0.516	617.159	2.958	2893.659	1.618	2029.635	1.618	2029.635
1.0500	0.3500	0.525	619.874	2.913	2816.479	1.575	1954.167	1.575	1954.167
1.1000	0.3667	0.534	622.139	2.871	2744.591	1.535	1883.978	1.535	1883.978
1.1500	0.3834	0.542	624.018	2.831	2677.467	1.496	1818.541	1.496	1818.541
1.2000	0.4000	0.550	625.564	2.793	2614.647	1.460	1757.395	1.460	1757.395
1.2500	0.4167	0.557	626.824	2.756	2555.727	1.426	1700.138	1.426	1700.138
1.3000	0.4334	0.564	627.836	2.722	2500.352	1.393	1646.414	1.393	1646.414
1.3500	0.4500	0.571	628.633	2.689	2448.209	1.362	1595.910	1.362	1595.910
1.4000	0.4667	0.577	629.245	2.658	2399.018	1.333	1548.347	1.333	1548.347
1.4500	0.4834	0.583	629.695	2.628	2352.533	1.305	1503.478	1.305	1503.478
1.5000	0.5000	0.589	630.004	2.599	2308.533	1.278	1461.082	1.278	1461.082
1.5500	0.5167	0.595	630.191	2.572	2266.821	1.252	1420.964	1.252	1420.964
1.6000	0.5334	0.600	630.273	2.546	2227.219	1.228	1382.944	1.228	1382.944
1.6500	0.5500	0.605	630.261	2.520	2189.569	1.204	1346.865	1.204	1346.865
1.7000	0.5667	0.610	630.169	2.496	2153.726	1.182	1312.583	1.182	1312.583
1.7500	0.5834	0.615	630.006	2.473	2119.561	1.160	1279.968	1.160	1279.968
1.8000	0.6000	0.620	629.782	2.450	2086.957	1.139	1248.902	1.139	1248.902
1.8500	0.6167	0.624	629.504	2.428	2055.806	1.119	1219.280	1.119	1219.280
1.9000	0.6334	0.629	629.180	2.407	2026.011	1.100	1191.003	1.100	1191.003
1.9500	0.6501	0.633	628.815	2.387	1997.483	1.082	1163.983	1.082	1163.983
2.0000	0.6667	0.637	628.416	2.368	1970.142	1.064	1138.139	1.064	1138.139
2.0500	0.6834	0.641	627.986	2.349	1943.913	1.046	1113.397	1.046	1113.397
2.1000	0.7001	0.645	627.530	2.330	1918.727	1.030	1089.689	1.030	1089.689
2.1500	0.7167	0.648	627.051	2.313	1894.523	1.014	1066.952	1.014	1066.952
2.2000	0.7334	0.652	626.553	2.296	1871.242	0.998	1045.129	0.998	1045.129
2.2500	0.7501	0.655	626.039	2.279	1848.831	0.983	1024.166	0.983	1024.166
2.3000	0.7667	0.659	625.510	2.263	1827.241	0.969	1004.014	0.969	1004.014
2.3500	0.7834	0.662	624.970	2.247	1806.426	0.955	984.629	0.955	984.629
2.4000	0.8001	0.665	624.420	2.232	1786.345	0.941	965.967	0.941	965.967
2.4500	0.8167	0.668	623.863	2.217	1766.958	0.928	947.990	0.928	947.990
2.5000	0.8334	0.671	623.298	2.203	1748.228	0.915	930.661	0.915	930.661
2.5500	0.8501	0.674	622.729	2.189	1730.122	0.903	913.947	0.903	913.947
2.6000	0.8667	0.677	622.156	2.175	1712.608	0.891	897.816	0.891	897.816
2.6500	0.8834	0.680	621.580	2.162	1695.657	0.879	882.238	0.879	882.238
2.7000	0.9001	0.683	621.002	2.149	1679.241	0.867	867.187	0.867	867.187
2.7500	0.9167	0.685	620.424	2.136	1663.335	0.856	852.637	0.856	852.637
2.8000	0.9334	0.688	619.845	2.124	1647.913	0.846	838.563	0.846	838.563
2.8500	0.9501	0.690	619.267	2.112	1632.955	0.835	824.943	0.835	824.943
2.9000	0.9667	0.693	618.689	2.100	1618.437	0.825	811.756	0.825	811.756
2.9500	0.9834	0.695	618.114	2.089	1604.341	0.815	798.982	0.815	798.982
3.0000	1.0001	0.698	617.540	2.078	1590.648	0.805	786.603	0.805	786.603
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDJAK01
Date and time : 06MAY96:15:51
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.5540
F-max factor : 1.6181
F-0.1 reference F : 0.1847
F-max reference F : 0.5394
Recruitment : Single recruit

Table 2.5.1 Saithe in the Faroes. Nominal catches (t) by countries, 1982-95 as officially reported to ICES

Country	1982	1983	1984	1985	1986	1987	1988
Denmark	-	-	-	-	21	255	94
Faroe Islands	30,808	38,963	54,344	42,874	40,139	39,301	44,402
France	130	180	243	839	87	153	313
German Dem.Rep.	-	-	-	31	-	-	-
German Fed. Rep.	19	28	73	227	105	49	74
Netherlands	-	-	-	-	-	-	-
Norway	15	5	5	-	24	14	52
UK (Eng. & W.)	-	-	-	4	-	108	-
UK (Scotland)	1	-	-	630	1,340	140	92
United Kingdom	-	-	-	-	-	-	-
USSR	-	-	-	-	-	-	-
Total	30,973	39,176	54,665	44,605	41,716	40,020	45,027

Country	1989	1990	1991	1992	1993	1994	1995 [1]
Denmark		2					
Faroe Islands	43624	59821	53321	35979	32719	32406	27217
France [3]	-	-	-	1999	75	-	-
German Dem.Rep.	9		32	5	2	1	19
German Fed. Rep.	20	15	-	-	-	-	-
Netherlands	22	67	65	-	-	-	-
Norway	51	46	103	85	34	156	14
UK (Eng. & W.)	-	-	5	74	280	151	-
UK (Scotland)	9	33	79	98	425	438	-
United Kingdom	-	-	-	-	-	-	221
USSR/Russia [2]	-	30	-	12	-	-	-
Total	43735	60014	53605	38252	33535	33152	27471

[1] Preliminary.
[2] As from 1991.
[3] Quantity unknown 1989-91 and 1994.

Table 2.5.2 Saithe in the Faroes. Nominal catches (t) by countries, 1982-95 as used in the assessment

Country	1982	1983	1984	1985	1986	1987	1988
Denmark	-	-	-	-	21	255	94
Faroe Islands							
Vb	30,808	38,963	54,344	42,874	40,139	39,301	44,402
IIa4	-	-	-	-	-	-	258
France	130	180	243	839	87	153	313
German Dem.Rep.	-	-	-	31	-	-	-
German Fed. Rep.	19	28	73	227	105	49	74
Netherlands	-	-	-	-	-	-	-
Norway	15	5	5	-	24	14	52
UK (Eng. & W.)	-	-	-	4	-	108	-
UK (Scotland)	1	-	-	630	1,340	140	92
United Kingdom	-	-	-	-	-	-	-
USSR	-	-	-	-	-	-	-
Total	30,973	39,176	54,665	44,605	41,716	40,020	45,285

Country	1989	1990	1991	1992	1993	1994	1995 [1]
Denmark	-	2	-	-	-	-	-
Faroe Islands							
Vb	43624	59821	53321	35979	32719	32406	27217
IIa4	269	988	963	165	-	-	-
France [3]	473	626	283	1999	75	10	-
German Dem.Rep.	9		-	-	-	-	-
German Fed. Rep.	20	15	32	5	2	1	-
Netherlands	22	67	65	-	-	-	-
Norway	51	46	103	34	85	156	14
UK (Eng. & W.)	-	-	5	74	280	151	-
UK (Scotland)	9	33	79	98	425	438	-
United Kingdom	-	-	-	-	-	-	221
USSR/Russia [2]	-	30	7	12	11	11	9
Total	44477	61628	54858	38366	33597	33173	27461

[1] Preliminary.
[2] As from 1991.
[3] Quantity unknown 1989-91 and 1994.

Table 2.5.3 Saithe in the Faroes. CPUE (tonnes/days) by fleet categories.

Year	Open boats	Long liners <100 GRT	Single trawl >400 HP	Gill net	Jiggers	Single trawl < 1000 HP	Single trawl > 1000 HP	Pair trawl < 1000 HP	Pair trawl > 1000 HP	Long liners >100 GRT	Indust. trawl	Other vessels	Total
1985	0.239	0.005	0.012		0.300	1.274	2.441	2.206	3.526	0.010			1.232
1986	0.236	0.010	0.021		0.480	0.886	1.887	1.667	3.038	0.010			1.205
1987	0.439	0.008	0.092		0.677	0.997	1.743	1.459	2.913	0.015			1.171
1988	0.064	0.012	0.033		0.325	1.223	1.843	1.351	2.891	0.011			0.949
1989	0.090	0.004	0.097		0.352	1.098	1.557	1.893	3.231	0.019			0.828
1990	0.108	0.009	0.096		0.427	1.131	2.983	2.489	3.158	0.030			1.106
1991	0.101	0.004	0.071		0.471	0.577	1.864	2.307	2.943	0.019			0.971
1992	0.070	0.011	0.016		0.347	0.290	0.629	2.003	2.552	0.013			0.777
1993	0.119	0.008	0.029		0.348	0.152	0.530	2.250	2.963	0.017			0.870
1994	0.063	0.015	0.028		0.286	0.495	0.570	2.756	3.252	0.027			0.776
1995	0.015	0.002	0.045		0.138	0.161	0.557	1.653	2.188	0.018			0.465

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Table 2.5.4 Saithe in the Faroes. Catch numbers at age Numbers*10**-3.

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

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
3,	183,	562,	614,	684,	996,
4,	379,	542,	340,	1908,	850,
5,	483,	617,	340,	1506,	1708,
6,	403,	495,	415,	617,	965,
7,	216,	286,	406,	572,	510,
8,	129,	131,	202,	424,	407,
9,	116,	129,	174,	179,	306,
10,	82,	113,	158,	150,	201,
11,	45,	71,	94,	100,	156,
+gp,	82,	105,	274,	174,	285,
TOTALNUM,	2118,	3051,	3017,	6314,	6384,
TONSLAND,	9592,	10454,	12693,	21893,	22181,
SOPCOF %,	108,	93,	96,	99,	92,

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	488,	595,	614,	1191,	1445,	2857,	2714,	2515,	3504,	2062,
4,	1540,	796,	1689,	2086,	6577,	3316,	1774,	6253,	4126,	3361,
5,	1201,	1364,	1116,	2294,	1558,	5585,	2588,	7075,	4011,	3801,
6,	1686,	792,	1095,	1414,	1478,	1005,	2742,	3478,	2784,	1939,
7,	806,	1192,	548,	1118,	899,	828,	1529,	1634,	1401,	1045,
8,	377,	473,	655,	589,	730,	469,	1305,	693,	640,	714,
9,	294,	217,	254,	580,	316,	326,	1017,	550,	368,	302,
10,	205,	190,	128,	239,	241,	164,	743,	403,	340,	192,
11,	156,	97,	89,	115,	86,	100,	330,	215,	197,	193,
+gp,	225,	140,	187,	190,	132,	100,	210,	186,	265,	298,
TOTALNUM,	6978,	5856,	6375,	9816,	13462,	14750,	14952,	23002,	17636,	13907,
TONSLAND,	25563,	21319,	20387,	27437,	29110,	32706,	42663,	57431,	47188,	41576,
SOPCOF %,	98,	104,	102,	97,	96,	109,	100,	120,	113,	116,

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	3178,	1609,	611,	287,	996,	411,	387,	2483,	368,	1224,
4,	3217,	2937,	1743,	933,	877,	1804,	4076,	1103,	11067,	3990,
5,	1720,	2034,	1736,	1341,	720,	769,	994,	5052,	2359,	5583,
6,	1250,	1288,	548,	1033,	673,	932,	1114,	1343,	4093,	1182,
7,	877,	767,	373,	584,	726,	908,	380,	575,	875,	1898,
8,	641,	708,	479,	414,	284,	734,	417,	339,	273,	273,
9,	468,	498,	466,	247,	212,	343,	296,	273,	161,	103,
10,	223,	338,	473,	473,	171,	192,	105,	98,	52,	38,
11,	141,	272,	407,	368,	196,	92,	88,	98,	65,	26,
+gp,	287,	330,	535,	691,	786,	1021,	902,	540,	253,	275,
TOTALNUM,	12002,	10781,	7371,	6371,	5641,	7206,	8759,	11904,	19566,	14592,
TONSLAND,	33065,	34835,	28138,	27246,	25230,	30103,	30964,	39176,	54665,	44605,
SOPCOF %,	107,	104,	100,	102,	99,	96,	96,	100,	100,	94,

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	1167,	1581,	866,	451,	294,	1030,	548,	1319,	690,	402,
4,	1997,	5793,	2950,	5981,	3837,	5125,	4281,	2615,	3960,	1028,
5,	4473,	3827,	9555,	5300,	10131,	7451,	3860,	4696,	2662,	3501,
6,	3730,	2785,	2784,	7136,	9229,	5543,	2820,	1668,	2367,	1853,
7,	953,	990,	1300,	793,	5076,	3487,	1445,	859,	746,	1188,
8,	1077,	532,	621,	546,	478,	1630,	941,	493,	500,	348,
9,	245,	333,	363,	185,	123,	405,	645,	449,	307,	243,
10,	104,	81,	159,	83,	61,	238,	129,	246,	303,	194,
11,	67,	43,	27,	55,	60,	128,	66,	54,	150,	105,
+gp,	158,	97,	60,	39,	79,	118,	114,	52,	49,	118,
TOTALNUM,	13971,	16062,	18685,	20569,	29368,	25155,	14849,	12451,	11734,	8980,
TONSLAND,	41716,	40020,	45285,	44477,	61561,	54863,	38366,	33481,	33187,	27480,
SOPCOF %,	94,	96,	99,	97,	98,	99,	105,	101,	102,	102,

Table 2.5.5 Saithe in the Faroes. Catch weights at age (kg).

Table 2 Catch weights at age (kg)

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
3,	1.4300,	1.2730,	1.2800,	1.1750,	1.1810,
4,	2.3020,	2.0450,	2.1970,	2.0550,	2.1250,
5,	3.3480,	3.2930,	3.2120,	3.2660,	2.9410,
6,	4.2870,	4.1910,	4.5680,	4.2550,	4.0960,
7,	5.1280,	5.1460,	5.0560,	5.0380,	4.8780,
8,	6.1550,	5.6550,	5.9320,	5.6940,	5.9320,
9,	7.0600,	6.4690,	6.2590,	6.6620,	6.3210,
10,	7.2650,	6.7060,	8.0000,	6.8370,	7.2880,
11,	7.4970,	7.1500,	7.2650,	7.6860,	8.0740,
+gp,	9.3400,	9.0240,	8.8590,	8.5590,	8.9040,
0 SOPCOFAC,	1.0779,	.9342,	.9590,	.9933,	.9220,

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	1.3610,	1.2730,	1.3020,	1.1880,	1.2440,	1.1010,	1.0430,	1.0880,	1.4300,	1.1140,
4,	2.0260,	1.7800,	1.7370,	1.6670,	1.4450,	1.3160,	1.4850,	1.4610,	1.5250,	1.6580,
5,	3.0550,	2.5340,	2.0360,	2.3020,	2.2490,	1.8180,	2.0550,	1.5820,	2.2070,	2.2600,
6,	3.6580,	3.5720,	3.1200,	2.8530,	2.8530,	2.9780,	2.8290,	2.2490,	2.5000,	3.1200,
7,	4.5850,	4.3680,	4.0490,	3.6730,	3.5150,	3.7020,	3.7910,	3.6870,	3.1200,	3.5570,
8,	5.5200,	5.3130,	5.1830,	5.0020,	4.4180,	4.2710,	4.1750,	4.3850,	4.6010,	4.0960,
9,	6.8370,	5.8120,	6.2380,	5.7140,	5.4440,	5.3880,	4.8080,	5.1280,	5.5590,	5.1280,
10,	7.2650,	6.5540,	7.5200,	6.4050,	5.7330,	5.9720,	5.2940,	5.2760,	5.7140,	6.0940,
11,	7.6620,	7.8060,	8.0490,	6.5540,	6.6620,	6.4900,	6.9480,	6.7270,	6.2590,	7.1960,
+gp,	9.2230,	8.1490,	9.0920,	8.0870,	8.5840,	8.0050,	7.5150,	8.0310,	8.0100,	8.5980,
0 SOPCOFAC,	.9769,	1.0357,	1.0194,	.9663,	.9634,	1.0935,	1.0043,	1.2006,	1.1296,	1.1607,

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	1.0880,	1.2230,	1.4930,	1.2200,	1.2300,	1.3100,	1.3370,	1.2080,	1.4310,	1.4010,
4,	1.6760,	1.6410,	2.3240,	1.8800,	2.1200,	2.1300,	1.8510,	2.0290,	1.9530,	2.0320,
5,	2.8780,	2.6600,	3.0680,	2.6200,	3.3200,	3.0000,	2.9510,	2.9650,	2.4700,	2.9650,
6,	3.0810,	3.7900,	3.7460,	3.4000,	4.2800,	3.8100,	3.5770,	4.1430,	3.8500,	3.5960,
7,	4.2870,	4.2390,	4.9130,	4.1800,	5.1600,	4.7500,	4.9270,	4.7240,	5.1770,	5.3360,
8,	4.3520,	5.5970,	4.3680,	4.9500,	6.4200,	5.2500,	6.2430,	5.9010,	6.3470,	7.2020,
9,	4.7900,	5.3500,	5.2760,	5.6900,	6.8700,	5.9500,	7.2320,	6.8110,	7.8250,	6.9660,
10,	5.9120,	5.9120,	5.8320,	6.3800,	7.0900,	6.4300,	7.2390,	7.0510,	6.7460,	9.8620,

Table 2.5.5 (Continued)

11,	6.6190,	6.8370,	6.0530,	7.0200,	7.9300,	7.0000,	8.3460,	7.2480,	8.6360,	10.6700,
+gp,	7.8940,	7.7080,	7.5760,	8.6260,	9.2150,	8.9620,	10.0410,	10.0550,	10.0980,	11.9500,
0 SOPCOFAC,	1.0680,	1.0442,	1.0049,	1.0248,	.9937,	.9564,	.9632,	.9997,	.9991,	.9415,

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	1.7180,	1.6090,	1.5000,	1.3090,	1.2230,	1.2400,	1.2640,	1.4080,	1.5030,	1.4560,
4,	1.9860,	1.8350,	1.9750,	1.7350,	1.6330,	1.5680,	1.6020,	1.8600,	1.9510,	2.1770,
5,	2.6180,	2.3950,	1.9780,	1.9070,	1.8300,	1.8640,	2.0690,	2.3230,	2.2670,	2.4200,
6,	3.2770,	3.1820,	2.9370,	2.3730,	2.0520,	2.2110,	2.5540,	3.1310,	2.9360,	2.8950,
7,	4.1860,	4.0670,	3.7980,	3.8100,	2.8660,	2.6480,	3.0570,	3.7300,	4.2140,	3.6510,
8,	5.5890,	5.1490,	4.4190,	4.6670,	4.4740,	3.3800,	4.0780,	4.3940,	4.9710,	5.0640,
9,	6.0500,	5.5010,	5.1150,	5.5090,	5.4240,	4.8160,	5.0120,	5.2090,	5.6570,	5.4400,
10,	6.1500,	6.6260,	6.7120,	5.9720,	6.4690,	5.5160,	6.7680,	6.5400,	5.9500,	6.1670,
11,	9.5360,	6.3430,	9.0400,	6.9390,	6.3430,	6.4070,	7.7540,	8.4030,	6.8910,	7.0800,
+gp,	10.2180,	10.2440,	9.3370,	9.9360,	8.2870,	7.7290,	8.2270,	8.0500,	9.1090,	7.5410,
0 SOPCOFAC,	.9419,	.9620,	.9928,	.9698,	.9789,	.9940,	1.0497,	1.0133,	1.0244,	1.0211,

Table 2.5.6 Saithe in the Faroes. Proportion mature at age.

Table 5 Proportion mature at age

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
3,	.0400,	.0400,	.0400,	.0400,	.0400,
4,	.2600,	.2600,	.2600,	.2600,	.2600,
5,	.5700,	.5700,	.5700,	.5700,	.5700,
6,	.8200,	.8200,	.8200,	.8200,	.8200,
7,	.9100,	.9100,	.9100,	.9100,	.9100,
8,	.9800,	.9800,	.9800,	.9800,	.9800,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,
4,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,
5,	.5700,	.5700,	.5700,	.5700,	.5700,	.5700,	.5700,	.5700,	.5700,	.5700,
6,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,
7,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,
8,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

1

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.1100,	.1300,	.1300,
4,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,	.3400,	.3200,	.3400,
5,	.5700,	.5700,	.5700,	.5700,	.5700,	.5700,	.5700,	.7000,	.6000,	.7000,
6,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.9300,	.9100,	.8900,
7,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9800,	.9900,	.9900,
8,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.5.6 (Continued

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	.1600,	.1500,	.1400,	.1200,	.1100,	.1100,	.1100,	.1300,	.1400,	.1300,
4,	.3300,	.3000,	.3300,	.2800,	.2600,	.2500,	.2600,	.3000,	.3200,	.3700,
5,	.6300,	.5800,	.4900,	.4700,	.4500,	.4600,	.5100,	.5600,	.5500,	.5900,
6,	.8600,	.8500,	.8200,	.7200,	.6600,	.6900,	.7600,	.8400,	.8200,	.8100,
7,	.9600,	.9600,	.9500,	.9500,	.8900,	.8700,	.9100,	.9500,	.9700,	.9400,
8,	.9900,	.9900,	.9800,	.9900,	.9900,	.9600,	.9800,	.9800,	.9900,	.9900,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9900,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.5.7 Saithe in the Faroes. Effort (fishing days) and catch at age (thousands) for the Cuba trawlrs.

Year	Effort days	Age 3	4	5	6	7	8	9	10	11	12	13	14
1982	1805	0	984	275	516	107	47	37	34	14	12	9	17
1983	1792	225	231	1052	312	116	85	73	15	31	32	2	36
1984	1714	77	1780	328	762	182	49	19	3	8	17	2	5
1985	1224	93	518	1196	249	313	41	16	3	6	12	4	1
1986	1341	170	324	891	638	177	188	45	17	9	6	16	1
1987	1762	239	943	798	633	237	125	65	15	10	1	3	4
1988	1705	129	539	1706	599	244	102	67	16	2	2	3	4
1989	1473	96	1096	931	1178	133	79	26	15	10	2	0	2
1990	1820	44	477	1442	1395	768	71	19	8	8	3	2	1
1991	1985	72	594	1035	837	528	258	31	29	21	11	0	0
1992	1932	19	464	488	413	207	120	104	20	10	4	6	1
1993	1649	144	559	906	326	174	103	77	46	10	7	0	0
1994	1638	122	906	558	524	167	117	76	70	34	4	5	0
1995	1872	79	299	957	392	242	82	41	30	23	13	2	3

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output.

Lowestoft VPA Version 3.1

8-May-96 09:48:38

Extended Survivors Analysis

Saithe Faroes Vb (run: XSAANI15/X15)

CPUE data from file /users/fish/ifad/ifapwork/nwwg/sai_faro/FLEET.X15

Catch data for 35 years. 1961 to 1995. Ages 3 to 12.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
CUBA: CUBA TRAWL NO,	1982,	1995,	3,	11,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 9

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

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

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

Prior weighting not applied

Tuning converged after 24 iterations

1

Regression weights

.751,	.820,	.877,	.921,	.954,	.976,	.990,	.997,	1.000,	1.000

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
3,	.021,	.036,	.021,	.017,	.015,	.044,	.036,	.058,	.082,	.030
4,	.138,	.137,	.088,	.202,	.195,	.389,	.260,	.244,	.246,	.170
5,	.455,	.426,	.349,	.225,	.620,	.716,	.575,	.507,	.421,	.358
6,	.754,	.576,	.638,	.480,	.770,	.854,	.661,	.528,	.522,	.589
7,	.440,	.454,	.588,	[illegible],	.766,	.765,	.562,	.428,	.478,	.545
8,	.746,	.473,	.581,	.528,	.403,	.601,	.476,	.377,	.478,	.429
9,	.874,	.542,	.701,	.338,	.213,	.719,	.508,	.439,	.428,	.453
10,	.541,	.831,	.544,	.333,	.176,	.821,	.527,	.369,	.606,	.532
11,	.637,	.450,	.749,	.365,	.430,	.682,	.564,	.438,	.403,	.435

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

1

XSA population numbers (Thousands)

	AGE								
YEAR	3	4	5	6	7	8	9	10	11
1986	6.26E+04	1.71E+04	1.35E+04	7.78E+03	2.96E+03	2.26E+03	4.65E+02	2.75E+02	1.57E+02
1987	4.91E+04	5.02E+04	1.22E+04	7.03E+03	3.00E+03	1.56E+03	8.79E+02	1.59E+02	1.31E+02
1988	4.52E+04	3.88E+04	3.58E+04	6.53E+03	3.23E+03	1.56E+03	7.96E+02	4.19E+02	5.66E+01
1989	2.97E+04	3.62E+04	2.91E+04	2.07E+04	2.82E+03	1.47E+03	7.13E+02	3.24E+02	1.99E+02
1990	2.18E+04	2.39E+04	2.42E+04	1.90E+04	1.05E+04	1.59E+03	7.10E+02	4.17E+02	1.90E+02
1991	2.64E+04	1.76E+04	1.61E+04	1.07E+04	7.21E+03	3.99E+03	8.73E+02	4.70E+02	2.86E+02
1992	1.69E+04	2.07E+04	9.76E+03	6.44E+03	3.72E+03	2.74E+03	1.79E+03	3.48E+02	1.69E+02
1993	2.60E+04	1.33E+04	1.30E+04	4.49E+03	2.72E+03	1.73E+03	1.40E+03	8.82E+02	1.68E+02
1994	9.65E+03	2.01E+04	8.56E+03	6.43E+03	2.17E+03	1.45E+03	9.74E+02	7.36E+02	5.00E+02
1995	1.49E+04	7.28E+03	1.29E+04	4.60E+03	3.12E+03	1.10E+03	7.38E+02	5.20E+02	3.29E+02

Estimated population abundance at 1st Jan 1996

.00E+00	1.18E+04	5.03E+03	7.37E+03	2.09E+03	1.48E+03	5.87E+02	3.84E+02	2.50E+02

Taper weighted geometric mean of the VPA populations:

2.45E+04	1.99E+04	1.39E+04	7.19E+03	3.35E+03	1.60E+03	8.17E+02	4.05E+02	2.05E+02

Standard error of the weighted Log(VPA populations) :

.5409	.5639	.5316	.5616	.5080	.4289	.4079	.5131	.6200

1

Log catchability residuals.

Fleet : CUBA: CUBA TRAWL NO

Age	1982	1983	1984	1985
3	99.99	.70	-.30	.61
4	.18	-.46	.82	.21
5	-.39	-.10	-.46	.63
6	.60	-.09	-.08	-.22
7	-.17	-.07	.31	.27
8	-.44	.33	-.11	.02
9	-.10	.97	-.31	-.20
10	.03	-.28	-1.37	-1.27
11	-.07	.47	-.21	.18

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	.26	.60	-.13	.08	-.99	-.60	-1.96	.64	1.43	.18
4	-.20	-.48	-.77	.21	-.43	.10	-.34	.44	.52	.26
5	.37	.08	-.24	-.55	.04	.07	-.21	.24	.15	.12
6	.37	.11	.19	-.21	-.04	-.03	-.28	-.06	.06	.00
7	.05	.07	.11	-.31	.09	.01	-.33	-.09	.12	.03
8	.64	.21	.09	.01	-.44	-.07	-.49	-.07	.29	.06
9	.96	.28	.51	-.34	-.92	-.50	-.07	.00	.35	-.11
10	.37	.65	-.35	-.11	-1.27	.10	-.07	-.08	.63	-.04
11	.34	.27	-.34	-.01	-.37	.21	-.03	.08	.20	.11

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

Age	4	5	6	7	8	9	10	11
Mean Log q	-10.8045	-9.9854	-9.6308	-9.7692	-9.8910	-10.0067	-10.0067	-10.0067
S.E(Log q)	.4528	.3155	.2081	.1866	.3096	.5213	.6736	.2475

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
3,	1.38,	-.665,	14.01,	.25,	13,	.97,	-12.94,

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
4,	1.41,	-1.105,	11.15,	.44,	14,	.63,	-10.80,
5,	1.13,	-.559,	10.04,	.65,	14,	.37,	-9.99,
6,	1.11,	-.848,	9.71,	.86,	14,	.23,	-9.63,
7,	.96,	.379,	9.70,	.90,	14,	.19,	-9.77,
8,	1.11,	-.455,	10.18,	.62,	14,	.36,	-9.89,
9,	1.17,	-.351,	10.57,	.31,	14,	.64,	-10.01,
10,	.78,	.665,	9.26,	.49,	14,	.52,	-10.19,
11,	.84,	1.520,	9.19,	.90,	14,	.19,	-9.96,

1

Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
CUBA: CUBA TRAWL NO,	14107.,	1.019,	.000,	.00,	1,	.116,	.025
P shrinkage mean ,	19944.,	.56,,,,				.389,	.018
F shrinkage mean ,	7520.,	.50,,,,				.495,	.047

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
11822.,	.35,	.35,	3,	.992,	.030

1

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
CUBA: CUBA TRAWL NO,	7883.,	.429,	.435,	1.01,	2,	.531,	.112
F shrinkage mean ,	3024.,	.50,,,,				.469,	.268

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5029.,	.33,	.52,	3,	1.577,	.170

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
CUBA: CUBA TRAWL NO,	9456.,	.263,	.139,	.53,	3,	.701,	.289
F shrinkage mean ,	4097.,	.50,,,,				.299,	.573

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7366.,	.24,	.28,	4,	1.182,	.358

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

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

 Year class = 1989

 Fleet,                   Estimated,    Int,       Ext,     Var,     N, Scaled,  Estimated
     ,                    Survivors,    s.e,       s.e,    Ratio,     , Weights,    F
 CUBA: CUBA TRAWL  NO,       2229.,    .205,       .172,     .84,    4,  .733,      .561

   F shrinkage mean  ,       1746.,     .50,,,,                          .267,      .673

 Weighted prediction :

 Survivors,         Int,       Ext,     N,     Var,      F
 at end of year,   s.e,       s.e,      ,    Ratio,
      2088.,        .20,       .14,     5,     .708,    .589

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

 Year class = 1988

 Fleet,                   Estimated,    Int,       Ext,     Var,     N, Scaled,  Estimated
     ,                    Survivors,    s.e,       s.e,    Ratio,     , Weights,    F
 CUBA: CUBA TRAWL  NO,       1546.,    .181,       .068,     .37,    5,  .765,      .528

   F shrinkage mean  ,       1293.,     .50,,,,                          .235,      .605

 Weighted prediction :

 Survivors,         Int,       Ext,     N,     Var,      F
 at end of year,   s.e,       s.e,      ,    Ratio,
      1482.,        .18,       .07,     6,     .361,    .545

1
 Age  8   Catchability constant w.r.t. time and dependent on age

 Year class = 1987

 Fleet,                   Estimated,    Int,       Ext,     Var,     N, Scaled,  Estimated
     ,                    Survivors,    s.e,       s.e,    Ratio,     , Weights,    F
 CUBA: CUBA TRAWL  NO,        605.,    .172,       .054,     .31,    6,  .790,      .419

   F shrinkage mean  ,        524.,     .50,,,,                          .210,      .471

 Weighted prediction :

 Survivors,         Int,       Ext,     N,     Var,      F
 at end of year,   s.e,       s.e,      ,    Ratio,
       587.,        .17,       .05,     7,     .298,    .429

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


 Year class = 1986

 Fleet,                   Estimated,    Int,       Ext,     Var,     N, Scaled,  Estimated
     ,                    Survivors,    s.e,       s.e,    Ratio,     , Weights,    F
 CUBA: CUBA TRAWL  NO,        389.,    .177,       .089,     .50,    7,  .735,      .448

   F shrinkage mean  ,        371.,     .50,,,,                          .265,      .465

 Weighted prediction :

 Survivors,         Int,       Ext,     N,     Var,      F
 at end of year,   s.e,       s.e,      ,    Ratio,
       384.,        .19,       .07,     8,     .384,    .453
```

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

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

Year class = 1985

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
CUBA: CUBA TRAWL NO,	241.,	.189,	.080,	.42,	8,	.660,	.547
F shrinkage mean ,	268.,	.50,,,,				.340,	.504

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
250.,	.21,	.06,	9,	.306,	.532

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1984

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
CUBA: CUBA TRAWL NO,	181.,	.203,	.093,	.46,	9,	.740,	.422
F shrinkage mean ,	156.,	.50,,,,				.260,	.475

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
174.,	.20,	.08,	10,	.401,	.435

Table 2.5.9 Saithe in the Faroes. Fishing mortality (F) at age.

Table 8 Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,	1964,	1965,
AGE					
3,	.0226,	.0465,	.0307,	.0478,	.0494,
4,	.0556,	.0863,	.0358,	.1260,	.0772,
5,	.0993,	.1207,	.0716,	.2197,	.1587,
6,	.1219,	.1401,	.1114,	.1796,	.2136,
7,	.0933,	.1192,	.1633,	.2212,	.2215,
8,	.0852,	.0752,	.1156,	.2565,	.2422,
9,	.0972,	.1149,	.1354,	.1423,	.2981,
10,	.0915,	.1294,	.2011,	.1657,	.2354,
11,	.0916,	.1069,	.1513,	.1890,	.2599,
+gp,	.0916,	.1069,	.1513,	.1890,	.2599,
0 FBAR 4- 8,	.0910,	.1083,	.0995,	.2006,	.1826,

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	.0250,	.0247,	.0320,	.0327,	.0478,	.0883,	.0932,	.1269,	.2293,	.1469,
4,	.1006,	.0517,	.0908,	.1449,	.2542,	.1476,	.0726,	.3214,	.3164,	.3595,
5,	.1490,	.1216,	.0953,	.1716,	.1535,	.3570,	.1644,	.4570,	.3523,	.5426,
6,	.2324,	.1386,	.1355,	.1680,	.1593,	.1400,	.2974,	.3473,	.3263,	.2868,
7,	.2782,	.2561,	.1342,	.1997,	.1533,	.1258,	.3276,	.2905,	.2285,	.1947,
8,	.2534,	.2613,	.2180,	.2090,	.1939,	.1115,	.2985,	.2415,	.1758,	.1741,
9,	.2768,	.2266,	.2180,	.3058,	.1653,	.1241,	.3747,	.1973,	.1950,	.1174,
10,	.3344,	.2900,	.2024,	.3283,	.2004,	.1209,	.4586,	.2484,	.1799,	.1476,
11,	.2898,	.2607,	.2138,	.2826,	.1873,	.1193,	.3797,	.2302,	.1844,	.1469,
+gp,	.2898,	.2607,	.2138,	.2826,	.1873,	.1193,	.3797,	.2302,	.1844,	.1469,
0 FBAR 4- 8,	.2027,	.1658,	.1348,	.1786,	.1828,	.1764,	.2321,	.3315,	.2799,	.3115,

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.2065,	.1473,	.0829,	.0370,	.0930,	.0137,	.0294,	.0692,	.0158,	.0627,
4,	.3589,	.2997,	.2356,	.1757,	.1515,	.2429,	.1830,	.1096,	.4940,	.2366,
5,	.3153,	.4056,	.2908,	.2872,	.1997,	.1925,	.2046,	.3625,	.3603,	.5002,
6,	.3416,	.4140,	.1799,	.2814,	.2281,	.4301,	.4711,	.4694,	.5662,	.3085,
7,	.2028,	.3641,	.2001,	.2964,	.3270,	.5486,	.3115,	.4770,	.6476,	.5644,
8,	.1756,	.2506,	.4080,	.3572,	.2293,	.6495,	.5275,	.5078,	.4377,	.4264,
9,	.1652,	.2011,	.2600,	.3817,	.3127,	.4783,	.5986,	.8107,	.4842,	.2918,
10,	.1192,	.1725,	.2989,	.4590,	.4992,	.5210,	.2605,	.4026,	.3435,	.1979,
11,	.1539,	.2090,	.3242,	.4020,	.3493,	.5542,	.4825,	.4143,	.5135,	.2881,
+gp,	.1539,	.2090,	.3242,	.4020,	.3493,	.5542,	.4825,	.4143,	.5135,	.2881,
0 FBAR 4- 8,	.2788,	.3468,	.2629,	.2796,	.2271,	.4127,	.3395,	.3853,	.5012,	.4072,

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
3,	.0208,	.0362,	.0214,	.0169,	.0150,	.0441,	.0365,	.0577,	.0823,	.0303,	.0568,
4,	.1381,	.1365,	.0879,	.2017,	.1952,	.3889,	.2600,	.2441,	.2457,	.1697,	.2198,
5,	.4549,	.4257,	.3492,	.2251,	.6204,	.7159,	.5750,	.5073,	.4212,	.3577,	.4287,
6,	.7544,	.5764,	.6377,	.4800,	.7696,	.8544,	.6609,	.5279,	.5222,	.5894,	.5465,
7,	.4399,	.4543,	.5879,	.3717,	.7663,	.7653,	.5618,	.4283,	.4779,	.5454,	.4839,
8,	.7458,	.4727,	.5809,	.5284,	.4026,	.6010,	.4763,	.3770,	.4783,	.4293,	.4282,
9,	.8744,	.5421,	.7006,	.3377,	.2127,	.7194,	.5078,	.4393,	.4282,	.4526,	.4401,
10,	.5410,	.8308,	.5442,	.3333,	.1765,	.8211,	.5272,	.3685,	.6065,	.5320,	.5023,
11,	.6373,	.4502,	.7492,	.3646,	.4297,	.6825,	.5642,	.4383,	.4033,	.4354,	.4257,
+gp,	.6373,	.4502,	.7492,	.3646,	.4297,	.6825,	.5642,	.4383,	.4033,	.4354,	
0 FBAR 4- 8,	.5066,	.4131,	.4487,	.3614,	.5508,	.6651,	.5068,	.4169,	.4291,	.4183,	

1

Table 2.5.10 Saithe in the Faroes (Division Vb). Stock in numbers at age, 1961-1995.

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

	YEAR,	1961,	1962,	1963,	1964,	1965,
	AGE					
	3,	9051,	13669,	22442,	16207,	22826,
	4,	7741,	7245,	10683,	17818,	12651,
	5,	5645,	5995,	5441,	8438,	12862,
	6,	3882,	4185,	4350,	4147,	5546,
	7,	2681,	2814,	2978,	3186,	2837,
	8,	1747,	1999,	2045,	2071,	2091,
	9,	1385,	1313,	1518,	1491,	1312,
	10,	1036,	1029,	958,	1086,	1059,
	11,	568,	774,	740,	642,	753,
	+gp,	1033,	1141,	2148,	1111,	1368,
0	TOTAL,	34768,	40163,	53303,	56199,	63305,

	YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	
	AGE											
	3,	21863,	26926,	21550,	40867,	34212,	37351,	33711,	23315,	18897,	16679,	
	4,	17787,	17459,	21506,	17088,	32382,	26703,	27996,	25145,	16813,	12301,	
	5,	9588,	13169,	13574,	16080,	12103,	20561,	18862,	21316,	14929,	10032,	
	6,	8985,	6764,	9548,	10103,	11089,	8500,	11780,	13101,	11050,	8593,	
	7,	3668,	5831,	4821,	6826,	6993,	7742,	6049,	7164,	7580,	6528,	
	8,	1861,	2274,	3695,	3451,	4577,	4912,	5589,	3569,	4387,	4938,	
	9,	1344,	1183,	1433,	2433,	2293,	3087,	3597,	3395,	2295,	3012,	
	10,	797,	834,	772,	944,	1467,	1591,	2233,	2025,	2282,	1546,	
	11,	685,	467,	511,	516,	556,	983,	1154,	1156,	1293,	1561,	
	+gp,	982,	670,	1068,	848,	850,	979,	729,	994,	1731,	2400,	
0	TOTAL,	67561,	75576,	78479,	99157,	106522,	112409,	111700,	101180,	81256,	67590,	

	YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
	AGE										
	3,	18821,	12987,	8491,	8740,	12394,	33352,	14773,	41068,	25969,	22248,
	4,	11790,	12534,	9177,	6399,	6896,	9246,	26934,	11745,	31377,	20929,
	5,	7030,	6742,	7604,	5936,	4395,	4852,	5938,	18364,	8618,	15676,
	6,	4774,	4199,	3679,	4655,	3647,	2947,	3277,	3962,	10464,	4921,
	7,	5281,	2778,	2273,	2516,	2877,	2377,	1569,	1675,	2029,	4863,
	8,	4399,	3530,	1580,	1523,	1532,	1698,	1124,	941,	851,	869,
	9,	3397,	3022,	2250,	860,	873,	997,	726,	543,	464,	450,
	10,	2193,	2358,	2023,	1420,	481,	523,	506,	327,	198,	234,
	11,	1092,	1594,	1624,	1229,	735,	239,	254,	319,	179,	115,
	+gp,	2214,	1924,	2120,	2288,	2925,	2624,	2579,	1745,	689,	1207,
0	TOTAL,	60991,	51666,	40822,	35567,	36753,	58854,	57681,	80688,	80837,	71511,

	YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST 61-93	AMST 61-93
	AGE													
	3,	62558,	49090,	45165,	29705,	21796,	26377,	16903,	25996,	9653,	14884,	0,	22566,	25333,
	4,	17108,	50162,	38761,	36195,	23913,	17579,	20663,	13343,	20091,	7279,	11822,	16868,	19275,
	5,	13525,	12199,	35828,	29065,	24222,	16106,	9755,	13044,	8558,	12866,	5029,	11240,	12954,
	6,	7782,	7026,	6525,	20688,	19001,	10664,	6445,	4494,	6431,	4598,	7366,	6648,	7599,
	7,	2960,	2997,	3232,	2823,	10481,	7206,	3716,	2725,	2170,	3123,	2088,	3814,	4305,
	8,	2264,	1561,	1558,	1470,	1594,	3988,	2745,	1735,	1454,	1102,	1482,	2228,	2551,
	9,	465,	879,	796,	713,	710,	873,	1790,	1396,	974,	738,	587,	1318,	1585,
	10,	275,	159,	419,	324,	417,	470,	348,	882,	736,	520,	384,	774,	1006,
	11,	157,	131,	57,	199,	190,	286,	169,	168,	500,	329,	250,	459,	639,
	+gp,	366,	293,	124,	140,	248,	260,	289,	160,	162,	366,	368,		
0	TOTAL,	107460,	124497,	132465,	121322,	102570,	83808,	62823,	63944,	50728,	45804,	29377,		

Table 2.5.11 Saithe in the Faroes (Division Vb). Summary of population statistics, 1961-1995.

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 8,
1961,	9051,	122010.	83823,	9592,	.1144,	.0910,
1962,	13669,	126506,	85664,	10454,	.1220,	.1083,
1963,	22442,	158304,	100670,	12693,	.1261,	.0995,
1964,	16207,	160513,	98427,	21893,	.2224,	.2006,
1965,	22826,	174899,	107278,	22181,	.2068,	.1826,
1966,	21863,	184329,	108865,	25563,	.2348,	.2027,
1967,	26926,	181882,	104748,	21319,	.2035,	.1658,
1968,	21550,	190085,	116119,	20387,	.1756,	.1348,
1969,	40867,	215397,	124001,	27437,	.2213,	.1786,
1970,	34212,	224906,	129406,	29110,	.2250,	.1828,
1971,	37351,	228950,	139838,	32706,	.2339,	.1764,
1972,	33711,	237700,	147985,	42663,	.2883,	.2321,
1973,	23315,	211205,	137174,	57431,	.4187,	.3315,
1974,	18897,	204825,	138238,	47188,	.3414,	.2799,
1975,	16679,	188642,	138643,	41576,	.2999,	.3115,
1976,	18821,	170905,	122857,	33065,	.2691,	.2788,
1977,	12987,	157661,	115162,	34835,	.3025,	.3468,
1978,	8491,	138749,	97142,	28138,	.2897,	.2629,
1979,	8740,	114691,	84919,	27246,	.3208,	.2796,
1980,	12394,	127544,	91016,	25230,	.2772,	.2271,
1981,	33352,	143853,	77862,	30103,	.3866,	.4127,
1982,	14773,	150535,	84201,	30964,	.3677,	.3395,
1983,	41068,	183627,	106104,	39176,	.3692,	.3853,
1984,	25969,	189381,	103135,	54665,	.5300,	.5012,
1985,	22248,	191164,	119829,	44605,	.3722,	.4072,
1986,	62558,	236467,	106138,	41716,	.3930,	.5066,
1987,	49090,	252554,	104790,	40020,	.3819,	.4131,
1988,	45165,	261947,	112050,	45285,	.4041,	.4487,
1989,	29705,	232307,	109147,	44477,	.4075,	.3614,
1990,	21796,	195993,	102361,	61561,	.6014,	.5508,
1991,	26377,	157385,	80783,	54863,	.6791,	.6651,
1992,	16903,	128679,	70081,	38366,	.5475,	.5068,
1993,	25996,	139323,	73861,	33481,	.4533,	.4169,
1994,	9653,	123166,	71560,	33187,	.4638,	.4291,
1995,	14884,	111253,	66382,	27480,	.4140,	.4183,
Arith. Mean ,	24587,	177638,	104579,	34019,	.3333,	.3153,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.5.12

Saithe in the Faroes Grounds (Fishing Area Vb)

Prediction with management option table: Input data

Year: 1996								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	16850.000	0.2000	0.1300	0.0000	0.0000	1.456	0.0560	1.456
4	11822.000	0.2000	0.3400	0.0000	0.0000	2.060	0.2180	2.060
5	5029.000	0.2000	0.6400	0.0000	0.0000	2.709	0.4260	2.709
6	7366.000	0.2000	0.8400	0.0000	0.0000	3.188	0.5430	3.188
7	2088.000	0.2000	0.9500	0.0000	0.0000	3.886	0.4810	3.886
8	1482.000	0.2000	0.9900	0.0000	0.0000	4.794	0.4250	4.794
9	587.000	0.2000	1.0000	0.0000	0.0000	6.018	0.4370	6.018
10	384.000	0.2000	1.0000	0.0000	0.0000	6.366	0.4980	6.366
11	250.000	0.2000	1.0000	0.0000	0.0000	7.206	0.4230	7.206
12+	368.000	0.2000	1.0000	0.0000	0.0000	8.072	0.4230	8.072
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	16850.000	0.2000	0.1300	0.0000	0.0000	1.456	0.0560	1.456
4	.	0.2000	0.3000	0.0000	0.0000	2.060	0.2180	2.060
5	.	0.2000	0.5600	0.0000	0.0000	2.709	0.4260	2.709
6	.	0.2000	0.8100	0.0000	0.0000	3.188	0.5430	3.188
7	.	0.2000	0.9400	0.0000	0.0000	3.886	0.4810	3.886
8	.	0.2000	0.9900	0.0000	0.0000	4.794	0.4250	4.794
9	.	0.2000	1.0000	0.0000	0.0000	6.018	0.4370	6.018
10	.	0.2000	1.0000	0.0000	0.0000	6.366	0.4980	6.366
11	.	0.2000	1.0000	0.0000	0.0000	7.206	0.4230	7.206
12+	.	0.2000	1.0000	0.0000	0.0000	8.072	0.4230	8.072
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	16850.000	0.2000	0.1300	0.0000	0.0000	1.456	0.0560	1.456
4	.	0.2000	0.3000	0.0000	0.0000	2.060	0.2180	2.060
5	.	0.2000	0.5600	0.0000	0.0000	2.709	0.4260	2.709
6	.	0.2000	0.8100	0.0000	0.0000	3.188	0.5430	3.188
7	.	0.2000	0.9400	0.0000	0.0000	3.886	0.4810	3.886
8	.	0.2000	0.9900	0.0000	0.0000	4.794	0.4250	4.794
9	.	0.2000	1.0000	0.0000	0.0000	6.018	0.4370	6.018
10	.	0.2000	1.0000	0.0000	0.0000	6.366	0.4980	6.366
11	.	0.2000	1.0000	0.0000	0.0000	7.206	0.4230	7.206
12+	.	0.2000	1.0000	0.0000	0.0000	8.072	0.4230	8.072
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANJAK05
Date and time: 19MAY96:16:58

Table 2.5.13

16:48 Sunday, May 19, 1996

Saithe in the Faroes Grounds (Fishing Area Vb)

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4186	111961	65405	27459	0.0000	0.0000	110547	58619	0	139134	80656
.	.	.	.	.	0.1000	0.0419	.	58619	3054	135780	77882
.	.	.	.	.	0.2000	0.0837	.	58619	5991	132558	75225
.	.	.	.	.	0.3000	0.1256	.	58619	8816	129460	72678
.	.	.	.	.	0.4000	0.1674	.	58619	11535	126483	70237
.	.	.	.	.	0.5000	0.2093	.	58619	14151	123619	67897
.	.	.	.	.	0.6000	0.2512	.	58619	16669	120866	65654
.	.	.	.	.	0.7000	0.2930	.	58619	19093	118218	63503
.	.	.	.	.	0.8000	0.3349	.	58619	21427	115670	61440
.	.	.	.	.	0.9000	0.3767	.	58619	23674	113219	59462
.	.	.	.	.	1.0000	0.4186	.	58619	25839	110860	57565
.	.	.	.	.	1.1000	0.4605	.	58619	27924	108589	55745
.	.	.	.	.	1.2000	0.5023	.	58619	29934	106403	53999
.	.	.	.	.	1.3000	0.5442	.	58619	31870	104298	52324
.	.	.	.	.	1.4000	0.5860	.	58619	33737	102271	50716
.	.	.	.	.	1.5000	0.6279	.	58619	35537	100318	49173
.	.	.	.	.	1.6000	0.6698	.	58619	37273	98437	47692
.	.	.	.	.	1.7000	0.7116	.	58619	38947	96624	46270
.	.	.	.	.	1.8000	0.7535	.	58619	40562	94876	44904
.	.	.	.	.	1.9000	0.7953	.	58619	42120	93192	43593
.	.	.	.	.	2.0000	0.8372	.	58619	43624	91567	42334
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANJAK05
Date and time : 19MAY96:16:58
Computation of ref. F: Simple mean, age 4 - 8
Basis for 1996 : F factors

Table 2.5.14

Saithe in the Faroes Grounds (Fishing Area Vb)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.2000	0.1300	0.0000	0.0000	1.304	0.0560	1.304
4	.	0.2000	0.3000	0.0000	0.0000	1.851	0.2180	1.851
5	.	0.2000	0.5600	0.0000	0.0000	2.535	0.4260	2.535
6	.	0.2000	0.8100	0.0000	0.0000	3.313	0.5430	3.313
7	.	0.2000	0.9400	0.0000	0.0000	4.200	0.4810	4.200
8	.	0.2000	0.9900	0.0000	0.0000	5.118	0.4250	5.118
9	.	0.2000	1.0000	0.0000	0.0000	5.866	0.4370	5.866
10	.	0.2000	1.0000	0.0000	0.0000	6.550	0.4980	6.550
11	.	0.2000	1.0000	0.0000	0.0000	7.403	0.4230	7.403
12+	.	0.2000	1.0000	0.0000	0.0000	8.946	0.4230	8.946
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDANI01
Date and time: 07MAY96:21:41

Table 2.5.15

21:28 Tuesday, May 7, 1996

Saithe in the Faroes Grounds (Fishing Area Vb)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	23141.420	3.644	19720.916	3.644	19720.916
0.1000	0.0419	0.142	643.952	4.807	18020.571	2.956	14665.771	2.956	14665.771
0.2000	0.0837	0.241	1006.856	4.315	14677.193	2.485	11383.920	2.485	11383.920
0.3000	0.1256	0.314	1219.753	3.955	12370.719	2.144	9135.173	2.144	9135.173
0.4000	0.1674	0.370	1347.883	3.680	10710.810	1.888	7529.527	1.888	7529.527
0.5000	0.2093	0.414	1426.072	3.463	9474.885	1.689	6344.703	1.689	6344.703
0.6000	0.2512	0.449	1473.888	3.287	8528.286	1.530	5446.312	1.530	5446.312
0.7000	0.2930	0.479	1502.766	3.142	7785.678	1.401	4749.259	1.401	4749.259
0.8000	0.3349	0.504	1519.607	3.020	7190.902	1.294	4197.606	1.294	4197.606
0.9000	0.3767	0.525	1528.681	2.916	6705.825	1.205	3753.411	1.205	3753.411
1.0000	0.4186	0.543	1532.691	2.825	6303.847	1.129	3390.253	1.129	3390.253
1.1000	0.4605	0.560	1533.377	2.746	5965.979	1.063	3089.299	1.063	3089.299
1.2000	0.5023	0.574	1531.881	2.676	5678.383	1.007	2836.856	1.007	2836.856
1.3000	0.5442	0.587	1528.959	2.614	5430.790	0.957	2622.785	0.957	2622.785
1.4000	0.5860	0.598	1525.119	2.558	5215.453	0.913	2439.457	0.913	2439.457
1.5000	0.6279	0.609	1520.705	2.507	5026.441	0.874	2281.046	0.874	2281.046
1.6000	0.6698	0.619	1515.952	2.461	4859.148	0.839	2143.047	0.839	2143.047
1.7000	0.7116	0.627	1511.019	2.419	4709.960	0.807	2021.931	0.807	2021.931
1.8000	0.7535	0.636	1506.019	2.380	4575.999	0.779	1914.904	0.779	1914.904
1.9000	0.7953	0.643	1501.024	2.344	4454.958	0.753	1819.731	0.753	1819.731
2.0000	0.8372	0.650	1496.087	2.310	4344.965	0.729	1734.608	0.729	1734.608
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDANI01
Date and time : 07MAY96:21:41
Computation of ref. F: Simple mean, age 4 - 8
F-0.1 factor : 0.4287
F-max factor : 1.0754
F-0.1 reference F : 0.1794
F-max reference F : 0.4502
Recruitment : Single recruit

Table 3.2.1 Nominal catch (tonnes) of SAITHE in Division Va, by countries, 1981–1995, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	19
Belgium	532	201	224	269	158	218	217	2
Faroe Islands	3,545	3,582	2,138	2,044	1,778	783	2,139	2,5
France	-	23	-	-	-	-	-	
Iceland	54,921	65,124	55,904	60,406	55,135	63,867	78,175	74,3
Norway	3	1	+	-	1	-	-	
UK (Engl. and Wales)	-	-	-	-	29	-	-	
Total	59,001	68,931	58,266	62,719	57,101	64,868	80,531	77,2
Working Group estimate	-	-	-	-	-	66,376[2)]	-	

Country	1989	1990	1991	1992	1993	1994	1995[1)]
Belgium	369	190	236	195	104	30	-
Faroe Islands	2,246	2,905	2,690	1,570	1,562	975	1,184
France	-	-	-	-	-	-	
Iceland	79,796	95,032	99,390	77,832	69,982	63,333	47,344
Norway	-	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-
Total	82,411	98,127	102,316	79,597	71,648	64,338	48,528
Working Group estimate	-		102,737[3)]	-			

1) Provisional.

2) Additional catch by Faroe Islands of 1,508 t included.

3) Additional catch by Iceland of 451 t included.

Table 3.2.2

Run title : Saithe Iceland Va (run: SVPBS06/V06)

At 4-May-96 12:06:57

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	329,	59,	548,	480,	275,	203,	508,	107,	53,	376,
4,	3234,	2099,	1145,	3764,	2540,	1325,	1092,	1750,	657,	4014,
5,	3045,	2858,	2435,	1991,	5214,	3503,	2804,	1065,	800,	3366,
6,	2530,	1801,	1556,	3616,	2596,	5404,	4845,	2455,	1825,	1958,
7,	2154,	1036,	1275,	1566,	2169,	1457,	4293,	4454,	2184,	1536,
8,	2367,	1068,	961,	718,	1341,	1415,	1215,	2311,	3610,	1172,
9,	1530,	1528,	537,	292,	387,	578,	975,	501,	844,	747,
10,	1064,	958,	575,	669,	262,	242,	306,	251,	376,	479,
11,	295,	538,	476,	589,	155,	61,	59,	38,	291,	74,
12,	191,	166,	279,	489,	112,	154,	35,	12,	135,	23,
13,	94,	71,	139,	150,	64,	135,	48,	2,	185,	72,
14,	68,	12,	91,	72,	33,	128,	46,	4,	226,	71,
+gp,	18,	49,	55,	0,	58,	141,	99,	174,	190,	291,
TOTALNUM,	16919,	12243,	10072,	14396,	15206,	14746,	16325,	13124,	11376,	14179,
TONSLAND,	82003,	62026,	49672,	63504,	58347,	58986,	68615,	58266,	62719,	57101,
SOPCOF %,	97,	98,	97,	98,	100,	99,	99,	99,	100,	99,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	3108,	956,	1318,	315,	143,	198,	242,	657,	702,	1567,
4,	1400,	5135,	5067,	4313,	1692,	874,	2928,	1083,	2955,	1847,
5,	4170,	4428,	6619,	8471,	5471,	3613,	3844,	2841,	1770,	2652,
6,	2665,	5409,	3678,	7309,	10112,	6844,	4355,	2252,	2603,	1802,
7,	1550,	2915,	2859,	1794,	6174,	10772,	3884,	2247,	1377,	2364,
8,	1116,	1348,	1775,	1928,	1816,	3223,	4046,	2314,	1243,	903,
9,	628,	661,	845,	848,	1087,	858,	1290,	3671,	1263,	573,
10,	1549,	496,	226,	270,	380,	838,	350,	830,	2009,	481,
11,	216,	498,	270,	191,	151,	228,	196,	223,	454,	520,
12,	51,	58,	107,	135,	55,	40,	56,	188,	158,	106,
13,	30,	27,	24,	76,	76,	6,	54,	81,	188,	35,
14,	14,	48,	1,	10,	37,	5,	15,	12,	82,	13,
+gp,	95,	22,	1,	8,	42,	42,	1,	1,	51,	17,
TOTALNUM,	16592,	22001,	22790,	25668,	27236,	27541,	21261,	16400,	14855,	12880,
TONSLAND,	66376,	80559,	77247,	82425,	98130,	102737,	79597,	71648,	64338,	48528,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 3.2.3

Run title : Saithe Iceland Va (run: SVPBS06/V06)

At 4-May-96 12:06:57

Table 2 Catch weights at age (kg)

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	1.1200,	1.1200,	1.1200,	1.1200,	1.4280,	1.5850,	1.5470,	1.5300,	1.6530,	1.6090,
4,	1.7600,	1.7600,	1.7600,	1.7600,	1.9830,	2.0370,	2.1940,	2.2210,	2.4320,	2.1720,
5,	2.7300,	2.7300,	2.7300,	2.7300,	2.6670,	2.6960,	3.0150,	3.1710,	3.3300,	3.1690,
6,	4.2900,	4.2900,	4.2900,	4.2900,	3.6890,	3.5250,	3.1830,	4.2700,	4.6810,	3.9220,
7,	5.5400,	5.5400,	5.5400,	5.5400,	5.4090,	4.5410,	5.1140,	4.1070,	5.4660,	4.6970,
8,	7.2700,	7.2700,	7.2700,	7.2700,	6.3210,	6.2470,	6.2020,	5.9840,	4.9730,	6.4110,
9,	8.4200,	8.4200,	8.4200,	8.4200,	7.2130,	6.9910,	7.2560,	7.5650,	7.4070,	6.4920,
10,	9.4100,	9.4100,	9.4100,	9.4100,	8.5650,	8.2020,	7.9220,	8.6730,	8.1790,	8.3460,
11,	10.0000,	10.0000,	10.0000,	10.0000,	9.1470,	9.5370,	8.9240,	8.8010,	8.7700,	9.4010,
12,	10.5600,	10.5600,	10.5600,	10.5600,	9.6170,	9.0890,	10.1340,	9.0390,	8.8310,	10.3350,
13,	11.8700,	11.8700,	11.8700,	11.8700,	10.0660,	9.3510,	9.4470,	11.1380,	11.0100,	11.0270,
14,	13.1200,	13.1200,	13.1200,	13.1200,	11.0410,	10.2250,	10.5350,	9.8180,	11.1270,	10.6440,
+gp,	14.0000,	14.0000,	14.0000,	13.1200,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,
SOPCOFAC,	.9706,	.9769,	.9691,	.9840,	.9989,	.9933,	.9922,	.9915,	.9975,	.9929,

Table 2 Catch weights at age (kg)

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	1.4500,	1.5160,	1.2610,	1.4030,	1.6470,	1.2240,	1.2690,	1.3810,	1.4440,	1.3700,
4,	2.1900,	1.7150,	2.0170,	2.0210,	1.9830,	1.9390,	1.9090,	2.1430,	1.8360,	1.9770,
5,	2.9590,	2.6700,	2.5130,	2.1940,	2.5660,	2.4320,	2.5780,	2.7420,	2.6490,	2.7700,
6,	4.4020,	3.8390,	3.4760,	3.0470,	3.0210,	3.1600,	3.2880,	3.6360,	3.5120,	3.7230,
7,	5.4880,	5.0810,	4.7190,	4.5050,	4.0770,	3.6340,	4.1500,	4.3980,	4.9060,	4.6210,
8,	6.4060,	6.1850,	5.9320,	5.8890,	5.7440,	4.9670,	4.8650,	5.4210,	5.5390,	5.8540,
9,	7.5700,	7.3300,	7.5230,	7.1720,	7.0380,	6.6290,	6.1680,	5.3190,	6.8180,	6.4160,
10,	6.4870,	8.0250,	8.4390,	8.8520,	7.5640,	7.7040,	7.9260,	7.0060,	6.3740,	7.3560,
11,	9.6160,	7.9740,	8.7480,	10.1700,	8.8540,	9.0610,	8.3490,	8.0700,	8.3410,	6.8150,
12,	10.4620,	9.6150,	9.5590,	10.3920,	10.6450,	9.1170,	9.0290,	10.0480,	9.7700,	8.3120,
13,	11.7470,	12.2460,	10.8240,	12.5220,	11.6740,	10.9220,	11.5740,	9.1060,	10.5280,	9.1190,
14,	11.9020,	11.6560,	14.0990,	11.9230,	11.4310,	11.3420,	9.4660,	11.5910,	11.2570,	11.9100,
+gp,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,
SOPCOFAC,	.9987,	1.0005,	.9999,	.9998,	1.0005,	.9999,	1.0002,	1.0013,	1.0018,	1.0027,

Table 3.2.4 Icelandic Saithe. Maturity at age, data and fitted values.

Fitted:

Year/age	3	4	5	6	7	8	9
1980	0.1168	0.164	0.3355	0.6483	0.7869	0.9033	0.9568
1981	0.1313	0.2354	0.3135	0.5403	0.811	0.8958	0.9561
1982	0.1275	0.2635	0.4174	0.5153	0.7323	0.909	0.9524
1983	0.1085	0.2539	0.4543	0.6252	0.7122	0.8643	0.9588
1984	0.0865	0.2207	0.442	0.6597	0.7952	0.8521	0.9368
1985	0.1069	0.1807	0.3973	0.6483	0.8186	0.9004	0.9306
1986	0.0588	0.2178	0.3392	0.6055	0.811	0.9131	0.9546
1987	0.0326	0.1269	0.3933	0.5444	0.7813	0.909	0.9607
1988	0.0754	0.0727	0.2528	0.6015	0.7356	0.8927	0.9588
1989	0.1101	0.1595	0.1543	0.4405	0.7784	0.8662	0.9517
1990	0.1257	0.2236	0.3064	0.2981	0.647	0.891	0.9378
1991	0.1101	0.2507	0.4013	0.507	0.4972	0.8101	0.9501
1992	0.1332	0.2236	0.4379	0.6094	0.7053	0.6971	0.9085
1993	0.1085	0.2635	0.4013	0.6445	0.7841	0.8478	0.8427
1994	0.0977	0.2207	0.4543	0.6094	0.8085	0.8942	0.9284
1995	0.0977	0.2013	0.3973	0.6597	0.7841	0.9076	0.9517

Data:

Year/age	3	4	5	6	7	8	9
1980	0	0.05	0.21	0.53	0.9	0.98	0.99
1981	0.04	0.06	0.32	0.6	0.76	0.97	1
1982	0	0	0.31	0.53	0.77	0.84	1
1983	0.33	0.5	0.45	0.86	0.54	0.97	0.97
1984	0.39	0.14	0.4	0.77	0.91	0.79	0.99
1985	0	0.76	0.62	0.65	0.67	0.82	0.84
1986	0	0.01	0.1	0.71	0.9	0.79	0.82
1987	0	0	0.13	0.52	0.73	0.97	0.98
1988	0	0.01	0.09	0.2	0.79	0.79	1
1989	0	0.04	0.13	0.38	0.79	0.97	0.99
1990	0	0.1	0.36	0.45	0.75	0.9	1
1991	0	0.06	0.24	0.42	0.4	0.58	0.79
1992	0	0.16	0.44	0.6	0.73	0.78	0.95
1993	0.14	0.54	0.82	0.94	0.96	0.99	0.95
1994	0	0.68	0.92	0.97	0.99	0.99	1
1995	0.24	0.49	0.46	0.41	0.41	0.55	0.7

Table 3.2.5

Run title : Saithe Iceland Va (run: SVPBS06/V06)

At 4-May-96 12:06:57

Table 5 Proportion mature at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.1200,	.1300,	.1300,	.1100,	.0900,	.1100,
4,	.0600,	.0600,	.0600,	.0600,	.1600,	.2400,	.2600,	.2500,	.2200,	.1800,
5,	.2700,	.2700,	.2700,	.2700,	.3400,	.3100,	.4200,	.4500,	.4400,	.4000,
6,	.6300,	.6300,	.6300,	.6300,	.6500,	.5400,	.5200,	.6300,	.6600,	.6500,
7,	.8100,	.8100,	.8100,	.8100,	.7700,	.8100,	.7300,	.7100,	.8000,	.8200,
8,	.9700,	.9700,	.9700,	.9700,	.9000,	.9000,	.9100,	.8600,	.8600,	.9000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	.9600,	.9600,	.9500,	.9600,	.9400,	.9300,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	.0600,	.0300,	.0800,	.1100,	.1300,	.1100,	.1300,	.1100,	.1000,	.2000,
4,	.2200,	.1300,	.0700,	.1600,	.2200,	.2500,	.2200,	.2600,	.2200,	.3800,
5,	.3400,	.3900,	.2500,	.1500,	.3100,	.4000,	.4400,	.4000,	.4500,	.6600,
6,	.6100,	.5400,	.6000,	.4400,	.3000,	.5100,	.6100,	.6400,	.6100,	.7800,
7,	.8100,	.7800,	.7400,	.7800,	.6500,	.4800,	.7100,	.7800,	.8100,	.9100,
8,	.9100,	.9100,	.8900,	.8700,	.8900,	.8100,	.7000,	.8500,	.8900,	.9500,
9,	.9500,	.9600,	.9600,	.9500,	.9400,	.9500,	.9100,	.8400,	.9300,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.2.6

09:00 Friday, May 3, 1996

SAI-ICEL: Saithe in the Iceland Grounds (Fishing Area Va)

FLT04: TRW EFFORT

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13
1980	26	275	2534	5153	2320	1525	704	176	154	101	67	132
1981	23	203	1325	3499	5232	1117	384	127	98	6	13	37
1982	26	508	1092	2483	4404	1857	400	181	92	26	29	176
1983	29	103	1589	996	1991	3563	1106	196	61	1	1	307
1984	35	53	657	680	1463	981	2705	331	361	279	135	616
1985	34	376	3934	3145	1765	1204	672	488	266	21	1	361
1986	32	3104	1370	4021	1965	1121	552	343	536	145	42	118
1987	43	956	5116	4289	4805	2008	842	337	239	141	27	85
1988	46	1318	5066	6596	3526	2368	959	447	90	127	35	19
1989	50	315	4302	8328	6944	1279	774	434	171	137	112	103
1990	62	143	1681	5378	9655	5381	1099	571	217	127	41	146
1991	59	191	848	3542	6664	10126	2484	496	575	152	20	5
1992	47	242	2928	3712	4167	3480	3184	895	231	96	24	49
1993	36	631	963	2509	1911	1649	1251	2206	458	105	132	67
1994	35	678	2830	1623	1944	715	602	616	1216	274	91	199
1995	27	1565	1812	2443	1484	1630	461	250	200	235	54	30

09:00 Friday, May 3, 1996

SAI-ICEL: Saithe in the Iceland Grounds (Fishing Area Va)

FLT06: TRW CPU JAN.- MAY

Year	Fishing effort	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11
1980	100	0.0534	0.1119	0.0512	0.0280	0.0191	0.0040	0.0066	0.0052
1981	100	0.0279	0.1012	0.2176	0.0473	0.0140	0.0035	0.0013	0.0003
1982	100	0.0213	0.1374	0.0556	0.0638	0.0262	0.0164	0.0033	0.0016
1983	100	0.0095	0.0278	0.0723	0.1359	0.0380	0.0037	0.0007	0.0000
1984	100	0.0394	0.0516	0.0446	0.0298	0.0840	0.0053	0.0026	0.0000
1985	100	0.0095	0.0589	0.0364	0.0524	0.0349	0.0182	0.0044	0.0007
1986	100	0.0277	0.2478	0.0703	0.0203	0.0018	0.0000	0.0018	0.0000
1987	100	0.1257	0.0864	0.1132	0.0440	0.0149	0.0039	0.0031	0.0016
1988	100	0.0189	0.1013	0.0774	0.0700	0.0280	0.0206	0.0049	0.0074
1989	100	0.0097	0.0434	0.1263	0.0531	0.0381	0.0179	0.0060	0.0022
1990	100	0.0211	0.0484	0.1039	0.0899	0.0192	0.0123	0.0062	0.0052
1991	100	0.0059	0.0387	0.0783	0.1292	0.0412	0.0135	0.0126	0.0042
1992	100	0.0235	0.0483	0.0713	0.0736	0.0734	0.0185	0.0037	0.0016
1993	100	0.0048	0.0242	0.0546	0.0710	0.0520	0.0480	0.0112	0.0026
1994	100	0.0369	0.0316	0.0632	0.0298	0.0265	0.0222	0.0392	0.0056
1995	100	0.0278	0.0421	0.0421	0.0603	0.0194	0.0090	0.0081	0.0096

09:00 Friday, May 3, 1996

SAI-ICEL: Saithe in the Iceland Grounds (Fishing Area Va)

FLT08: TRW CPU JUNE - DES.

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12
1980	100	0.0007	0.0203	0.0721	0.0413	0.0518	0.0243	0.0105	0.0098	0.0058	0.0040
1981	100	0.0114	0.0517	0.1159	0.1249	0.0270	0.0098	0.0031	0.0023	0.0000	0.0008
1982	100	0.0098	0.0242	0.0600	0.1590	0.0585	0.0103	0.0025	0.0015	0.0003	0.0008
1983	100	0.0045	0.1260	0.0386	0.0379	0.0932	0.0186	0.0013	0.0006	0.0000	0.0000
1984	100	0.0019	0.0139	0.0057	0.0368	0.0152	0.0780	0.0063	0.0082	0.0076	0.0038
1985	100	0.0105	0.1504	0.0900	0.0561	0.0197	0.0055	0.0105	0.0055	0.0000	0.0000
1986	100	0.0716	0.0284	0.0734	0.0400	0.0248	0.0144	0.0122	0.0160	0.0077	0.0025
1987	100	0.0236	0.0721	0.0676	0.0575	0.0409	0.0216	0.0112	0.0070	0.0039	0.0008
1988	100	0.0173	0.1087	0.1042	0.0592	0.0343	0.0159	0.0048	0.0007	0.0007	0.0003
1989	100	0.0022	0.0557	0.1058	0.0947	0.0156	0.0118	0.0088	0.0037	0.0033	0.0028
1990	100	0.0047	0.0305	0.0928	0.1423	0.0435	0.0064	0.0022	0.0006	0.0006	0.0000
1991	100	0.0026	0.0118	0.0440	0.0875	0.1380	0.0353	0.0041	0.0041	0.0002	0.0000
1992	100	0.0027	0.0505	0.0703	0.0687	0.0550	0.0530	0.0142	0.0023	0.0011	0.0002
1993	100	0.0142	0.0232	0.0628	0.0383	0.0261	0.0211	0.0540	0.0105	0.0023	0.0008
1994	100	0.0200	0.0432	0.0324	0.0381	0.0162	0.0140	0.0127	0.0386	0.0057	0.0030
1995	100	0.0875	0.0322	0.0536	0.0322	0.0349	0.0115	0.0089	0.0063	0.0066	0.0030

Table 3.2.7

Lowestoft VPA Version 3.1

2-May-96 15:48:56

Extended Survivors Analysis

Saithe Iceland Va (run: XSABS07/X07)

CPUE data from file /users/fish/ifad/ifapwork/nwwg/sai_icel/FLEET.X07

Catch data for 20 years. 1976 to 1995. Ages 3 to 13.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT04: TRW EFFORT (C,	1985,	1995,	3,	12,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 11

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 29 iterations

Regression weights

,	.751,	.820,	.877,	.921,	.954,	.976,	.990,	.997,	1.000,	1.000

Fishing mortalities

Age,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
3,	.047,	.010,	.026,	.011,	.007,	.007,	.013,	.018,	.017,	.021
4,	.056,	.103,	.065,	.111,	.073,	.052,	.131,	.072,	.102,	.058
5,	.179,	.254,	.188,	.147,	.201,	.220,	.337,	.181,	.162,	.126
6,	.242,	.372,	.347,	.327,	.262,	.415,	.450,	.338,	.251,	.246
7,	.329,	.456,	.344,	.284,	.509,	.493,	.441,	.444,	.357,	.380
8,	.490,	.534,	.562,	.413,	.521,	.551,	.346,	.516,	.474,	.421
9,	.341,	.612,	.778,	.580,	.434,	.503,	.445,	.612,	.598,	.418
10,	.960,	.497,	.434,	.615,	.563,	.717,	.393,	.580,	.831,	.480
11,	.837,	1.003,	.558,	.824,	.869,	.808,	.356,	.470,	.746,	.526
12,	.629,	.561,	.604,	.610,	.598,	.594,	.467,	.695,	.733,	.380

Table 3.2.7 (continued)

XSA population numbers (Thousands)

YEAR	AGE 3	4	5	6	7	8	9	10		
1986	7.40E+04	2.82E+04	2.81E+04	1.37E+04	6.11E+03	3.18E+03	2.40E+03	2.77E+03	4.21E+02	1.21E+02
1987	1.10E+05	5.78E+04	2.18E+04	1.92E+04	8.79E+03	3.60E+03	1.60E+03	1.40E+03	8.69E+02	1.49E+02
1988	5.69E+04	8.94E+04	4.27E+04	1.39E+04	1.09E+04	4.56E+03	1.73E+03	7.09E+02	6.98E+02	2.61E+02
1989	3.28E+04	4.54E+04	6.86E+04	2.90E+04	8.02E+03	6.30E+03	2.13E+03	6.49E+02	3.76E+02	3.27E+02
1990	2.35E+04	2.66E+04	3.32E+04	4.85E+04	1.71E+04	4.94E+03	3.41E+03	9.75E+02	2.87E+02	1.35E+02
1991	3.25E+04	1.91E+04	2.02E+04	2.23E+04	3.06E+04	8.41E+03	2.40E+03	1.81E+03	4.55E+02	9.87E+01
1992	2.13E+04	2.64E+04	1.48E+04	1.33E+04	1.20E+04	1.53E+04	3.97E+03	1.19E+03	7.23E+02	1.66E+02
1993	4.18E+04	1.72E+04	1.90E+04	8.68E+03	6.93E+03	6.34E+03	8.86E+03	2.08E+03	6.57E+02	4.15E+02
1994	4.50E+04	3.36E+04	1.31E+04	1.30E+04	5.07E+03	3.64E+03	3.10E+03	3.94E+03	9.55E+02	3.36E+02
1995	8.16E+04	3.62E+04	2.48E+04	9.12E+03	8.27E+03	2.90E+03	1.85E+03	1.40E+03	1.40E+03	3.71E+02

Estimated population abundance at 1st Jan 1996

, .00E+00, 6.54E+04, 2.80E+04, 1.79E+04, 5.84E+03, 4.63E+03, 1.56E+03, 1.00E+03, 7.07E+02, 6.79E+02,

Taper weighted geometric mean of the VPA populations:

, 4.13E+04, 3.12E+04, 2.30E+04, 1.53E+04, 9.43E+03, 5.12E+03, 2.61E+03, 1.26E+03, 5.25E+02, 1.91E+02,

Standard error of the weighted Log(VPA populations) :

, .5100, .4811, .4949, .5221, .5194, .4990, .5265, .5962, .6239, .7162,

Log catchability residuals.

Fleet : FLT04: TRW EFFORT (C

Age	1985
3	.13
4	.62
5	.23
6	.02
7	.16
8	-.03
9	-.42
10	.43
11	-.77
12	-2.44

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	.53	-.65	.15	-.10	-.30	-.45	.22	.19	.17	.16
4	-.09	.23	-.30	.16	-.48	-.80	.38	-.06	.39	.11
5	.21	.27	-.07	-.42	-.32	-.18	.45	.01	-.03	-.02
6	-.17	.15	.09	-.06	-.50	.03	.32	.18	-.21	.13
7	.04	.02	-.14	-.57	.00	.09	.16	.24	-.30	.31
8	.18	.20	.04	-.65	-.22	.12	-.09	.20	.03	.23
9	-.09	.12	.33	-.08	-.55	-.26	.03	.47	.26	.06
10	.32	-.29	-.69	.04	-.37	.11	-.30	.17	.65	-.01
11	.78	-.20	-.34	.39	.38	.13	-.77	-.26	.47	.10
12	.70	-.28	-.62	.23	-.11	-.46	-.63	.52	.41	-.11

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

Age	4	5	6	7	8	9	10	11	12
Mean Log q	-6.2727	-5.4345	-5.0238	-4.9494	-5.0699	-5.0619	-4.9073	-4.8387	-4.8387
S.E(Log q)	.4170	.2649	.2326	.2594	.2604	.3144	.3906	.4917	.8096

Table 3.2.7 (continued)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
3,	.53,	2.057,	9.27,	.70,	11,	.36,	-8.00,

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4,	.82,	.759,	7.03,	.68,	11,	.35,	-6.27,
5,	1.53,	-2.308,	2.98,	.71,	11,	.33,	-5.43,
6,	1.38,	-2.376,	3.24,	.83,	11,	.26,	-5.02,
7,	.92,	.494,	5.27,	.84,	11,	.25,	-4.95,
8,	1.20,	-.946,	4.38,	.74,	11,	.31,	-5.07,
9,	.92,	.401,	5.29,	.76,	11,	.30,	-5.06,
10,	.67,	2.897,	5.69,	.90,	11,	.19,	-4.91,
11,	1.06,	-.175,	4.75,	.52,	11,	.55,	-4.84,
12,	.55,	2.287,	5.15,	.77,	11,	.36,	-5.04,

Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	76444.,	.406,	.000,	.00,	1,	.417,	.018
P shrinkage mean ,	31199.,	.48,,,,				.303,	.044
F shrinkage mean ,	115143.,	.50,,,,				.280,	.012

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
65364.,	.26,	.38,	3,	1.445,	.021

Table 3.2.7 (continued)

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	32328.,	.286,	.032,	.11,	2,	.740,	.050
F shrinkage mean ,	18555.,	.50,,,,				.260,	.086

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
27985.,	.25,	.20,	3,	.809,	.058

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	20367.,	.207,	.117,	.56,	3,	.829,	.111
F shrinkage mean ,	9696.,	.50,,,,				.171,	.221

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17943.,	.19,	.20,	4,	1.027,	.126

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	6239.,	.172,	.060,	.35,	4,	.853,	.232
F shrinkage mean ,	3954.,	.50,,,,				.147,	.345

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5835.,	.16,	.10,	5,	.607,	.246

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	4806.,	.153,	.137,	.89,	5,	.851,	.368
F shrinkage mean ,	3742.,	.50,,,,				.149,	.452

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4630.,	.15,	.12,	6,	.805,	.380

Table 3.2.7 (continued)

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	1614.,	.147,	.148,	1.01,	6,	.840,	.410
F shrinkage mean ,	1308.,	.50,,,,				.160,	.485

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1561.,	.15,	.13,	7,	.874,	.421

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	1063.,	.148,	.068,	.46,	7,	.820,	.397
F shrinkage mean ,	756.,	.50,,,,				.180,	.523

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1000.,	.15,	.08,	8,	.523,	.418

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	786.,	.159,	.057,	.36,	8,	.763,	.441
F shrinkage mean ,	504.,	.50,,,,				.237,	.622

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
707.,	.17,	.09,	9,	.529,	.480

Age 11 Catchability constant w.r.t. time and dependent on age

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	785.,	.179,	.130,	.73,	9,	.668,	.470
F shrinkage mean ,	508.,	.50,,,,				.332,	.656

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
679.,	.20,	.13,	10,	.638,	.526

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT (C,	237.,	.195,	.067,	.35,	10,	.607,	.340
F shrinkage mean ,	170.,	.50,,,,				.393,	.448

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
208.,	.23,	.08,	11,	.361,	.380

Table 3.2.8

```
Lowestoft VPA Version 3.1

   2-May-96  16:20:47

Extended Survivors Analysis

Saithe Iceland Va (run: XSABS08/X08)

CPUE data from file /users/fish/ifad/ifapwork/nwwg/sai_icel/FLEET.X08

Catch data for  20 years. 1976 to 1995. Ages  3 to  13.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                  ,     year, year,  age ,  age
FLT06: TRW CPU JAN.-,   1985, 1995,    4,    11,   .000,   .420
FLT08: TRW CPU JUNE ,   1985, 1995,    3,    12,   .420,  1.000


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years


Catchability analysis :

     Catchability dependent on stock size for ages <    4

        Regression type = C
        Minimum of   5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  4


     Catchability independent of age for ages >=   11


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning converged after   31 iterations
```

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


Fishing mortalities
   Age, 1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994,  1995

     3, .047,  .010,  .026,  .010,  .007,  .007,  .014,  .020,  .020,  .021
     4, .056,  .103,  .065,  .111,  .071,  .050,  .129,  .078,  .120,  .066
     5, .179,  .253,  .188,  .147,  .200,  .214,  .324,  .179,  .177,  .151
     6, .242,  .372,  .345,  .327,  .263,  .414,  .432,  .319,  .247,  .276
     7, .327,  .455,  .344,  .282,  .509,  .497,  .439,  .416,  .330,  .372
     8, .488,  .529,  .559,  .412,  .515,  .551,  .350,  .513,  .428,  .375
     9, .330,  .607,  .764,  .575,  .432,  .493,  .445,  .625,  .593,  .358
    10, .963,  .473,  .429,  .594,  .554,  .712,  .382,  .580,  .868,  .472
    11, .842, 1.009,  .514,  .806,  .807,  .783,  .352,  .449,  .745,  .574
    12, .563,  .568,  .612,  .528,  .572,  .513,  .441,  .682,  .674,  .379
```

Table 3.2.8 (continued)

XSA population numbers (Thousands)

YEAR	AGE 3	4	5	6	7	8	9	10		
1986	7.41E+04	2.83E+04	2.81E+04	1.37E+04	6.14E+03	3.19E+03	2.47E+03	2.77E+03	4.19E+02	1.31E+02
1987	1.10E+05	5.78E+04	2.19E+04	1.93E+04	8.81E+03	3.62E+03	1.60E+03	1.46E+03	8.66E+02	1.48E+02
1988	5.69E+04	8.91E+04	4.27E+04	1.39E+04	1.09E+04	4.58E+03	1.75E+03	7.16E+02	7.43E+02	2.58E+02
1989	3.36E+04	4.54E+04	6.84E+04	2.90E+04	8.07E+03	6.31E+03	2.14E+03	6.66E+02	3.82E+02	3.64E+02
1990	2.43E+04	2.72E+04	3.33E+04	4.83E+04	1.71E+04	4.98E+03	3.42E+03	9.87E+02	3.01E+02	1.40E+02
1991	3.28E+04	1.97E+04	2.08E+04	2.23E+04	3.04E+04	8.41E+03	2.44E+03	1.82E+03	4.64E+02	1.10E+02
1992	1.97E+04	2.67E+04	1.54E+04	1.37E+04	1.21E+04	1.51E+04	3.97E+03	1.22E+03	7.30E+02	1.74E+02
1993	3.59E+04	1.59E+04	1.92E+04	9.11E+03	7.30E+03	6.37E+03	8.73E+03	2.08E+03	6.81E+02	4.20E+02
1994	3.97E+04	2.88E+04	1.20E+04	1.31E+04	5.42E+03	3.94E+03	3.12E+03	3.83E+03	9.55E+02	3.56E+02
1995	8.32E+04	3.18E+04	2.09E+04	8.25E+03	8.41E+03	3.19E+03	2.10E+03	1.41E+03	1.32E+03	3.71E+02

Estimated population abundance at 1st Jan 1996

, .00E+00, 6.59E+04, 2.19E+04, 1.41E+04, 5.04E+03, 4.80E+03, 1.78E+03, 1.21E+03, 7.23E+02, 6.11E+02,

Taper weighted geometric mean of the VPA populations:

, 4.04E+04, 3.05E+04, 2.27E+04, 1.53E+04, 9.55E+03, 5.21E+03, 2.65E+03, 1.28E+03, 5.33E+02, 2.00E+02,

Standard error of the weighted Log(VPA populations) :

, .5175, .4829, .4995, .5249, .5071, .4818, .5143, .5859, .6076, .6945,

Log catchability residuals.

Fleet : FLT06: TRW CPU JAN.-

Age	1985
3	No data for this fleet at this age
4	-.82
5	.27
6	-.19
7	.44
8	.50
9	-.26
10	-.09
11	-.68
12	No data for this fleet at this age

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	.55	1.36	-.98	-.96	.32	-.64	.46	-.62	.83	.44
5	1.39	.60	.08	-1.25	-.41	-.16	.39	-.56	.18	-.10
6	.11	.28	.21	-.03	-.75	-.23	.16	.28	.05	.11
7	-.61	-.17	.06	.07	-.11	-.32	.03	.49	-.10	.18
8	-2.13	-.14	.27	.22	-.21	.04	-.01	.55	.33	.22
9	99.99	-.76	.85	.47	-.41	.04	-.14	.06	.31	-.25
10	-1.91	-.82	.34	.64	.27	.40	-.49	.12	.82	.17
11	99.99	-1.01	.58	.09	1.19	.54	-.97	-.39	.10	.28
12	No data for this fleet at this age									

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

Age	4	5	6	7	8	9	10	11
Mean Log q	-18.9368	-17.5541	-16.8066	-16.5090	-16.7202	-16.6058	-16.7032	-16.5559
S.E(Log q)	.8083	.6612	.3086	.3046	.6856	.4541	.7458	.7183

Table 3.2.8 (continued)

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4,	1.09,	-.138,	19.69,	.24,	11,	.93,	-18.94,
5,	2.53,	-1.438,	28.99,	.10,	11,	1.58,	-17.55,
6,	1.70,	-2.959,	21.78,	.69,	11,	.38,	-16.81,
7,	1.23,	-.964,	18.20,	.69,	11,	.38,	-16.51,
8,	.75,	.685,	14.67,	.48,	11,	.53,	-16.72,
9,	1.08,	-.215,	17.26,	.53,	10,	.52,	-16.61,
10,	1.33,	-.524,	19.83,	.24,	11,	1.04,	-16.70,
11,	1.45,	-.626,	21.08,	.21,	10,	1.08,	-16.56,

Fleet : FLT08: TRW CPU JUNE

Age	1985
3	.12
4	1.13
5	.46
6	.40
7	-.01
8	-.94
9	-.45
10	.57
11	99.99
12	99.99

Age	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995
3	1.32,	-.22,	.14,	-1.40,	-.32,	-1.22,	-.66,	.40,	.64,	1.38
4	-.27,	-.02,	-.07,	-.03,	-.15,	-.79,	.42,	.12,	.18,	-.25
5	-.08,	.14,	-.14,	-.62,	.01,	-.26,	.59,	.15,	-.05,	-.11
6	-.30,	-.18,	.15,	-.12,	-.27,	.12,	.38,	.12,	-.30,	.02
7	.10,	.33,	-.13,	-.67,	-.24,	.34,	.30,	.04,	-.20,	.16
8	.41,	.72,	.20,	-.52,	-.82,	.39,	.07,	.12,	.13,	.11
9	.31,	.85,	.03,	.30,	-1.65,	-.65,	.07,	.74,	.30,	.18
10	.83,	.31,	-1.31,	.54,	-1.70,	-.28,	-.69,	.43,	1.32,	.23
11	1.92,	.63,	-1.27,	1.15,	-.32,	-1.87,	-.91,	-.04,	.73,	.44
12	1.77,	.51,	-1.00,	.84,	99.99,	99.99,	-1.12,	-.45,	1.03,	.78

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

Age ,	4,	5,	6,	7,	8,	9,	10,	11,	12
Mean Log q,	-17.9678,	-17.1186,	-16.7439,	-16.7546,	-16.8470,	-16.7640,	-16.6885,	-16.7089,	-16.7089,
S.E(Log q),	.4517,	.3305,	.2508,	.3062,	.5037,	.7155,	.9381,	1.1417,	1.0654,

Table 3.2.8 (continued)

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
3,	.51,	1.939,	15.17,	.66,	11,	.41,	-19.59,

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
4,	.87,	.449,	17.01,	.61,	11,	.41,	-17.97,
5,	1.75,	-2.359,	22.36,	.56,	11,	.47,	-17.12,
6,	1.26,	-1.396,	18.56,	.79,	11,	.30,	-16.74,
7,	.85,	.897,	15.62,	.82,	11,	.26,	-16.75,
8,	1.08,	-.190,	17.47,	.44,	11,	.57,	-16.85,
9,	1.00,	-.005,	16.78,	.32,	11,	.76,	-16.76,
10,	.49,	2.193,	11.86,	.70,	11,	.38,	-16.69,
11,	.93,	.087,	15.96,	.16,	10,	1.13,	-16.71,
12,	1.06,	-.055,	17.07,	.15,	8,	1.18,	-16.45,

Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT06: TRW CPU JAN.-,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT08: TRW CPU JUNE ,	265287.,	.968,	.000,	.00,	1,	.112,	.005
P shrinkage mean ,	30461.,	.48,,,,				.459,	.045
F shrinkage mean ,	104794.,	.50,,,,				.429,	.013

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
65904.,	.33,	1.12,	3,	3.435,	.021

Table 3.2.8 (continued)

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	37722.,	.848,	.000,	.00,	1,	.125,	.043
FLT08: TRW CPU JUNE ,	22456.,	.426,	.352,	.83,	2,	.493,	.072
F shrinkage mean ,	17727.,	.50,,,,				.383,	.090

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
21882.,	.30,	.21,	4,	.694,	.066

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	18907.,	.538,	.447,	.83,	2,	.157,	.119
FLT08: TRW CPU JUNE ,	14871.,	.269,	.120,	.45,	3,	.624,	.150
F shrinkage mean ,	9764.,	.50,,,,				.220,	.220

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
14077.,	.22,	.14,	6,	.665,	.151

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	5435.,	.278,	.150,	.54,	3,	.309,	.262
FLT08: TRW CPU JUNE ,	5076.,	.201,	.079,	.39,	4,	.559,	.279
F shrinkage mean ,	4067.,	.50,,,,				.132,	.337

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5035.,	.16,	.07,	8,	.441,	.276

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	5178.,	.212,	.114,	.54,	4,	.372,	.346
FLT08: TRW CPU JUNE ,	4763.,	.173,	.151,	.87,	5,	.516,	.371
F shrinkage mean ,	3854.,	.50,,,,				.111,	.441

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4799.,	.13,	.09,	10,	.669,	.372

Table 3.2.8 (continued)

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	1934.,	.209,	.114,	.55,	5,	.359,	.352
FLT08: TRW CPU JUNE ,	1812.,	.172,	.153,	.89,	6,	.504,	.372
F shrinkage mean ,	1343.,	.50,,,,				.137,	.475

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1780.,	.13,	.09,	12,	.689,	.375

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

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	1384.,	.213,	.138,	.65,	6,	.398,	.318
FLT08: TRW CPU JUNE ,	1296.,	.180,	.108,	.60,	7,	.430,	.336
F shrinkage mean ,	757.,	.50,,,,				.172,	.522

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1213.,	.14,	.10,	14,	.684,	.358

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	802.,	.233,	.109,	.47,	7,	.366,	.433
FLT08: TRW CPU JUNE ,	864.,	.203,	.042,	.21,	8,	.356,	.408
F shrinkage mean ,	502.,	.50,,,,				.278,	.625

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
723.,	.18,	.08,	16,	.465,	.472

Age 11 Catchability constant w.r.t. time and dependent on age

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	616.,	.284,	.187,	.66,	8,	.321,	.568
FLT08: TRW CPU JUNE ,	751.,	.245,	.186,	.76,	9,	.265,	.486
F shrinkage mean ,	533.,	.50,,,,				.414,	.633

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
611.,	.24,	.10,	18,	.437,	.574

Table 3.2.8 (continued)

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	209.,	.261,	.068,	.26,	8,	.258,	.377
FLT08: TRW CPU JUNE ,	274.,	.316,	.138,	.44,	10,	.273,	.300
F shrinkage mean ,	177.,	.50,,,,				.469,	.433

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
208.,	.26,	.08,	19,	.301,	.379

Run title : Saithe Iceland Va (run: XSABS08/X08)

At 2-May-96 16:21:34

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.0119,	.0030,	.0122,	.0096,	.0106,	.0115,	.0260,	.0038,	.0012,	.0120,
4,	.1882,	.0976,	.0728,	.1086,	.0647,	.0649,	.0792,	.1176,	.0286,	.1215,
5,	.3500,	.2529,	.1570,	.1748,	.2157,	.1194,	.1904,	.1033,	.0722,	.2006,
6,	.4698,	.3605,	.2124,	.3687,	.3628,	.3635,	.2412,	.2540,	.2585,	.2535,
7,	.3840,	.3566,	.4706,	.3438,	.3954,	.3564,	.5541,	.3656,	.3771,	.3613,
8,	.4323,	.3334,	.6643,	.5333,	.5606,	.4885,	.5728,	.6670,	.5745,	.3570,
9,	.3361,	.5558,	.2784,	.4309,	.6232,	.5038,	.7553,	.4934,	.5500,	.2184,
10,	.4554,	.3645,	.4180,	.6702,	.8922,	1.0806,	.5508,	.4382,	.8788,	.7098,
11,	.4003,	.4403,	.3105,	1.0477,	.3149,	.5270,	.8666,	.1181,	1.5079,	.4132,
12,	.4044,	.4130,	.4314,	.6105,	.5619,	.5964,	.6660,	.4194,	.7855,	.4148,
+gp,	.4044,	.4130,	.4314,	.6105,	.5619,	.5964,	.6660,	.4194,	.7855,	.4148,
FBAR 4- 9,	.3600,	.3261,	.3093,	.3267,	.3704,	.3161,	.3988,	.3335,	.3102,	.2520,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
3,	.0475,	.0097,	.0259,	.0104,	.0065,	.0067,	.0137,	.0204,	.0198,	.0210,	.0204,
4,	.0562,	.1033,	.0649,	.1108,	.0712,	.0502,	.1293,	.0783,	.1202,	.0663,	.0883,
5,	.1790,	.2529,	.1880,	.1473,	.2004,	.2136,	.3235,	.1786,	.1774,	.1508,	.1689,
6,	.2418,	.3718,	.3453,	.3270,	.2632,	.4141,	.4317,	.3193,	.2470,	.2763,	.2808,
7,	.3271,	.4549,	.3436,	.2820,	.5093,	.4971,	.4394,	.4159,	.3298,	.3721,	.3726,
8,	.4881,	.5293,	.5594,	.4120,	.5154,	.5506,	.3502,	.5133,	.4284,	.3753,	.4390,
9,	.3296,	.6073,	.7642,	.5752,	.4325,	.4928,	.4447,	.6248,	.5928,	.3582,	.5253,
10,	.9626,	.4727,	.4291,	.5937,	.5544,	.7123,	.3818,	.5800,	.8679,	.4721,	.6400,
11,	.8423,	1.0093,	.5138,	.8057,	.8069,	.7830,	.3520,	.4491,	.7447,	.5742,	.5893,
12,	.5632,	.5682,	.6118,	.5279,	.5718,	.5134,	.4407,	.6817,	.6745,	.3789,	.5783,
+gp,	.5632,	.5682,	.6118,	.5279,	.5718,	.5134,	.4407,	.6817,	.6745,	.3789,	
FBAR 4- 9,	.2703,	.3866,	.3776,	.3091,	.3320,	.3697,	.3531,	.3550,	.3159,	.2665,	

Table 3.2.9 Icelandic Saithe. Results from TSA-runs.

A. Catch-at-age observations only.

STOCK IN NUMBERS:

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	23172	16563	18611	27291	38728	28915	58341	87303	46603	26556	20910	25864	15151	28639	29444
5	33122	17778	12476	13899	21300	28097	22214	42962	66077	34454	20129	16029	18404	11379	20965
6	20874	23488	12104	8883	10051	14349	19303	14066	29185	45217	23336	13280	9477	12446	7736
7	5628	12543	14762	7675	5673	6318	9114	10945	8276	17763	27743	13030	7149	5545	7702
8	4797	3222	6392	8447	4303	3294	3736	4867	6088	4827	9341	14511	7052	3769	3138
9	1364	2575	1572	3230	4325	2394	1767	1893	2388	3205	2362	4552	7893	3483	1908
10	517	636	1258	828	1673	2514	1282	868	865	1207	1626	1131	2424	3715	1682
11	169	240	290	682	401	922	1233	646	447	437	618	735	586	1193	1711

STANDARD DEVIATION OF STOCK ESTIMATE:

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	1709	1235	1339	1748	2834	1905	4473	6686	3579	2204	2065	3681	3010	7354	11495
5	2549	1340	982	1032	1382	2083	1498	3334	5059	2668	1735	1639	2944	2406	5907
6	1398	1930	998	715	780	985	1567	1080	2434	3555	1985	1320	1302	2263	1823
7	604	950	1302	670	478	507	694	1051	745	1612	2307	1364	931	993	1636
8	479	335	647	770	454	294	332	457	710	500	1016	1432	922	675	727
9	206	300	212	403	497	285	192	212	304	454	314	659	904	642	475
10	142	140	200	131	301	329	204	137	153	212	303	221	441	653	460
11	76	91	94	115	92	196	226	131	93	102	139	201	142	291	449

FISHING MORTALITY RATES:

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	0.065	0.072	0.083	0.047	0.116	0.064	0.108	0.074	0.102	0.077	0.066	0.127	0.079	0.106	0.074
5	0.140	0.179	0.135	0.124	0.193	0.169	0.237	0.186	0.176	0.189	0.210	0.293	0.185	0.185	0.169
6	0.301	0.265	0.256	0.249	0.262	0.252	0.344	0.307	0.296	0.283	0.371	0.401	0.309	0.279	0.293
7	0.358	0.438	0.345	0.377	0.337	0.323	0.421	0.372	0.336	0.439	0.448	0.410	0.418	0.360	0.388
8	0.423	0.508	0.480	0.469	0.380	0.422	0.480	0.501	0.440	0.512	0.513	0.400	0.498	0.469	0.428
9	0.524	0.515	0.429	0.450	0.324	0.424	0.510	0.575	0.479	0.478	0.529	0.429	0.554	0.520	0.440
10	0.516	0.547	0.371	0.517	0.395	0.512	0.485	0.463	0.481	0.470	0.581	0.458	0.509	0.570	0.452
11	0.473	0.428	0.358	0.482	0.384	0.446	0.504	0.507	0.520	0.485	0.529	0.465	0.510	0.523	0.463
F(4-9)	0.302	0.330	0.288	0.286	0.269	0.276	0.350	0.336	0.305	0.330	0.356	0.343	0.341	0.320	0.299

STANDARD DEVIATIONS OF LOG(F):

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	0.22	0.15	0.18	0.19	0.25	0.20	0.30	0.33	0.26	0.18	0.14	0.21	0.14	0.26	0.32
5	0.13	0.13	0.10	0.09	0.14	0.11	0.12	0.14	0.16	0.12	0.12	0.12	0.13	0.15	0.19
6	0.11	0.15	0.12	0.15	0.13	0.11	0.11	0.10	0.13	0.15	0.12	0.12	0.11	0.16	0.20
7	0.16	0.10	0.14	0.12	0.13	0.13	0.11	0.11	0.11	0.12	0.14	0.12	0.13	0.14	0.20
8	0.13	0.13	0.10	0.14	0.13	0.13	0.13	0.11	0.12	0.12	0.13	0.15	0.14	0.16	0.20
9	0.14	0.15	0.14	0.15	0.16	0.17	0.15	0.14	0.14	0.16	0.15	0.16	0.17	0.18	0.21
10	0.18	0.16	0.18	0.19	0.17	0.19	0.19	0.18	0.17	0.18	0.19	0.18	0.20	0.20	0.22
11	0.21	0.20	0.20	0.21	0.19	0.20	0.20	0.20	0.20	0.20	0.21	0.20	0.21	0.22	0.22

B. Catch at age and trawlers (June-December), ages 5-7:

STOCK IN NUMBERS:

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	21685	16495	19111	27635	37160	29002	57197	85482	46660	26219	21470	26882	15935	26538	29555
5	34901	16600	12462	14279	21584	26886	22297	41997	64578	34570	19843	16433	19277	11994	19304
6	20839	24864	11268	8879	10282	14571	18495	14192	28475	44066	23419	13131	9790	13079	8182
7	5622	12551	15732	7059	5656	6524	9260	10500	8373	17302	27181	13102	7089	5766	8144
8	4827	3221	6477	9118	3950	3286	3852	4953	5852	4839	9052	14449	7025	3766	3286
9	1366	2593	1573	3273	4633	2211	1749	1940	2439	3060	2354	4393	7851	3468	1912
10	511	636	1271	831	1719	2749	1170	858	894	1236	1534	1123	2315	3682	1677
11	166	235	292	692	407	954	1333	590	440	452	629	697	575	1134	1698

STANDARD DEVIATION OF STOCK ESTIMATE:

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	1460	1068	1110	1575	2576	1778	3986	5729	3232	1906	1650	2654	2223	5536	11188
5	2360	1141	843	839	1239	1896	1391	2882	4290	2369	1492	1301	2105	1777	4449
6	1385	1788	835	614	617	896	1404	976	2070	2960	1742	1092	1030	1626	1361
7	604	939	1207	536	402	404	627	903	657	1342	1894	1174	752	778	1178
8	481	335	628	755	338	263	280	416	589	423	829	1252	798	538	567
9	208	303	209	394	499	228	181	195	279	366	264	551	833	563	383
10	145	142	201	130	290	352	167	130	141	190	241	190	377	610	405
11	78	94	95	116	89	199	248	111	87	92	122	161	124	251	417

Table 3.2.9 Continued

FISHING MORTALITY RATES:

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	0.066	0.070	0.082	0.046	0.116	0.063	0.110	0.075	0.100	0.079	0.067	0.124	0.078	0.109	0.074
5	0.136	0.183	0.135	0.123	0.190	0.170	0.241	0.188	0.173	0.190	0.213	0.295	0.183	0.181	0.175
6	0.298	0.258	0.265	0.251	0.255	0.252	0.357	0.317	0.298	0.270	0.378	0.411	0.313	0.274	0.286
7	0.357	0.436	0.341	0.378	0.342	0.326	0.418	0.381	0.348	0.447	0.431	0.422	0.424	0.360	0.368
8	0.422	0.509	0.481	0.476	0.376	0.431	0.484	0.501	0.446	0.519	0.523	0.404	0.503	0.474	0.417
9	0.520	0.512	0.426	0.442	0.314	0.437	0.512	0.568	0.480	0.486	0.540	0.439	0.557	0.524	0.437
10	0.513	0.541	0.367	0.510	0.389	0.524	0.485	0.467	0.482	0.473	0.586	0.468	0.513	0.573	0.451
11	0.471	0.425	0.354	0.475	0.379	0.439	0.497	0.524	0.524	0.483	0.533	0.481	0.517	0.529	0.462
F(4-9)	0.300	0.328	0.288	0.286	0.266	0.280	0.354	0.338	0.308	0.332	0.359	0.349	0.343	0.320	0.293

STANDARD DEVIATIONS OF LOG(F):

Age/year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
4	0.22	0.16	0.19	0.20	0.25	0.21	0.30	0.33	0.25	0.17	0.13	0.19	0.13	0.24	0.32
5	0.13	0.12	0.10	0.09	0.14	0.12	0.12	0.13	0.16	0.12	0.12	0.12	0.11	0.13	0.16
6	0.11	0.15	0.13	0.14	0.14	0.11	0.12	0.11	0.13	0.15	0.12	0.13	0.11	0.14	0.17
7	0.16	0.10	0.13	0.14	0.12	0.12	0.11	0.12	0.11	0.13	0.14	0.12	0.13	0.13	0.18
8	0.13	0.13	0.11	0.13	0.15	0.13	0.11	0.11	0.13	0.13	0.14	0.14	0.14	0.16	0.19
9	0.14	0.15	0.14	0.15	0.16	0.17	0.15	0.13	0.13	0.16	0.16	0.17	0.17	0.18	0.21
10	0.18	0.16	0.18	0.19	0.18	0.18	0.19	0.17	0.17	0.18	0.19	0.19	0.20	0.20	0.22
11	0.21	0.20	0.20	0.21	0.19	0.20	0.19	0.19	0.20	0.20	0.21	0.21	0.21	0.21	0.22

Table 3.2.10

Run title : Saithe Iceland Va (run: SVPBS06/V06)

At 4-May-96 19:26:33

Traditional vpa using screen input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.0117,	.0030,	.0123,	.0096,	.0109,	.0115,	.0256,	.0035,	.0012,	.0121,
4,	.1880,	.0959,	.0740,	.1094,	.0644,	.0664,	.0790,	.1153,	.0268,	.1204,
5,	.2919,	.2524,	.1537,	.1777,	.2173,	.1188,	.1948,	.1031,	.0707,	.1854,
6,	.3475,	.2809,	.2120,	.3572,	.3693,	.3661,	.2392,	.2611,	.2570,	.2465,
7,	.4000,	.2334,	.3288,	.3419,	.3776,	.3656,	.5578,	.3606,	.3908,	.3578,
8,	.3934,	.3540,	.3528,	.3118,	.5533,	.4542,	.5940,	.6737,	.5595,	.3761,
9,	.3324,	.4772,	.3025,	.1714,	.2758,	.4933,	.6584,	.5260,	.5615,	.2114,
10,	.4916,	.3587,	.3310,	.7625,	.2290,	.2778,	.5312,	.3487,	.9936,	.7355,
11,	.3598,	.4977,	.3039,	.6698,	.3939,	.0762,	.1005,	.1132,	.8813,	.5309,
12,	.3386,	.3534,	.5249,	.5861,	.2524,	.8706,	.0571,	.0267,	.7237,	.1487,
13,	1.0598,	.2025,	.5657,	.6027,	.1374,	.5457,	.7539,	.0041,	.6991,	1.1616,
14,	.5630,	.3530,	.4310,	.6550,	.2530,	.4430,	.3610,	.1230,	.8240,	.6440,
+gp,	.5630,	.3530,	.4310,	.6550,	.2530,	.4430,	.3610,	.1230,	.8240,	.6440,
FBAR 4- 9,	.3255,	.2823,	.2373,	.2449,	.3096,	.3107,	.3872,	.3400,	.3110,	.2496,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	.0480,	.0096,	.0259,	.0108,	.0069,	.0069,	.0143,	.0224,	.0195,	.0441,
4,	.0571,	.1043,	.0644,	.1108,	.0742,	.0530,	.1324,	.0818,	.1327,	.0655,
5,	.1769,	.2563,	.1897,	.1458,	.2000,	.2235,	.3438,	.1835,	.1862,	.1690,
6,	.2192,	.3648,	.3509,	.3300,	.2594,	.4112,	.4578,	.3475,	.2551,	.2930,
7,	.3146,	.3953,	.3346,	.2886,	.5145,	.4844,	.4344,	.4556,	.3714,	.3880,
8,	.4796,	.4969,	.4466,	.3959,	.5309,	.5597,	.3377,	.5033,	.4938,	.4460,
9,	.3551,	.5878,	.6760,	.3987,	.4071,	.5181,	.4578,	.5859,	.5721,	.4460,
10,	.8910,	.5278,	.4081,	.4752,	.3127,	.6375,	.4136,	.6074,	.7572,	.4460,
11,	.9082,	.8325,	.6191,	.7288,	.5364,	.3134,	.2960,	.5076,	.8128,	.4460,
12,	.8827,	.6680,	.4204,	.7391,	.4761,	.2623,	.1174,	.5143,	.8422,	.4460,
13,	.2941,	2.2834,	.6546,	.6014,	1.3666,	.0853,	.6757,	.2479,	1.6451,	.4460,
14,	.7440,	1.0780,	.5260,	.6360,	.6730,	.2730,	.3160,	.3060,	.4260,	.4460,
+gp,	.7440,	1.0780,	.5260,	.6360,	.6730,	.2730,	.3160,	.3060,	.4260,	.4460,
FBAR 4- 9,	.2671,	.3676,	.3437,	.2783,	.3310,	.3750,	.3607,	.3596,	.3352,	.3012,

Table 3.2.11

Run title : Saithe Iceland Va (run: SVPBS06/V06)

At 4-May-96 19:26:33

Traditional vpa using screen input for terminal F

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	31242,	21673,	49446,	55312,	28074,	19562,	22175,	33645,	47661,	34399,
4,	20754,	25281,	17691,	39988,	44852,	22737,	15833,	17697,	27449,	38974,
5,	13207,	14079,	18806,	13451,	29346,	34430,	17420,	11978,	12911,	21880,
6,	9455,	8076,	8956,	13203,	9220,	19333,	25031,	11737,	8846,	9849,
7,	7161,	5469,	4993,	5932,	7562,	5218,	10977,	16134,	7402,	5601,
8,	7978,	3930,	3546,	2942,	3450,	4244,	2964,	5144,	9210,	4100,
9,	5937,	4407,	2258,	2040,	1764,	1624,	2206,	1340,	2147,	4310,
10,	2998,	3486,	2239,	1366,	1407,	1096,	812,	935,	648,	1003,
11,	1071,	1501,	1994,	1317,	522,	916,	680,	391,	540,	196,
12,	730,	612,	747,	1205,	552,	288,	695,	503,	286,	183,
13,	156,	426,	352,	362,	549,	351,	99,	537,	401,	113,
14,	173,	44,	285,	164,	162,	392,	166,	38,	438,	163,
+gp,	46,	181,	172,	0,	285,	432,	358,	1655,	368,	669,
TOTAL,	100906,	89166,	111484,	137282,	127745,	110623,	99416,	101735,	118309,	121440,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1
AGE											
3,	73184,	110368,	56768,	32203,	22959,	31963,	18824,	32692,	40002,	40002,	
4,	27824,	57113,	89498,	45287,	26081,	18668,	25990,	15193,	26173,	32117,	3
5,	28290,	21517,	42129,	68703,	33189,	19827,	14495,	18640,	11462,	18765,	2
6,	14883,	19406,	13633,	28532,	48616,	22247,	12981,	8415,	12703,	7790,	1
7,	6302,	9786,	11032,	7859,	16794,	30708,	12074,	6724,	4867,	8059,	
8,	3206,	3767,	5396,	6464,	4821,	8220,	15488,	6402,	3491,	2749,	
9,	2305,	1625,	1876,	2827,	3562,	2321,	3845,	9046,	3169,	1744,	
10,	2856,	1323,	739,	781,	1553,	1941,	1132,	1992,	4122,	1464,	
11,	393,	959,	639,	402,	398,	930,	840,	613,	888,	1583,	
12,	95,	130,	342,	282,	159,	190,	557,	512,	302,	323,	
13,	129,	32,	55,	184,	110,	81,	120,	405,	250,	107,	
14,	29,	79,	3,	23,	82,	23,	61,	50,	259,	40,	
+gp,	197,	36,	3,	19,	94,	193,	4,	4,	161,	52,	
TOTAL,	159694,	226141,	222113,	193566,	158418,	137313,	106412,	100688,	107849,	114792,	8

Table 3.2.12

Run title : Saithe Iceland Va (run: SVPBS07/V07)

At 4-May-96 19:42:29

Table 16 Summary (without SOP correction)

Traditional vpa using screen input for terminal F

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 9,
1961,	32739,	268195,	129872,	50826,	.3914,	.2185,
1962,	30999,	277003,	142184,	50514,	.3553,	.2867,
1963,	84106,	336274,	144613,	48011,	.3320,	.3040,
1964,	55195,	380521,	141947,	60257,	.4245,	.2500,
1965,	94062,	465836,	165999,	60177,	.3625,	.2313,
1966,	70223,	550397,	214136,	52003,	.2429,	.1783,
1967,	68332,	648019,	279292,	75712,	.2711,	.2375,
1968,	59672,	697092,	345778,	77549,	.2243,	.2102,
1969,	88751,	762546,	395280,	115853,	.2931,	.2947,
1970,	66328,	755885,	399454,	116601,	.2919,	.3225,
1971,	50638,	717074,	381384,	136764,	.3586,	.4429,
1972,	26456,	603752,	334676,	111301,	.3326,	.3609,
1973,	26109,	516607,	313690,	110888,	.3535,	.3446,
1974,	25128,	434176,	288073,	97568,	.3387,	.2875,
1975,	25929,	387997,	264701,	87954,	.3323,	.2779,
1976,	31242,	347177,	227245,	82003,	.3609,	.3255,
1977,	21673,	300274,	186683,	62026,	.3323,	.2823,
1978,	49446,	307948,	165578,	49672,	.3000,	.2373,
1979,	55312,	342306,	159551,	63504,	.3980,	.2449,
1980,	28074,	349895,	164248,	58347,	.3552,	.3096,
1981,	19562,	333100,	167922,	58986,	.3513,	.3107,
1982,	22175,	318648,	176781,	68615,	.3881,	.3872,
1983,	33645,	330042,	191385,	58266,	.3044,	.3400,
1984,	47661,	358753,	181376,	62719,	.3458,	.3110,
1985,	34399,	352330,	169212,	57101,	.3375,	.2496,
1986,	73184,	416577,	179207,	66376,	.3704,	.2671,
1987,	110368,	503447,	173106,	80559,	.4654,	.3676,
1988,	56768,	519305,	169585,	77247,	.4555,	.3437,
1989,	32203,	484875,	177222,	82425,	.4651,	.2783,
1990,	22959,	463202,	199879,	98130,	.4909,	.3310,
1991,	31963,	390421,	198520,	102737,	.5175,	.3750,
1992,	18824,	325760,	189434,	79597,	.4202,	.3607,
1993,	32692,	300174,	174807,	71648,	.4099,	.3596,
1994,	40002,	289889,	158147,	64338,	.4068,	.3352,
1995,	40002,	290152,	178734,	48528,	.2715,	.3012,
Arith. Mean ,	45909,	432161,	215134,	75566,	.3615,	.3019,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 3.2.13

09:00 Friday, May 3, 1996

Saithe in the Iceland Grounds (Fishing Area Va)

Prediction with management option table: Input data

Year: 1996								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	40.000	0.2000	0.1000	0.0000	0.0000	1.398	0.0210	1.398
4	31.941	0.2000	0.2000	0.0000	0.0000	1.990	0.0870	1.990
5	24.359	0.2000	0.3700	0.0000	0.0000	2.720	0.1620	2.720
6	12.975	0.2000	0.6100	0.0000	0.0000	3.714	0.2690	3.714
7	4.758	0.2000	0.8200	0.0000	0.0000	4.837	0.3650	4.837
8	4.476	0.2000	0.8900	0.0000	0.0000	5.797	0.4340	5.797
9	1.441	0.2000	0.9600	0.0000	0.0000	7.199	0.4820	7.199
10	0.914	0.2000	1.0000	0.0000	0.0000	7.429	0.5440	7.429
11	0.767	0.2000	1.0000	0.0000	0.0000	8.253	0.5310	8.253
12	0.830	0.2000	1.0000	0.0000	0.0000	9.377	0.5420	9.377
13	0.169	0.2000	1.0000	0.0000	0.0000	9.584	0.7550	9.584
14	0.056	0.2000	1.0000	0.0000	0.0000	11.586	0.5930	11.586
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	40.000	0.2000	0.1000	0.0000	0.0000	1.398	0.0210	1.398
4	.	0.2000	0.2000	0.0000	0.0000	2.010	0.0870	2.010
5	.	0.2000	0.3700	0.0000	0.0000	2.729	0.1620	2.729
6	.	0.2000	0.5800	0.0000	0.0000	3.635	0.2690	3.635
7	.	0.2000	0.7800	0.0000	0.0000	4.741	0.3650	4.741
8	.	0.2000	0.9100	0.0000	0.0000	6.027	0.4340	6.027
9	.	0.2000	0.9500	0.0000	0.0000	7.103	0.4820	7.103
10	.	0.2000	1.0000	0.0000	0.0000	7.429	0.5440	7.429
11	.	0.2000	1.0000	0.0000	0.0000	8.253	0.5310	8.253
12	.	0.2000	1.0000	0.0000	0.0000	9.377	0.5420	9.377
13	.	0.2000	1.0000	0.0000	0.0000	9.584	0.7550	9.584
14	.	0.2000	1.0000	0.0000	0.0000	11.586	0.5930	11.586
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit- ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	40.000	0.2000	0.1000	0.0000	0.0000	1.398	0.0210	1.398
4	.	0.2000	0.2000	0.0000	0.0000	2.010	0.0870	2.010
5	.	0.2000	0.3700	0.0000	0.0000	2.742	0.1620	2.742
6	.	0.2000	0.5800	0.0000	0.0000	3.641	0.2690	3.641
7	.	0.2000	0.7600	0.0000	0.0000	4.643	0.3650	4.643
8	.	0.2000	0.8900	0.0000	0.0000	5.872	0.4340	5.872
9	.	0.2000	0.9600	0.0000	0.0000	6.833	0.4820	6.833
10	.	0.2000	1.0000	0.0000	0.0000	7.429	0.5440	7.429
11	.	0.2000	1.0000	0.0000	0.0000	8.253	0.5310	8.253
12	.	0.2000	1.0000	0.0000	0.0000	9.377	0.5420	9.377
13	.	0.2000	1.0000	0.0000	0.0000	9.584	0.7550	9.584
14	.	0.2000	1.0000	0.0000	0.0000	11.586	0.5930	11.586
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PRED94
Date and time: 03MAY96:10:52

Table 3.2.14

12:00 Friday, May 3, 1996

Saithe in the Iceland Grounds (Fishing Area Va)

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.8557	0.2566	316435	147310	46011	0.6000	0.1799	343428	161890	37560	378946	188305
.	.	.	.	.	0.7000	0.2099	.	161890	43148	372795	183586
.	.	.	.	.	0.8000	0.2399	.	161890	48564	366832	179032
.	.	.	.	.	0.9000	0.2698	.	161890	53814	361051	174634
.	.	.	.	.	1.0000	0.2998	.	161890	58904	355446	170386
.	.	.	.	.	1.1000	0.3298	.	161890	63842	350008	166283
.	.	.	.	.	1.2000	0.3598	.	161890	68632	344732	162319
.	.	.	.	.	1.3000	0.3898	.	161890	73280	339613	158488
.	.	.	.	.	1.4000	0.4198	.	161890	77792	334643	154784
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED94
Date and time : 03MAY96:12:21
Computation of ref. F: Simple mean, age 4 - 9
Basis for 1996 : F factors

Table 3.2.15

12:00 Friday, May 3, 1996

Saithe in the Iceland Grounds (Fishing Area Va)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.2000	0.1000	0.0000	0.0000	1.457	0.0500	1.457
4	.	0.2000	0.2000	0.0000	0.0000	2.048	0.2400	2.048
5	.	0.2000	0.3700	0.0000	0.0000	2.758	0.5300	2.758
6	.	0.2000	0.5700	0.0000	0.0000	3.648	0.9000	3.648
7	.	0.2000	0.7500	0.0000	0.0000	4.682	1.1500	4.682
8	.	0.2000	0.8700	0.0000	0.0000	5.809	1.5900	5.809
9	.	0.2000	0.9400	0.0000	0.0000	6.932	1.5900	6.932
10	.	0.2000	1.0000	0.0000	0.0000	7.851	1.5900	7.851
11	.	0.2000	1.0000	0.0000	0.0000	8.786	1.5900	8.786
12	.	0.2000	1.0000	0.0000	0.0000	9.625	1.5900	9.625
13	.	0.2000	1.0000	0.0000	0.0000	10.769	1.5900	10.769
14	.	0.2000	1.0000	0.0000	0.0000	11.248	1.5900	11.248
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YIELD3
Date and time: 03MAY96:12:45

Table 3.2.16

12:00 Friday, May 3, 1996

Saithe in the Iceland Grounds (Fishing Area Va)

Yield per recruit: Summary table

(cont.)						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1.3600	1.3600	0.623	1689.141	2.448	5177.472	0.562	1488.994	0.562	1488.994
1.3800	1.3800	0.624	1687.405	2.440	5148.277	0.558	1472.236	0.558	1472.236
1.4000	1.4000	0.626	1685.694	2.432	5119.709	0.554	1455.924	0.554	1455.924
1.4200	1.4200	0.628	1684.007	2.424	5091.745	0.550	1440.041	0.550	1440.041
1.4400	1.4400	0.629	1682.344	2.416	5064.364	0.546	1424.570	0.546	1424.570
1.4600	1.4600	0.631	1680.704	2.408	5037.545	0.542	1409.495	0.542	1409.495
1.4800	1.4800	0.633	1679.087	2.401	5011.269	0.538	1394.799	0.538	1394.799
1.5000	1.5000	0.634	1677.493	2.393	4985.518	0.534	1380.470	0.534	1380.470
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YIELD3
Date and time : 03MAY96:12:45
Computation of ref. F: Simple mean, age 4 - 9
F-0.1 factor : 0.1834
F-max factor : 0.4385
F-0.1 reference F : 0.1834
F-max reference F : 0.4385
Recruitment : Single recruit

Table 3.3.1 Nominal catch (tonnes) of COD in Division Va, by countries, 1982-1995, as offically reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988
Belgium	236	188	254	207	226	597	365
Faroe Islands	5,297	5,626	2,041	2,203	2,554	1,848	1,966
Iceland	382,297	293,890	281,481	322,810	365,852	389,808	375,741
Norway	557	109	90	46	1	4	4
UK (Engl. and Wales)	-	-	2	1	-	-	-
Total	388,387	299,813	283,868	325,267	368,633	392,257	378,076
Working Group estimate	-	-	-	-	-	-	-

Country	1989	1990	1991	1992	1993	1994	1995 [1]
Belgium	309	260	548	222	145	135	-
Faroe Islands	2,012	1,782	1,323	883	664	754	719
Iceland	353,985	333,348	306,697	266,662	251,170	175,296	168,685
Norway	3	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	+	-	-
Total	356,309	335,390	308,568	267,767	251,979	178,808	169,404
Working Group estimate	-	-	-	-	-	-	169,618 [2]

1) Provisional.

2) Additional catch by Iceland of 214 t included.

Table 3.3.2. Icelandic Cod. Landings (tonnes), effort, cpue and % changes in effort and cpue in the period 1991-1995 (with 1991 as 100%). Data are based on logbooks which have been mandatory in the fisheries since 1991.

Bottom trawl

Year	Catch	effort	effort % changes	cpue	cpue % changes
1991	175142	234946	100	745	100
1992	131504	228196	97	576	77
1993	114587	182882	78	627	84
1994	66186	83975	36	788	106
1995	60580	71202	30	851	114

Gillnet

Year	Catch	effort	effort % changes	cpue	cpue % changes
1991	58948	1060	100	56	100
1992	59712	984	93	61	109
1993	56701	1008	95	56	101
1994	39192	718	68	55	98
1995	32309	437	41	74	133

Long line

Year	Catch	effort	effort % changes	cpue	cpue % changes
1991	44711	2006	100	22	100
1992	42301	2016	100	21	94
1993	47263	2224	111	21	95
1994	36426	1652	82	22	99
1995	44588	1724	86	26	116

Table 3.3.3. Icelandic Cod, catch-in-numbers (millions).

Age	1976	1977	1978	1979	1980	1981	1982
3	23.578	2.614	5.999	7.186	4.348	2.118	3.285
4	39.790	42.659	16.287	28.427	28.530	13.297	20.812
5	21.092	32.465	43.931	13.772	32.500	39.195	24.462
6	24.395	12.162	17.626	34.443	15.119	23.247	28.351
7	5.803	13.017	8.729	14.130	27.090	12.710	14.012
8	5.343	2.809	4.119	4.426	7.847	26.455	7.666
9	1.297	1.773	0.978	1.432	2.228	4.804	11.517
10	0.633	0.421	0.348	0.350	0.646	1.677	1.912
11	0.205	0.086	0.119	0.168	0.246	0.582	0.327
12	0.155	0.024	0.048	0.043	0.099	0.228	0.094
13	0.065	0.006	0.015	0.024	0.025	0.053	0.043
14	0.029	0.002	0.027	0.004	0.004	0.068	0.011
Juvenile	84.607	77.549	66.317	66.657	74.804	79.027	73.043
Adult	37.778	30.489	31.909	37.748	43.878	45.407	39.449
Sum 3- 3	23.578	2.614	5.999	7.186	4.348	2.118	3.285
Sum 4-14	98.807	105.424	92.227	97.219	114.334	122.316	109.207
Total	122.385	108.038	98.226	104.405	118.682	124.434	112.492

Age	1983	1984	1985	1986	1987	1988	1989
3	3.554	6.750	6.457	20.642	11.002	6.713	2.605
4	10.910	31.553	24.552	20.330	62.130	39.323	27.983
5	24.305	19.420	35.392	26.644	27.192	55.895	50.059
6	18.944	15.326	18.267	30.839	15.127	18.663	31.455
7	17.382	8.082	8.711	11.413	15.695	6.399	6.010
8	8.381	7.336	4.201	4.441	4.159	5.877	1.915
9	2.054	2.680	2.264	1.771	1.463	1.345	0.881
10	2.733	0.512	1.063	0.805	0.592	0.455	0.225
11	0.514	0.538	0.217	0.392	0.253	0.305	0.107
12	0.215	0.195	0.233	0.103	0.142	0.157	0.086
13	0.064	0.090	0.102	0.076	0.046	0.114	0.038
14	0.037	0.036	0.038	0.040	0.058	0.025	0.005
Juvenile	58.426	65.651	69.001	80.654	107.928	103.170	82.565
Adult	30.667	26.867	32.496	36.842	29.931	32.101	38.804
Sum 3- 3	3.554	6.750	6.457	20.642	11.002	6.713	2.605
Sum 4-14	85.539	85.768	95.040	96.854	126.857	128.558	118.764
Total	89.093	92.518	101.497	117.496	137.859	135.271	121.369

Age	1990	1991	1992	1993	1994	1995
3	5.785	8.554	12.217	20.500	6.160	10.782
4	12.313	25.131	21.708	33.078	24.142	9.113
5	27.179	15.491	26.524	15.195	19.666	16.848
6	44.534	21.514	11.413	13.281	6.968	13.081
7	17.037	25.038	10.073	3.583	4.393	4.120
8	2.573	6.364	8.304	2.785	1.257	1.598
9	0.609	0.903	2.006	2.707	0.599	0.313
10	0.322	0.243	0.257	1.181	0.508	0.184
11	0.118	0.125	0.046	0.180	0.283	0.156
12	0.050	0.063	0.032	0.034	0.049	0.141
13	0.015	0.011	0.012	0.011	0.018	0.029
14	0.020	0.012	0.008	0.013	0.006	0.008
Juvenile	65.114	60.283	48.743	45.914	26.361	21.978
Adult	45.441	43.166	43.857	46.634	37.688	34.395
Sum 3- 3	5.785	8.554	12.217	20.500	6.160	10.782
Sum 4-14	104.770	94.895	80.383	72.048	57.889	45.591
Total	110.555	103.449	92.600	92.548	64.049	56.373

Table 3.3.4. Icelandic Cod, proportion of fishing and natural mortality before spawning.

Age	PropF	PropM
3	0.085	0.250
4	0.180	0.250
5	0.248	0.250
6	0.296	0.250
7	0.382	0.250
8	0.437	0.250
9	0.477	0.250
10	0.477	0.250
11	0.477	0.250
12	0.477	0.250
13	0.477	0.250
14	0.477	0.250

Table 3.3.5. Icelandic Cod, mean weight at age in the landings (g).

Age	1976	1977	1978	1979	1980	1981	1982
3	1350	1259	1289	1408	1392	1180	1006
4	1780	1911	1833	1956	1862	1651	1550
5	2650	2856	2929	2642	2733	2260	2246
6	4100	4069	3955	3999	3768	3293	3104
7	5070	5777	5726	5548	5259	4483	4258
8	6730	6636	6806	6754	6981	5821	5386
9	8250	7685	9041	8299	8037	7739	6682
10	9610	9730	10865	9312	10731	9422	9141
11	11540	11703	13068	13130	12301	11374	11963
12	11430	14394	11982	13418	17281	12784	14226
13	14060	17456	19062	13540	14893	12514	17287
14	16180	24116	21284	20072	19069	19069	16590

Age	1983	1984	1985	1986	1987	1988	1989
3	1095	1288	1407	1459	1316	1438	1186
4	1599	1725	1971	1961	1956	1805	1813
5	2275	2596	2576	2844	2686	2576	2590
6	3021	3581	3650	3593	3894	3519	3915
7	4096	4371	4976	4635	4716	4930	5210
8	5481	5798	6372	6155	6257	6001	6892
9	7049	7456	8207	7503	7368	7144	8035
10	8128	9851	10320	9084	9243	8822	9831
11	11009	11052	12197	10356	10697	9977	11986
12	13972	14338	14683	15283	10622	11732	10003
13	15882	15273	16175	14540	15894	14156	12611
14	18498	16660	19050	15017	12592	13042	16045

Age	1990	1991	1992	1993	1994	1995	1996
3	1290	1309	1289	1392	1443	1348	1368
4	1704	1899	1768	1887	2063	1959	1955
5	2383	2475	2469	2772	2562	2920	2775
6	3034	3159	3292	3762	3659	3625	3945
7	4624	3792	4394	4930	5117	5176	5028
8	6521	5680	5582	6054	6262	6416	6655
9	8888	7242	6830	7450	7719	7916	7479
10	10592	9804	8127	8641	8896	10273	8984
11	10993	9754	12679	10901	10847	11022	11362
12	14570	14344	13410	12517	12874	11407	12552
13	15732	14172	15715	14742	14742	13098	14574
14	17290	20200	11267	16874	17470	15182	15198

Table 3.3.6. Icelandic Cod, mean weight at age in the spawning stock (g).

Age	1976	1977	1978	1979	1980	1981	1982
3	1217	960	1031	1141	1333	967	996
4	1604	1723	1671	1647	1680	1513	1626
5	2516	2729	2863	2532	2708	2101	2095
6	4380	4108	3920	4027	3875	3225	3006
7	5407	5957	5976	5664	5446	4520	4339
8	6985	6696	6946	6951	7106	5851	5571
9	8752	7618	9204	8234	8120	7661	6801
10	10143	9669	10833	9500	10737	9084	9259
11	11829	12578	12920	12921	12628	10833	11550
12	11518	13884	12863	13028	17528	12401	13445
13	13916	17026	19104	13308	15939	11724	17138
14	15367	24652	21183	18930	25212	14326	16554

Age	1983	1984	1985	1986	1987	1988	1989
3	891	1002	1131	1182	1289	1218	1012
4	1472	1479	1597	1762	1811	1604	1542
5	2139	2257	2285	2681	2735	2499	2423
6	2918	3476	3524	3562	4202	3566	3743
7	4130	4480	5010	4824	5110	5161	5298
8	5553	5887	6195	6457	6497	6238	6910
9	7007	7660	7800	7843	7802	7302	7725
10	7770	9920	9225	9419	10220	8647	9397
11	10817	11035	11336	10674	11197	10184	11953
12	13176	14531	13277	13660	10620	11504	9529
13	14175	15378	15325	13812	15893	14159	12195
14	18543	16394	18932	18479	16514	10952	14270

Age	1990	1991	1992	1993	1994	1995	1996
3	813	1122	876	1037	1193	1066	1043
4	1330	1776	1389	1570	1748	1826	1715
5	2132	2233	2174	2518	2382	2735	2629
6	3187	3044	3185	3611	3684	3497	3973
7	4691	3891	4481	4872	5175	4741	5030
8	6627	5897	5587	6150	6210	6126	6368
9	8915	7657	6775	7538	7676	7582	7393
10	10362	10573	8225	8840	8814	9887	8942
11	12093	11230	11702	11088	10842	10829	11115
12	15453	14340	13474	12002	12595	11307	12345
13	15337	14172	15436	14402	14402	13098	14335
14	17257	20200	11267	18383	17470	15182	15575

Table 3.3.7. Icelandic Cod, sexual maturity at age.

Age	1976	1977	1978	1979	1980	1981	1982
3	0.030	0.000	0.020	0.040	0.020	0.000	0.010
4	0.110	0.040	0.080	0.050	0.050	0.020	0.060
5	0.370	0.190	0.210	0.200	0.170	0.090	0.170
6	0.560	0.550	0.470	0.490	0.460	0.260	0.260
7	0.670	0.840	0.860	0.740	0.740	0.570	0.530
8	0.930	0.960	0.960	0.900	0.850	0.810	0.810
9	0.990	0.990	0.980	0.980	0.970	0.910	0.930
10	1.000	1.000	1.000	0.930	0.980	0.950	0.950
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 3.3.7 (Continued)

Age	1983	1984	1985	1986	1987	1988	1989
3	0.000	0.010	0.040	0.010	0.020	0.040	0.040
4	0.040	0.050	0.110	0.070	0.040	0.060	0.120
5	0.160	0.200	0.200	0.230	0.140	0.220	0.250
6	0.330	0.410	0.490	0.460	0.460	0.350	0.490
7	0.510	0.650	0.700	0.720	0.670	0.610	0.760
8	0.710	0.810	0.880	0.810	0.840	0.780	0.840
9	0.860	0.930	0.910	0.960	0.930	0.840	0.890
10	0.980	0.990	1.000	0.970	1.000	0.950	0.970
11	1.000	1.000	1.000	0.980	1.000	0.980	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age	1990	1991	1992	1993	1994	1995	1996
3	0.040	0.086	0.097	0.276	0.292	0.141	0.141
4	0.080	0.193	0.236	0.383	0.447	0.415	0.415
5	0.260	0.262	0.466	0.575	0.664	0.720	0.720
6	0.480	0.464	0.612	0.722	0.785	0.849	0.849
7	0.730	0.678	0.829	0.921	0.915	0.849	0.849
8	0.870	0.855	0.909	0.970	0.929	0.956	0.956
9	0.960	0.850	0.972	0.956	0.990	1.000	1.000
10	0.990	0.771	1.000	0.977	0.860	1.000	1.000
11	1.000	0.648	1.000	1.000	0.986	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 3.3.8: Icelandic Cod. Bottom trawl CPUE (GLM) indices 1991-1995 used in XSA tuning.

Northern- Area Jun-Dec					
Age/Year	1991	1992	1993	1994	1995
4	1179	750	1492	2117	876
5	698	903	577	1409	1823
6	779	327	287	255	1173
7	467	231	102	92	170
8	79	90	49	28	42

South-Western Jun-Dec					
Age/Year	1991	1992	1993	1994	1995
4	573	679	997	1139	469
5	456	580	480	777	921
6	650	338	273	259	632
7	727	277	47	78	54

South-Eastern Jun-Dec					
Age/Year	1991	1992	1993	1994	1995
5	159	264	248	616	1218
6	318	186	313	143	1264
7	389	264	166	110	184
8	208	270	96	17	23

Northern- Area Jan-May					
Age/Year	1991	1992	1993	1994	1995
4	570	834	1504	978	41
5	651	1499	873	1432	2028
6	1438	829	813	673	1420
7	895	288	69	399	284

South-Western Jan-May					
Age/Year	1991	1992	1993	1994	1995
5	261	325	878	916	568
6	522	272	414	309	906
7	1146	362	77	164	507
8	265	429	53	19	61

Table 3.3.9: Icelandic Cod. Gillnet CPUE (GLM) indices 1988-1995 used in XSA tuning.

South and Western Areas Jan-May								
Age/Year	1988	1989	1990	1991	1992	1993	1994	1995
6	38	118	66	53	26	43	45	69
7	34	47	86	112	57	31	58	66
8	41	17	24	58	99	35	28	39
9	14	7	9	9	36	43	12	10
10	4	3	4	2	5	17	13	9

Table 3.3.10 Icelandic Cod. Icelandic Groundfish survey indices.

Northern Area

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3	55261	22540	77227	92490	60113	8272	22262	13601	31684	18211	4301	16420
4	48059	18404	15257	49378	46566	15722	8102	9542	9441	13369	11353	5609
5	13027	17203	7551	5573	18693	18464	8772	2499	5124	2675	7088	6580
6	6211	4864	7364	2906	1665	6501	9355	2303	1100	1550	1330	6431
7	1990	1388	1453	2306	545	456	1242	1347	672	263	417	1191
8	868	375	345	265	311	137	107	144	318	168	53	228

South-eastern Area

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3	233	452	772	4670	1914	85	113	349	1148	1098	350	810
4	561	686	404	3153	4474	419	114	511	391	1189	1943	462
5	470	1171	391	519	3858	1673	324	309	361	356	2084	1069
6	524	608	842	333	619	1762	1104	763	146	321	619	1650
7	373	294	286	385	274	265	396	1087	163	79	300	508
8	345	138	105	62	238	83	89	203	117	57	70	141

South-western Area

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3	1723	1413	4003	3929	5857	1702	3044	1088	4112	4366	1298	3709
4	4444	2203	1266	5935	9371	6149	2560	2019	1935	3533	4397	1928
5	2588	2968	1190	1144	5845	8867	4625	1016	1664	851	3538	3100
6	1911	1310	1656	860	812	4150	7491	1702	420	573	866	3747
7	813	535	410	873	296	409	1556	2172	359	114	355	798
8	417	232	104	102	224	113	193	387	255	66	22	180

Northern Area age 2 index on age 3 one year later.

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3		31297	84656	99294	68604	17511	19408	15633	30540	26030	5556	17477

Northern Area age 1 index on age 3 two years later.

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3			39301	52943	25874	5820	14921	11786	14473	16407	2237	10539

South-eastern Area age 2 index on age 3 one year later.

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3		49	859	787	1121	61	139	39	532	1222	347	395

South-eastern Area age 1 index on age 3 two years later.

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3			68	630	38	34	34	21	49	775	84	301

South-western Area age 2 index on age 3 one year later.

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
3		534	2667	2351	920	818	820	823	936	2340	795	2033

South-western Area age 1 index on age 3 two years later.

Age/Year	1984	1985	1986	1987	1988	189	1990	1991	1992	1993	1994	1995
			779	841	22	68	601	110	654	531	382	820

Table 3.3.11. Icelandic Cod. XSA diagnostic output.

```
 VPA Version 3.1 (MSDOS)

   20/04/1996   9:26

 Extended Survivors Analysis

" ICELANDIC COD (Div. Va); data from 1960-95(4/96)

 CPUE data from file /codvanet.dat

 Data for   15 fleets over   36 years
 Age range from    3 to   14

      Fleet                Alpha   Beta
 IceGFS. N.                 0.99    1
 IceGFS. a2 on a3. N         0.99   1
 IceGFS. a1 on a3. N.       0.99    1
 IceGFS. SE                  0.99   1
 IceGFS. a2 on a3. SE.       0.99   1
 IceGFS. a1on a3. SE.        0.99   1
 IceGFS. SW.                 0.99   1
 IceGFS. a2on a3. SW.        0.99   1
 IceGFS.a1 on a3. SW.        0.99   1
 TRAWL.JUN.DEC.N             0.58   1
 TRAWL.JUN.DEC.SW           0.58    1
 TRAWL.JUN.DEC.SE           0.58    1
 TRAWL.JAN.MAY.N                0   0.58
 TRAWL.JAN.MAY.SW               0   0.58
 GILLNET JAN.MAY.S              0   0.58

 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years

 Catchability analysis :

      Catchability dependent on stock size for ages <    5

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

      Catchability independent of age for ages >=   11


 Terminal population estimation :

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

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

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

      Prior weighting not applied
Regression weights
       0.751 0.82   0.877  0.921  0.954  0.976  0.99   0.997  1      1
```

Table 3.3.11 (Continued)

Fishing mortalities

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	0.07	0.044	0.044	0.035	0.05	0.096	0.077	0.132	0.089	0.081
4	0.22	0.308	0.218	0.263	0.232	0.315	0.372	0.309	0.228	0.185
5	0.578	0.515	0.504	0.136	0.441	0.514	0.647	0.487	0.305	0.246
6	0.694	0.783	0.833	0.599	0.637	0.767	0.929	0.814	0.433	0.343
7	0.882	0.973	0.953	0.716	0.784	0.946	1.078	0.885	0.709	0.497
8	0.935	0.996	1.398	0.873	0.792	0.782	1.015	1.065	0.941	0.613
9	0.806	0.974	1.122	0.817	0.779	0.73	0.61	1.207	0.691	0.645
10	0.764	0.705	0.985	0.55	0.829	0.855	0.468	0.929	0.771	0.468
11	0.735	0.581	1.033	0.657	0.634	0.948	0.375	0.713	0.594	0.572
12	0.672	0.654	0.908	0.976	0.756	0.861	0.682	0.528	0.425	0.681
13	0.445	0.74	2.361	0.575	0.434	0.362	0.272	0.529	0.597	0.482
14	0.691	0.738	1.298	0.722	0.691	0.759	0.49	0.802	0.624	0.586

1

XSA population numbers

	AGE						
YEAR	3	4	5	6	7	8	9
1986	3.39E+05	1.14E+05	6.70E+04	6.81E+04	2.15E+04	8.08E+03	3.54E+03
1987	2.83E+05	2.59E+05	7.46E+04	3.08E+04	2.79E+04	7.29E+03	2.60E+03
1988	1.71E+05	2.22E+05	1.56E+05	3.65E+04	1.15E+04	8.63E+03	2.20E+03
1989	8.30E+04	1.34E+05	1.46E+05	7.71E+04	1.30E+04	3.64E+03	1.74E+03
1990	1.32E+05	6.56E+04	8.42E+04	1.04E+05	3.47E+04	5.20E+03	1.24E+03
1991	1.04E+05	1.03E+05	4.26E+04	4.44E+04	4.52E+04	1.30E+04	1.93E+03
1992	1.81E+05	7.72E+04	6.15E+04	2.08E+04	1.69E+04	1.44E+04	4.85E+03
1993	1.83E+05	1.37E+05	4.35E+04	2.64E+04	6.74E+03	4.70E+03	4.27E+03
1994	7.95E+04	1.31E+05	8.26E+04	2.19E+04	9.56E+03	2.28E+03	1.33E+03
1995	1.53E+05	5.95E+04	8.54E+04	4.98E+04	1.16E+04	3.85E+03	7.27E+02

Estimated population abundance at 1st Jan 1996

0.00E+00	1.16E+05	4.05E+04	5.46E+04	2.90E+04	5.79E+03	1.71E+03

Taper weighted geometric mean of the VPA populations:

1.49E+05	1.17E+05	7.91E+04	4.15E+04	1.69E+04	6.48E+03	2.30E+03

Standard error of the weighted Log(VPA populations) :

0.4341	0.4602	0.423	0.519	0.5808	0.5998	0.6436	0.5361	0.5813	0.6524

	AGE				
	10	11	12	13	14
YEAR					
1986	1.67E+03	8.32E+02	2.33E+02	2.34E+02	9.75E+01
1987	1.29E+03	6.35E+02	3.27E+02	9.73E+01	1.23E+02
1988	8.03E+02	5.23E+02	2.91E+02	1.39E+02	3.80E+01
1989	5.88E+02	2.45E+02	1.53E+02	9.61E+01	1.07E+01
1990	6.31E+02	2.78E+02	1.04E+02	4.70E+01	4.43E+01
1991	4.67E+02	2.26E+02	1.21E+02	4.00E+01	2.49E+01
1992	7.61E+02	1.63E+02	7.15E+01	4.18E+01	2.28E+01
1993	2.16E+03	3.90E+02	9.16E+01	2.96E+01	2.61E+01
1994	1.05E+03	6.98E+02	1.57E+02	4.42E+01	1.43E+01
1995	5.44E+02	3.96E+02	3.15E+02	8.38E+01	1.99E+01

Table 3.3.11 (Continued)

Estimated population abundance at 1st Jan 1996

3.12E+02	2.79E+02	1.83E+02	1.31E+02	4.24E+01

Taper weighted geometric mean of the VPA populations:

9.35E+02	4.11E+02	1.83E+02	7.63E+01	3.36E+01

Standard error of the weighted Log(VPA populations) :

0.718 0.782

Log catchability residuals.

Fleet : IceGFS. N.

Age	1984	1985
3	0.52	0
4	0.32	0.23
5	0.48	0.38
6	0.55	0.21
7	0.46	0.2
8	0.69	0.1
9	No data for this fleet at this age	
10	No data for this fleet at this age	

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-0.17	0.09	0.36	0.02	0.09	0.1	-0.02	-0.29	-0.26	-0.2
4	0.02	0.06	0.11	-0.1	0.14	-0.14	0.18	-0.2	-0.32	-0.05
5	0.35	-0.12	0.34	0.02	0.13	-0.37	0.12	-0.35	-0.19	-0.36
6	0.36	0.32	-0.36	0.02	0.12	-0.3	-0.12	-0.13	-0.47	0.19
7	0.35	0.64	0.06	-0.47	-0.38	-0.41	0.02	-0.2	-0.26	0.38
8	0.33	0.23	0.62	0.14	-0.54	-1.17	-0.25	0.28	-0.27	0.33
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error

of ages with catchability independent of year class strength

Age	5	6	7	8
Mean Log q	-1.7587	-1.6995	-1.9682	-2.3515
S.E(Log q)	0.305	0.3056	0.375	0.5329

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	0.53	2.551	6.41	0.78	12	0.24	-1.6
4	0.69	2.223	4.72	0.86	12	0.2	-1.6

Ages with q constant w.r.t. time

Table 3.3.11 (Continued)

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.	Mean Q
5	0.72	1.843	4.4	0.84	12	0.2	-1.76
6	0.79	1.472	3.57	0.85	12	0.23	-1.7
7	1	0.02	2	0.71	12	0.39	-1.97
8	1.12	-0.362	1.56	0.51	12	0.63	-2.35

1

Fleet : IceGFS. a2 on a3.

Age	1984	1985
3	99.99	0.12
4	No data for this fleet at this age	
5	No data for this fleet at this age	
6	No data for this fleet at this age	
7	No data for this fleet at this age	
8	No data for this fleet at this age	
9	No data for this fleet at this age	
10	No data for this fleet at this age	

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-0.11	0.15	0.44	0.32	-0.07	0.07	-0.09	-0.16	-0.29	-0.26
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	0.61	2.101	5.59	0.78	11	0.25	-1.48

1

Fleet :IceGFS. a1 on a3. N.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-0.2	0.14	0.23	0.09	0.18	0.31	-0.14	-0.04	-0.38	-0.15
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	0.58	2.379	6.3	0.81	10	0.24	-2.15

1

Table 3.3.11 (Continued)

Fleet : IceGFS. SE

Age	1984	1985
3	-0.41	-0.1
4	-0.62	0.06
5	-0.53	0
6	-0.3	-0.25
7	-0.18	-0.32
8	0.35	-0.32
9	No data for this fleet at this age	
10	No data for this fleet at this age	

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-0.65	0.45	0.49	-0.42	-0.72	0.13	0.18	0.18	0.39	0.17
4	-0.31	0.04	0.34	-0.43	-0.45	-0.03	0.14	0.14	0.41	0.39
5	-0.3	-0.19	1.07	-0.07	-0.85	-0.14	-0.22	-0.05	0.89	0.13
6	-0.18	-0.22	0.27	0.34	-0.39	0.22	-0.51	-0.08	0.39	0.46
7	-0.24	-0.11	0.41	0.02	-0.49	0.41	-0.37	-0.37	0.44	0.56
8	-0.28	-0.65	0.93	0.22	-0.15	-0.25	-0.67	-0.22	0.58	0.43
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error
of ages with catchability independent of year class strength

Age	5	6	7	8
Mean Log q	-4.0706	-3.3238	-3.0013	-2.9301
S.E(Log q)	0.5467	0.3477	0.3923	0.5069

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	0.52	1.422	8.47	0.51	12	0.45	-5.32
4	0.55	1.771	7.81	0.64	12	0.36	-4.63

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
5	0.67	1.176	6.42	0.6	12	0.36	-4.07
6	0.99	0.04	3.39	0.69	12	0.36	-3.32
7	1.12	-0.477	2.18	0.64	12	0.46	-3
8	1.64	-1.524	-0.82	0.4	12	0.78	-2.93

1

Fleet : IceGFS. a2 on a3. SE.

Age	1984	1985
3	99.99	-0.95
4	No data for this fleet at this age	
5	No data for this fleet at this age	
6	No data for this fleet at this age	
7	No data for this fleet at this age	
8	No data for this fleet at this age	
9	No data for this fleet at this age	
10	No data for this fleet at this age	

Table 3.3.11 (Continued)

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-0.24	-0.12	0.58	-0.28	-0.29	-0.71	0.14	0.61	0.74	0.15
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	0.54	1.089	8.7	0.41	11	0.57	-5.97

1

Fleet : IceGFS. a1on a3. SE.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-1.05	0.86	-0.83	-0.21	-0.66	-0.76	-0.67	1.53	0.59	0.92
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	0.78	0.296	8.17	0.2	10	0.98	-7.14

1

Fleet : IceGFS. SW.

Age	1984	1985
3	-0.4	-0.65
4	-0.18	-0.28
5	-0.02	-0.27
6	0.15	-0.33
7	0.03	-0.29
8	0.3	-0.03
9	No data for this fleet at this age	
10	No data for this fleet at this age	

Table 3.3.11 (Continued)

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-0.41	-0.27	0.64	0.09	0.23	-0.53	0.25	0.36	-0.09	0.32
4	-0.95	-0.13	0.4	0.52	0.32	-0.29	0.02	-0.02	0.17	0.09
5	-0.39	-0.6	0.29	0.4	0.6	-0.16	0.1	-0.38	0.22	0
6	-0.36	-0.13	-0.3	0.35	0.67	0.17	-0.31	-0.35	-0.13	0.42
7	-0.45	0.13	-0.08	-0.12	0.31	0.53	-0.15	-0.57	0.04	0.45
8	-0.53	-0.38	0.64	0.29	0.39	0.16	-0.13	-0.31	-0.81	0.44
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error

of ages with catchability independent of year class strength

Age	5	6	7	8
Mean Log q	-2.868	-2.4727	-2.4308	-2.6963
S.E(Log q)	0.3621	0.3627	0.3482	0.4519

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	1.02	-0.066	3.58	0.54	12	0.43	-3.75
4	1.01	-0.027	3.07	0.6	12	0.4	-3.14

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
5	0.7	1.709	5.41	0.79	12	0.23	-2.87
6	0.68	2.759	5.12	0.89	12	0.19	-2.47
7	0.75	1.919	4.24	0.88	12	0.23	-2.43
8	0.84	0.754	3.66	0.73	12	0.39	-2.7

1

Fleet : IceGFS. a2on a3. SW.

Age	1984	1985
3	99.99	-0.91
4	No data for this fleet at this age	
5	No data for this fleet at this age	
6	No data for this fleet at this age	
7	No data for this fleet at this age	
8	No data for this fleet at this age	
9	No data for this fleet at this age	
10	No data for this fleet at this age	

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	0.11	0.12	-0.45	0.13	-0.32	-0.02	-0.45	0.65	0.2	0.61
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Table 3.3.11 (Continued)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	1.14	-0.395	3.51	0.49	11	0.49	-4.57

1

Fleet : IceGFS.a1 on a3. SW.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	-0.26	-0.04	-0.57	-0.78	0.47	-0.58	0.24	0.11	0.65	0.58
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
3	0.78	0.526	7.07	0.44	10	0.56	-5.7

1

Fleet : TRAWL.JUN.DEC.N

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	99.99	99.99	99.99	99.99	99.99	-0.05	-0.16	-0.12	0.21	0.11
5	99.99	99.99	99.99	99.99	99.99	0.06	0.06	-0.17	-0.06	0.12
6	99.99	99.99	99.99	99.99	99.99	0.23	0.24	-0.21	-0.44	0.19
7	99.99	99.99	99.99	99.99	99.99	-0.09	0.29	0.24	-0.35	-0.09
8	99.99	99.99	99.99	99.99	99.99	-0.45	-0.24	0.31	0.38	0
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error

of ages with catchability independent of year class strength

Age	5	6	7	8
Mean Log q	-10.5192	-10.4207	-10.491	-10.7885
S.E(Log q)	0.1164	0.3118	0.2661	0.3516

Regression statistics :

Table 3.3.11 (Continued)

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
4	0.97	0.133	10.94	0.84	5	0.18	-10.92

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
5	0.89	0.687	10.58	0.92	5	0.11	-10.52
6	0.71	1.066	10.39	0.82	5	0.22	-10.42
7	1.04	-0.181	10.53	0.87	5	0.32	-10.49
8	1.64	-3.292	12.13	0.9	5	0.31	-10.79

1

Fleet : TRAWL.JUN.DEC.SW

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	99.99	99.99	99.99	99.99	99.99	-0.29	0.22	0	0.12	-0.06
5	99.99	99.99	99.99	99.99	99.99	0.1	0.08	0.11	-0.19	-0.1
6	99.99	99.99	99.99	99.99	99.99	0.21	0.43	-0.1	-0.27	-0.27
7	99.99	99.99	99.99	99.99	99.99	0.65	0.77	-0.24	-0.22	-0.94
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error

of ages with catchability independent of year class strength

Age	5	6	7
Mean Log q	-10.9857	-10.5812	-10.7884
S.E(Log q)	0.1373	0.3103	0.7079

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
4	1.06	-0.179	11.41	0.77	5	0.23	-11.41

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
5	1.58	-3.515	10.97	0.92	5	0.11	-10.99
6	1.22	-0.41	10.64	0.55	5	0.42	-10.58
7	0.61	1.448	10.31	0.83	5	0.39	-10.79

1

Table 3.3.11 (Continued)

Fleet : TRAWL.JUN.DEC.SE

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	99.99	99.99	99.99	99.99	99.99	-0.46	-0.22	-0.06	0.07	0.67
6	99.99	99.99	99.99	99.99	99.99	-0.29	0.05	0.25	-0.65	0.64
7	99.99	99.99	99.99	99.99	99.99	-0.42	0.29	0.59	-0.31	-0.15
8	99.99	99.99	99.99	99.99	99.99	0.2	0.53	0.66	-0.45	-0.93
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error
of ages with catchability independent of year class strength

Age	5	6	7	8
Mean Log q	-11.473	-10.7935	-10.3513	-10.4656
S.E(Log q)	0.4238	0.496	0.4247	0.6743

Regression statistics :

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
5	0.51	1.997	11.25	0.85	5	0.16	-11.47
6	0.64	0.887	10.63	0.67	5	0.33	-10.79
7	1.51	-1.221	10.76	0.66	5	0.61	-10.35
8	0.66	1.306	9.87	0.83	5	0.41	-10.47
1							

Fleet : TRAWL.JAN.MAY.N

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	99.99	99.99	99.99	99.99	99.99	-0.01	0.39	-0.02	-0.1	-0.26
5	99.99	99.99	99.99	99.99	99.99	-0.24	0.26	0.02	-0.17	0.13
6	99.99	99.99	99.99	99.99	99.99	0.04	0.28	0	-0.11	-0.21
7	99.99	99.99	99.99	99.99	99.99	0	-0.11	-0.67	0.69	0.09
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error

of ages with catchability independent of year class strength

Age	5	6	7
Mean Log q	-10.6464	-10.1046	-10.5175
S.E(Log q)	0.2074	0.1842	0.4879

Regression statistics :

Ages with q dependent on year class strength

Table 3.3.11 (Continued)

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
4	0.3	1.799	11.65	0.69	5	0.28	-12.06

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
5	0.86	0.448	10.7	0.79	5	0.2	-10.65
6	1.32	-1.1	10.03	0.8	5	0.24	-10.1
7	0.92	0.238	10.44	0.73	5	0.51	-10.52

1

Fleet : TRAWL.JAN.MAY.SW

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	99.99	99.99	99.99	99.99	99.99	-0.33	-0.44	0.86	0.21	-0.32
6	99.99	99.99	99.99	99.99	99.99	-0.17	-0.03	0.13	-0.08	0.15
7	99.99	99.99	99.99	99.99	99.99	0.19	0.06	-0.62	-0.26	0.62
8	99.99	99.99	99.99	99.99	99.99	0.25	0.69	-0.27	-0.6	-0.
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Mean log catchability and standard error

of ages with catchability independent of year class strength

Age	5	6	7	8
Mean Log q	-11.4764	-10.9091	-10.4635	-10.7757
S.E(Log q)	0.5439	0.1375	0.4688	0.4951

Regression statistics :

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
5	1.99	-0.553	11.94	0.1	5	1.19	-11.48
6	0.96	0.216	10.89	0.91	5	0.15	-10.91
7	0.76	0.979	10.24	0.85	5	0.36	-10.46
8	0.63	4.363	10.01	0.98	5	0.13	-10.78

1

Fleet : GILLNET JAN.MAY.S

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	99.99	99.99	-0.16	0.16	-0.72	-0.04	0.04	0.28	0.41	-0.01
7	99.99	99.99	-0.2	-0.06	-0.42	-0.38	-0.03	0.23	0.46	0.34
8	99.99	99.99	-0.19	-0.34	-0.38	-0.41	0.08	0.17	0.64	0.36
9	99.99	99.99	-0.07	-0.61	-0.03	-0.48	-0.05	0.41	0.17	0.58
10	99.99	99.99	-0.31	-0.41	-0.11	-0.5	-0.17	0.13	0.54	0.75

Table 3.3.11 (Continued)

Mean log catchability and standard error
of ages with catchability independent of year class strength

Age	6	7	8	9	10
Mean Log q	-13.3259	-12.2181	-11.6332	-11.537	-11.5696
S.E(Log q)	0.341	0.3264	0.3894	0.4058	0.4564

Regression statistics :

Ages with q constant w.r.t. time

Age	Slope	t-value	Intercept	Rsquare	No Pts	Reg s.e	Mean Log q
6	1.69	-2.354	15.21	0.67	8	0.45	-13.33
7	1.68	-3.329	13.99	0.81	8	0.35	-12.22
8	1.46	-1.506	13.01	0.65	8	0.52	-11.63
9	1.11	-0.394	11.99	0.67	8	0.48	-11.54
10	0.8	0.651	10.61	0.66	8	0.38	-11.57

1

Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	94681	0.312	0	0	1	0.179	0.098
IceGFS.a2 on a3.N	89078	0.312	0	0	1	0.179	0.104
IceGFS a1 on a3.N	99200	0.312	0	0	1	0.179	0.094
IceGFS. SE	137490	0.493	0	0	1	0.072	0.069
IceGFS a2 on a3.SE	133769	0.619	0	0	1	0.046	0.07
IceGFS.a1on a3. SE	291504	1.125	0	0	1	0.014	0.033
IceGFS. SW.	159298	0.473	0	0	1	0.078	0.059
IGFS. a2on a3. SW.	212891	0.559	0	0	1	0.056	0.045
IGFS.a1 on a3. SW.	207440	0.637	0	0	1	0.043	0.046
TRAWL.JUN.DEC.N	1	0	0	0	0	0	0
TRAWL.JUN.DEC.SW	1	0	0	0	0	0	0
TRAWL.JUN.DEC.SE	1	0	0	0	0	0	0
TRAWL.JAN.MAY.N	1	0	0	0	0	0	0
TRAWL.JAN.MAY.SW	1	0	0	0	0	0	0
GIILLNET JAN.MAY.S	1	0	0	0	0	0	0
P shrinkage mean	117443	0.46				0.083	0.08
F shrinkage mean	104595	0.5				0.07	0.089

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
115684	0.13	0.09	11	0.688	0.081

1

Age 4 Catchability dependent on age and year class strength

Year class = 1991

Table 3.3.11 (Continued)

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	34893	0.238	0.102	0.43	2	0.191	0.212
IceGFS. a2 on a3. N	30156	0.35	0	0	1	0.088	0.242
IceGFS. a1 on a3. N	27570	0.345	0	0	1	0.091	0.262
IceGFS. SE	59936	0.333	0.002	0.01	2	0.098	0.129
IceGFS. a2 on a3.SE	84508	0.681	0	0	1	0.023	0.093
IceGFS. a1on a3. SE	72830	1.186	0	0	1	0.008	0.107
IceGFS. SW.	40916	0.361	0.086	0.24	2	0.083	0.184
IceGFS. a2on a3. SW	49523	0.601	0	0	1	0.03	0.154
IGFS.a1 on a3. SW.	77578	0.675	0	0	1	0.024	0.101
TRAWL.JUN.DEC.N	45287	0.329	0	0	1	0.1	0.167
TRAWL.JUN.DEC.SW	38060	0.329	0	0	1	0.1	0.196
TRAWL.JUN.DEC.SE	1	0	0	0	0	0	0
TRAWL.JAN.MAY.N	31322	0.426	0	0	1	0.06	0.234
TRAWL.JAN.MAY.SW	1	0	0	0	0	0	0
NET JAN.MAY.S	1	0	0	0	0	0	0
P shrinkage mean	79139	0.42				0.061	0.099
F shrinkage mean	24227	0.5				0.043	0.29

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
40522	0.1	0.08	17	0.812	0.185

1

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

Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	39342	0.22	0.019	0.09	3	0.181	0.327
IceGFS. a2 on a3.N	46361	0.407	0	0	1	0.053	0.284
IceGFS. a1 on a3.N	52232	0.407	0	0	1	0.053	0.256
IceGFS. SE	71917	0.338	0.09	0.27	3	0.077	0.192
IceGFS. a2 on a3.SE	100355	0.857	0	0	1	0.012	0.141
IceGFS. a1on a3.SE	252275	1.602	0	0	1	0.003	0.059
IceGFS. SW.	62215	0.296	0.102	0.35	3	0.1	0.219
IceGFS. a2on a3.SW	105090	0.755	0	0	1	0.015	0.135
IceGFS.a1 on a3.SW	60954	0.806	0	0	1	0.014	0.223
TRAWL.JUN.DEC.N	63963	0.253	0.045	0.18	2	0.137	0.214
TRAWL.JUN.DEC.SW	54593	0.253	0.11	0.44	2	0.137	0.246
TRAWL.JUN.DEC.SE	106523	0.525	0	0	1	0.032	0.134
TRAWL.JAN.MAY.N	56274	0.257	0.113	0.44	2	0.132	0.24
TRAWL.JAN.MAY.SW	39825	0.674	0	0	1	0.019	0.324
GILLNET JAN.MAY.S	1	0	0	0	0	0	0
F shrinkage mean	24571	0.5				0.035	0.483

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
54640	0.09	0.07	24	0.696	0.246

1

Table 3.3.11 (Continued)

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

Year class = 1989

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	28104	0.222	0.1	0.45	4	0.158	0.351
IceGFS. a2 on a3.N	26363	0.506	0	0	1	0.03	0.371
IceGFS. a1 on a3.N	25126	0.506	0	0	1	0.03	0.386
IceGFS. SE	43534	0.3	0.14	0.47	4	0.086	0.241
IceGFS. a2 on a3.SE	33165	1.011	0	0	1	0.008	0.305
IceGFS. a1on a3.SE	14831	1.763	0	0	1	0.003	0.587
IceGFS. SW.	37731	0.284	0.091	0.32	4	0.097	0.273
IceGFS. a2on a3.SW	18461	0.871	0	0	1	0.01	0.495
IceGFS.a1 on a3.SW	36666	1.011	0	0	1	0.008	0.28
TRAWL.JUN.DEC.N	29525	0.249	0.096	0.38	3	0.126	0.337
TRAWL.JUN.DEC.SW	24462	0.248	0.075	0.3	3	0.126	0.395
TRAWL.JUN.DEC.SE	41131	0.455	0.287	0.63	2	0.038	0.253
TRAWL.JAN.MAY.N	24803	0.24	0.052	0.22	3	0.135	0.39
TRAWL.JAN.MAY.SW	33924	0.327	0.023	0.07	2	0.073	0.299
GILLNET JAN.MAY.S	28677	0.431	0	0	1	0.042	0.346
F shrinkage mean	11161	0.5				0.031	0.723

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
28964	0.09	0.05	33	0.595	0.343

1

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

Year class = 1988

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	5523	0.271	0.18	0.66	5	0.141	0.516
IceGFS. a2 on a3.N	6210	0.779	0	0	1	0.017	0.47
IceGFS. a1 on a3.N	7887	0.779	0	0	1	0.017	0.387
IceGFS. SE	8409	0.331	0.1	0.3	5	0.094	0.367
IceGFS. a2 on a3SE	2852	1.717	0	0	1	0.003	0.836
IceGFS. a1on a3.SE	2708	2.856	0	0	1	0.001	0.866
IceGFS. SW.	6213	0.308	0.177	0.57	5	0.108	0.47
IceGFS. a2on a3.SW	5687	1.355	0	0	1	0.006	0.504
IceGFS.a1 on a3.SW	3233	1.674	0	0	1	0.004	0.767
TRAWL.JUN.DEC.N	4761	0.261	0.08	0.31	4	0.151	0.578
TRAWL.JUN.DEC.SW	5091	0.334	0.204	0.61	4	0.092	0.549
TRAWL.JUN.DEC.SE	4465	0.436	0.162	0.37	3	0.054	0.607
TRAWL.JAN.MAY.N	6045	0.303	0.098	0.32	4	0.112	0.48
TRAWL.JAN.MAY.SW	7252	0.369	0.266	0.72	3	0.076	0.415
GILLNET JAN.MAY.S	8323	0.353	0.036	0.1	2	0.083	0.37
F shrinkage mean	2599	0.5				0.041	0.89

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5791	0.1	0.06	42	0.575	0.497

1

Table 3.3.11 (Continued)

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

Year class = 1987

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	1717	0.403	0.107	0.26	6	0.121	0.611
IceGFS. a2 on a3.N	1597	1.482	0	0	1	0.009	0.645
IceGFS. a1 on a3.N	2040	1.482	0	0	1	0.009	0.536
IceGFS. SE	2212	0.445	0.131	0.29	6	0.099	0.503
IceGFS. a2 on a3SE	1282	2.98	0	0	1	0.002	0.755
IceGFS. a1on a3.SE	884	5.265	0	0	1	0.001	0.969
IceGFS. SW.	1977	0.404	0.125	0.31	6	0.12	0.549
IceGFS. a2on a3.SW	1246	2.59	0	0	1	0.003	0.77
IceGFS.a1 on a3.SW	2723	2.941	0	0	1	0.002	0.426
TRAWL.JUN.DEC.N	1486	0.337	0.082	0.24	5	0.172	0.679
TRAWL.JUN.DEC.SW	1532	0.616	0.076	0.12	4	0.052	0.665
TRAWL.JUN.DEC.SE	1107	0.587	0.229	0.39	4	0.057	0.835
TRAWL.JAN.MAY.N	2169	0.543	0.169	0.31	4	0.067	0.511
TRAWL.JAN.MAY.SW	1610	0.481	0.092	0.19	4	0.085	0.641
GILLNET JAN.MAY.S	2508	0.399	0.043	0.11	3	0.123	0.455
F shrinkage mean	943	0.5				0.078	0.929

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1710	0.14	0.05	49	0.365	0.613

1

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

Year class = 1986

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	261	0.7	0.06	0.09	6	0.093	0.735
IceGFS. a2 on a3.N	432	2.531	0	0	1	0.007	0.504
IceGFS. a1 on a3.N	342	2.531	0	0	1	0.007	0.603
IceGFS. SE	321	0.775	0.22	0.28	6	0.076	0.632
IceGFS. a2 on a3SE	237	5.379	0	0	1	0.002	0.786
IceGFS. a1on a3.SE	254	9	0	0	1	0.001	0.749
IceGFS. SW.	178	0.696	0.134	0.19	6	0.094	0.952
IceGFS. a2on a3.SW	355	4.433	0	0	1	0.002	0.586
IceGFS.a1 on a3.SW	143	5.907	0	0	1	0.001	1.093
TRAWL.JUN.DEC.N	419	0.596	0.053	0.09	4	0.128	0.516
TRAWL.JUN.DEC.SW	373	1.249	0.185	0.15	3	0.029	0.565
TRAWL.JUN.DEC.SE	321	1.018	0.281	0.28	4	0.044	0.633
TRAWL.JAN.MAY.N	264	1.068	0.293	0.27	3	0.04	0.728
TRAWL.JAN.MAY.SW	199	0.835	0.146	0.18	4	0.066	0.884
GILLNET JAN.MAY.S	524	0.449	0.098	0.22	4	0.227	0.432
F shrinkage mean	226	0.5				0.183	0.812

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
312	0.21	0.07	47	0.313	0.645

Table 3.3.11 (Continued)

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Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1985

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	304	0.993	0.096	0.1	6	0.066	0.437
IceGFS. a2 on a3.N	432	3.563	0	0	1	0.005	0.326
IceGFS. a1 on a3.N	352	3.563	0	0	1	0.005	0.387
IceGFS. SE	227	1.091	0.119	0.11	6	0.054	0.55
IceGFS. a2 on a3SE	498	7.406	0	0	1	0.001	0.288
IceGFS. a1on a3.SE	121	12.584	0	0	1	0	0.865
IceGFS. SW.	256	0.992	0.139	0.14	6	0.066	0.5
IceGFS. a2on a3.SW	178	6.158	0	0	1	0.002	0.66
IceGFS.a1 on a3.SW	157	7.132	0	0	1	0.001	0.722
TRAWL.JUN.DEC.N	374	0.886	0.017	0.02	3	0.083	0.368
TRAWL.JUN.DEC.SW	406	2.21	0.257	0.12	2	0.013	0.344
TRAWL.JUN.DEC.SE	408	1.539	0.224	0.15	3	0.027	0.342
TRAWL.JAN.MAY.N	272	1.788	0.072	0.04	2	0.02	0.477
TRAWL.JAN.MAY.SW	234	1.204	0.09	0.07	3	0.045	0.538
GILLNET JAN.MAY.S	433	0.43	0.154	0.36	5	0.351	0.325
F shrinkage mean	141	0.5				0.26	0.778

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
279	0.25	0.09	43	0.34	0.468

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Age 11 Catchability constant w.r.t. time and dependent on age

Year class = 1984

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	165	1.727	0.095	0.05	6	0.045	0.619
IceGFS. a2 on a3.N	214	5.3	0	0	1	0.005	0.507
IceGFS. a1 on a3.N	210	5.3	0	0	1	0.005	0.514
IceGFS. SE	152	2	0.216	0.11	6	0.034	0.657
IceGFS. a2 on a3SE	163	10.768	0	0	1	0.001	0.624
IceGFS. a1on a3.SE	432	20.247	0	0	1	0	0.283
IceGFS. SW.	228	1.8	0.153	0.09	6	0.042	0.482
IceGFS. a2on a3.SW	206	9.67	0	0	1	0.001	0.522
IceGFS.a1 on a3.SW	176	10.789	0	0	1	0.001	0.589
TRAWL.JUN.DEC.N	152	1.802	0.073	0.04	2	0.041	0.657
TRAWL.JUN.DEC.SW	349	7.49	0	0	1	0.002	0.34
TRAWL.JUN.DEC.SE	196	3.15	0.474	0.15	2	0.014	0.543
TRAWL.JAN.MAY.N	183	5.163	0	0	1	0.005	0.571
TRAWL.JAN.MAY.SW	314	2.714	0.226	0.08	2	0.018	0.371
GILLNET JAN.MAY.S	273	0.741	0.141	0.19	5	0.246	0.417
F shrinkage mean	151	0.5				0.539	0.659

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
183	0.37	0.07	38	0.178	0.572

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Table 3.3.11 (Continued)

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1983

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	89	1.788	0.238	0.13	6	0.049	0.888
IceGFS. a2 on a3. N	117	6.49	0	0	1	0.004	0.736
IceGFS. a1 on a3.N	107	6.49	0	0	1	0.004	0.784
IceGFS. SE	113	2.004	0.18	0.09	6	0.039	0.755
IceGFS. a2 on a3SE	103	13.275	0	0	1	0.001	0.805
IceGFS. a1on a3.SE	46	22.426	0	0	1	0	1.329
IceGFS. SW.	161	1.82	0.07	0.04	6	0.048	0.583
IceGFS. a2on a3.SW	146	12.21	0	0	1	0.001	0.627
IceGFS.a1 on a3.SW	101	13.15	0	0	1	0.001	0.818
TRAWL.JUN.DEC.N	83	2.356	0	0	1	0.028	0.928
TRAWL.JUN.DEC.SW	1	0	0	0	0	0	0
TRAWL.JUN.DEC.SE	159	4.519	0	0	1	0.008	0.589
TRAWL.JAN.MAY.N	1	0	0	0	0	0	0
TRAWL.JAN.MAY.SW	168	3.317	0	0	1	0.014	0.565
GILLNET JAN.MAY.S	124	0.958	0.108	0.11	5	0.172	0.705
F shrinkage mean	138	0.5				0.631	0.656

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
131	0.4	0.04	33	0.106	0.681

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Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1982

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	29	1.884	0.089	0.05	6	0.047	0.638
IceGFS. a2 on a3.N	48	7.158	0	0	1	0.003	0.437
IceGFS. a1 on a3.N	1	0	0	0	0	0	0
IceGFS. SE	41	2.073	0.074	0.04	6	0.039	0.496
IceGFS. a2 on a3SE	16	15.492	0	0	1	0.001	0.956
IceGFS. a1on a3.SE	1	0	0	0	0	0	0
IceGFS. SW.	42	1.893	0.171	0.09	6	0.047	0.484
IceGFS. a2on a3 SW	17	13.466	0	0	1	0.001	0.929
IceGFS.a1 on a3.SW	1	0	0	0	0	0	0
TRAWL.JUN.DEC.N	1	0	0	0	0	0	0
TRAWL.JUN.DEC.SW	1	0	0	0	0	0	0
TRAWL.JUN.DEC.SE	1	0	0	0	0	0	0
TRAWL.JAN.MAY.N	1	0	0	0	0	0	0
TRAWL.JAN.MAY.SW	1	0	0	0	0	0	0
GILLNET JAN.MAY.S	32	0.942	0.075	0.08	5	0.189	0.596
F shrinkage mean	47	0.5				0.672	0.442

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
42	0.41	0.06	27	0.146	0.482

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Table 3.3.11 (Continued)

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1981

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
IceGFS. N.	11	3.447	0.057	0.02	6	0.018	0.504
IceGFS. a2 on a3.N	1	0	0	0	0	0	0
IceGFS. a1 on a3.N	1	0	0	0	0	0	0
IceGFS. SE	11	3.723	0.107	0.03	6	0.015	0.516
IceGFS. a2 on a3SE	1	0	0	0	0	0	0
IceGFS. a1on a3 SE.	1	0	0	0	0	0	0
IceGFS. SW.	10	3.377	0.106	0.03	6	0.019	0.56
IceGFS. a2on a3 SW	1	0	0	0	0	0	0
IceGFS.a1 on a3.SW	1	0	0	0	0	0	0
TRAWL.JUN.DEC.N	1	0	0	0	0	0	0
TRAWL.JUN.DEC.SW	1	0	0	0	0	0	0
TRAWL.JUN.DEC.SE	1	0	0	0	0	0	0
TRAWL.JAN.MAY.N	1	0	0	0	0	0	0
TRAWL.JAN.MAY.SW	1	0	0	0	0	0	0
GILLNET JAN.MAY.S	7	1.531	0.119	0.08	4	0.091	0.742
F shrinkage mean	9	0.5				0.856	0.574

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9	0.46	0.04	23	0.094	0.586

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Table 3.3.12. Icelandic Cod. Fishing mortality

Age	1976	1977	1978	1979	1980	1981	1982
3	0.083	0.020	0.030	0.033	0.034	0.016	0.027
4	0.263	0.212	0.169	0.195	0.176	0.137	0.221
5	0.363	0.355	0.351	0.211	0.358	0.388	0.400
6	0.617	0.368	0.333	0.513	0.378	0.470	0.541
7	0.596	0.810	0.494	0.487	0.442	0.635	0.581
8	0.938	0.657	0.660	0.503	0.554	0.839	1.046
9	0.764	0.995	0.505	0.507	0.514	0.802	1.187
10	1.270	0.608	0.530	0.339	0.453	0.950	0.909
11	1.363	0.562	0.343	0.531	0.425	0.982	0.479
12	0.940	0.547	0.719	0.200	0.700	0.904	0.404
13	2.490	0.078	0.806	1.020	0.171	1.076	0.417
14	1.365	0.558	0.580	0.519	0.453	0.943	0.679
W.Av 5-10	0.521	0.438	0.372	0.403	0.404	0.528	0.582
Ave 5-10	0.758	0.632	0.479	0.427	0.450	0.681	0.777

Age	1983	1984	1985	1986	1987	1988	1989
3	0.017	0.055	0.051	0.070	0.045	0.045	0.036
4	0.120	0.211	0.288	0.222	0.309	0.222	0.265
5	0.433	0.323	0.388	0.580	0.517	0.506	0.485
6	0.622	0.539	0.572	0.697	0.784	0.832	0.601
7	0.767	0.598	0.683	0.882	0.976	0.951	0.716
8	0.852	0.900	0.730	0.935	0.993	1.391	0.871
9	0.930	0.746	0.801	0.806	0.973	1.108	0.816
10	1.082	0.634	0.770	0.763	0.706	0.982	0.542
11	0.671	0.639	0.612	0.740	0.581	1.028	0.658
12	0.678	0.586	0.641	0.672	0.664	0.902	0.966
13	0.532	0.685	0.710	0.445	0.738	2.330	0.571
14	0.779	0.658	0.707	0.685	0.733	1.270	0.711
W.Av 5-10	0.609	0.479	0.486	0.688	0.696	0.628	0.543
Ave 5-10	0.781	0.623	0.657	0.777	0.825	0.962	0.672

Age	1990	1991	1992	1993	1994	1995	1992-1995
3	0.050	0.096	0.078	0.133	0.090	0.081	0.095
4	0.234	0.316	0.373	0.309	0.228	0.185	0.274
5	0.443	0.517	0.648	0.487	0.306	0.246	0.422
6	0.639	0.769	0.928	0.813	0.434	0.343	0.629
7	0.783	0.946	1.076	0.885	0.708	0.497	0.792
8	0.791	0.782	1.016	1.060	0.939	0.613	0.907
9	0.777	0.728	0.612	1.201	0.689	0.645	0.787
10	0.829	0.849	0.468	0.926	0.769	0.468	0.658
11	0.617	0.943	0.373	0.711	0.595	0.572	0.563
12	0.757	0.808	0.678	0.523	0.425	0.681	0.577
13	0.430	0.365	0.344	0.524	0.588	0.482	0.485
14	0.682	0.739	0.495	0.777	0.613	0.570	0.614
W.Av 5-10	0.594	0.751	0.799	0.691	0.382	0.309	0.631
Ave 5-10	0.710	0.765	0.791	0.895	0.641	0.469	0.699

Table 3.3.13. Icelandic Cod. Stock in numbers (millions).

Age	1976	1977	1978	1979	1980	1981	1982
3	326.297	143.293	221.658	245.525	144.038	143.283	133.588
4	189.100	245.880	114.958	176.062	194.531	114.003	115.398
5	75.994	119.035	162.910	79.448	118.552	133.572	81.354
6	57.836	43.280	68.303	93.925	52.650	67.877	74.180
7	14.113	25.539	24.515	40.088	83.049	29.534	34.736
8	9.536	6.364	9.306	12.250	20.159	50.702	12.819
9	2.646	3.055	2.700	3.939	6.065	9.481	17.940
10	0.951	1.009	0.925	1.335	1.942	2.970	3.480
11	0.297	0.219	0.450	0.446	0.778	1.011	0.940
12	0.276	0.062	0.102	0.261	0.214	0.417	0.310
13	0.075	0.088	0.030	0.041	0.175	0.087	0.138
14	0.042	0.005	0.067	0.011	0.012	0.121	0.024
Juvenile	563.482	499.603	491.744	526.243	477.628	450.121	383.335
Adult	113.682	88.226	114.180	127.087	144.538	102.937	91.573
Sum 3- 3	326.297	143.293	221.658	245.525	144.038	143.283	133.589
Sum 4-14	350.867	444.536	384.266	407.805	478.128	409.775	341.319
Total	677.164	587.829	605.924	653.330	622.166	553.058	474.907

Age	1983	1984	1985	1986	1987	1988	1989
3	226.340	139.038	144.324	335.933	277.714	168.934	82.051
4	106.407	182.102	107.743	112.335	256.414	217.442	132.252
5	75.748	77.283	120.690	66.140	73.675	154.097	142.636
6	44.655	40.219	45.825	67.047	30.312	35.966	76.093
7	35.352	19.623	19.207	21.172	27.353	11.327	12.816
8	15.903	13.438	8.837	7.944	7.173	8.441	3.583
9	3.687	5.555	4.473	3.485	2.553	2.176	1.719
10	4.482	1.191	2.156	1.643	1.275	0.790	0.588
11	1.147	1.244	0.518	0.817	0.627	0.515	0.242
12	0.476	0.480	0.538	0.230	0.319	0.287	0.151
13	0.170	0.198	0.219	0.232	0.096	0.135	0.095
14	0.075	0.081	0.082	0.088	0.122	0.038	0.011
Juvenile	444.578	406.022	361.589	531.820	608.399	516.818	344.790
Adult	69.864	74.431	93.020	85.246	69.234	83.329	107.446
Sum 3- 3	226.340	139.038	144.324	335.933	277.714	168.934	82.051
Sum 4-14	288.103	341.415	310.285	281.133	399.918	431.213	370.185
Total	514.442	480.453	454.609	617.066	677.633	600.147	452.236

Age	1990	1991	1992	1993	1994	1995	1996
3	130.623	102.830	180.138	181.578	60.000	115.000	195.000
4	64.826	101.724	76.475	136.463	130.186	44.911	86.828
5	83.111	41.995	60.702	43.124	81.999	84.862	30.547
6	102.922	43.674	20.508	25.993	21.691	49.460	54.322
7	34.166	44.458	16.567	6.636	9.443	11.510	28.745
8	5.127	12.779	14.129	4.623	2.243	3.809	5.732
9	1.228	1.903	4.787	4.189	1.312	0.719	1.690
10	0.622	0.462	0.752	2.126	1.032	0.539	0.309
11	0.280	0.222	0.162	0.386	0.690	0.392	0.276
12	0.103	0.124	0.071	0.091	0.155	0.311	0.181
13	0.047	0.039	0.045	0.029	0.044	0.083	0.129
14	0.044	0.025	0.022	0.026	0.014	0.020	0.042
Juvenile	310.007	247.118	265.717	242.110	147.817	158.193	239.648
Adult	113.093	103.119	108.643	163.155	160.992	153.422	164.153
Sum 3- 3	130.623	102.830	180.138	181.578	60.000	115.000	195.000
Sum 4-14	292.476	247.407	194.221	223.687	248.810	196.615	208.801
Total	423.099	350.237	374.360	405.265	308.810	311.615	403.801

Table 3.3.14. Icelandic Cod. Spawning stock biomass (tonnes).

Age	1976	1977	1978	1979	1980	1981	1982
3	18.342	0.000	10.689	0.000	10.271	0.000	2.917
4	16.044	18.155	8.826	5.033	6.867	4.674	8.748
5	46.708	60.349	75.078	34.391	46.055	20.608	18.925
6	101.364	92.719	102.241	164.298	82.994	52.345	40.896
7	36.343	93.539	101.232	142.178	293.394	65.637	62.440
8	39.358	29.197	44.333	60.424	97.902	174.046	36.503
9	15.111	13.639	18.245	23.794	35.896	44.875	62.996
10	5.008	6.946	7.402	9.432	15.614	15.691	19.198
11	1.747	2.002	4.695	4.251	7.633	6.445	8.216
12	1.935	0.634	0.887	2.946	2.469	3.193	3.271
13	0.304	1.381	0.365	0.317	2.450	0.582	1.845
14	0.320	0.092	1.024	0.152	0.233	1.052	0.277
Total	282.583	318.652	375.017	447.214	601.778	389.148	266.232

Age	1983	1984	1985	1986	1987	1988	1989
3	0.000	0.000	4.174	1.877	6.784	7.604	0.000
4	12.671	10.556	9.014	9.769	19.219	6.376	8.878
5	23.104	28.993	48.131	35.640	40.128	66.566	65.882
6	34.837	47.196	71.065	100.372	56.193	45.492	124.735
7	53.323	43.631	54.581	52.847	74.002	26.681	40.286
8	41.485	39.725	34.175	28.893	27.058	22.660	13.810
9	13.517	24.331	21.240	17.369	11.340	8.275	7.591
10	19.368	7.882	13.104	9.843	8.850	3.847	4.023
11	8.440	9.328	4.167	5.760	4.958	2.976	2.012
12	4.322	4.755	5.002	2.166	2.349	1.679	0.779
13	1.773	2.090	2.272	2.465	1.021	0.596	0.724
14	0.906	0.929	1.051	1.116	1.348	0.214	0.104
Total	213.746	219.416	267.975	268.117	253.250	192.967	268.823

Age	1990	1991	1992	1993	1994	1995
3	0.000	0.000	10.736	13.814	6.487	4.980
4	5.897	10.227	21.259	47.419	58.382	29.726
5	45.753	16.793	60.072	43.022	98.175	151.417
6	163.448	54.683	33.328	50.121	53.217	126.209
7	92.568	89.526	42.408	20.599	31.746	36.619
8	20.863	45.182	46.295	16.748	8.081	16.200
9	6.849	9.258	22.513	16.479	6.895	3.809
10	4.073	2.610	4.709	11.126	5.107	4.056
11	2.401	1.516	1.508	2.898	5.274	3.071
12	1.052	1.148	0.658	0.812	1.517	2.420
13	0.559	0.447	0.563	0.315	0.458	0.822
14	0.524	0.338	0.190	0.316	0.177	0.222
Total	343.986	231.729	244.238	223.667	275.517	379.550

Table 3.3.15. Icelandic Cod. Average fishing mortality of agegroups 5-10, recruitment (at age 3, in millions), spawning stock at spawning time ('000 tonnes).

Year	F5-10	Recruitment	SSB
1955	0.31	260	1261
1956	0.26	307	1199
1957	0.32	153	1145
1958	0.32	191	1034
1959	0.33	143	928
1960	0.38	163	825
1961	0.33	292	760
1962	0.4	255	729
1963	0.45	273	683
1964	0.54	328	569
1965	0.61	174	454
1966	0.54	255	412
1967	0.49	186	476
1968	0.67	178	594
1969	0.53	136	693
1970	0.56	303	684
1971	0.62	170	615
1972	0.71	265	477
1973	0.71	432	436
1974	0.76	143	329
1975	0.81	222	339
1976	0.76	246	283
1977	0.63	144	319
1978	0.48	143	375
1979	0.43	134	447
1980	0.45	226	602
1981	0.68	139	389
1982	0.78	144	266
1983	0.78	336	214
1984	0.62	335	219
1985	0.66	169	268
1986	0.78	82	268
1987	0.82	131	253
1988	0.96	103	193
1989	0.67	180	269
1990	0.71	182	344
1991	0.77	60	232
1992	0.79	115	244
1993	0.9	195	224
1994	0.64	85	276
1995	0.47	150	380

Table 3.3.16. Iceland Cod. Capelin biomass ('000 tonnes) used for prediction of cod mean weights.

Year	Total
1979	2386
1980	1482
1981	998
1982	463
1983	1000
1984	1950
1985	2380
1986	2473
1987	2358
1988	2076
1989	1732
1990	1195
1991	1045
1992	1593
1993	1639
1994	1636
1995	1714
1996	2400
Average	**1696**

Table 3.3.17: Icelandic Cod, input file for the RCT3 program.

VPA and Groundfish survey indices
4 21 2

'Ycl '	'VPA'	'SUR4'	'SUR3'	'SUR2'	'SUR1'
75	222	-11	-11	-11	-11
76	245	-11	-11	-11	-11
77	144	-11	-11	-11	-11
78	143	-11	-11	-11	-11
79	134	-11	-11	-11	-11
80	226	-11	-11	-11	-11
81	139	55261	-11	-11	-11
82	144	22540	31297	-11	-11
83	336	77227	84656	39301	-11
84	278	92490	99294	52943	16492
85	169	60113	68604	25874	13903
86	82	8272	17511	5820	2605
87	131	22262	19408	14921	1711
88	103	13601	15633	11786	2048
89	180	31684	30540	14473	3509
90	182	18211	26030	16407	1712
91	-11	4301	5556	2237	223
92	-11	16420	17477	10539	1312
93	-11	-11	35893	28480	8920
94	-11	-11	-11	3833	487
95	-11	-11	-11	-11	2448

Table 3.3.18. Icelandic Cod, output from the RCT3.

Analysis by RCT3 ver3.1 of data from file :

gb96.inn3

Icelandic Cod: VPA and Groundfish survey indices

Data for 4 surveys over 21 years : 75 - 95

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

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as 0.20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 89

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SUR4	0.60	-1.13	0.25	0.804	8	10.36	5.04	0.313	0.226
SUR3	0.69	-2.21	0.24	0.838	7	10.33	4.94	0.312	0.228
SUR2	0.70	-1.85	0.19	0.913	6	9.58	4.88	0.256	0.338
SUR1	0.52	0.56	0.38	0.675	5	8.16	4.80	0.536	0.077
					VPA Mean =		5.09	0.413	0.130

Yearclass = 90

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SUR4	0.60	-1.16	0.24	0.797	9	9.81	4.73	0.300	0.258
SUR3	0.71	-2.31	0.25	0.806	8	10.17	4.86	0.312	0.238
SUR2	0.72	-1.95	0.22	0.861	7	9.71	5.01	0.282	0.292
SUR1	0.57	0.17	0.41	0.581	6	7.45	4.45	0.584	0.068
					VPA Mean =		5.09	0.401	0.144

Yearclass = 91

	Regression					Prediction			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
SUR4	0.62	-1.35	0.29	0.707	10	8.37	3.87	0.439	0.216
SUR3	0.73	-2.48	0.27	0.751	9	8.62	3.77	0.441	0.214
SUR2	0.73	-2.02	0.22	0.841	8	7.71	3.59	0.400	0.261
SUR1	0.69	-0.64	0.57	0.370	7	5.41	3.08	1.106	0.034
					VPA Mean =		5.10	0.389	0.275

Table 3.3.18 (Continued)

Yearclass = 92

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	---------I		I-----------	Prediction	----------	---------I
SUR4	0.62	-1.32	0.29	0.711	10	9.71	4.71	0.354	0.218
SUR3	0.73	-2.48	0.27	0.747	9	9.77	4.61	0.351	0.222
SUR2	0.73	-2.03	0.22	0.839	8	9.26	4.71	0.284	0.341
SUR1	0.69	-0.69	0.58	0.363	7	7.18	4.29	0.809	0.042
					VPA Mean =		5.09	0.394	0.177

Yearclass = 93

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	---------I		I-----------	Prediction	----------	---------I
SUR4									
SUR3	0.73	-2.49	0.28	0.743	9	10.49	5.13	0.340	0.302
SUR2	0.73	-2.04	0.22	0.836	8	10.26	5.44	0.287	0.426
SUR1	0.70	-0.77	0.59	0.353	7	9.10	5.63	0.816	0.052
					VPA Mean =		5.08	0.399	0.220

Yearclass = 94

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	---------I		I-----------	Prediction	----------	---------I
SUR4									
SUR3									
SUR2	0.73	-2.06	0.22	0.832	8	8.25	3.98	0.372	0.505
SUR1	0.72	-0.88	0.61	0.341	7	6.19	3.57	1.046	0.064
					VPA Mean =		5.08	0.403	0.431

Yearclass = 95

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------	---------I		I-----------	Prediction	----------	---------I
SUR4									
SUR3									
SUR2									
SUR1	0.74	-1.02	0.63	0.327	7	7.80	4.74	0.847	0.188
					VPA Mean =		5.07	0.408	0.812

Table 3.3.18 (Continued)

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
89	141	4.95	0.15	0.04	0.09	180	5.20
90	130	4.88	0.15	0.09	0.33	182	5.21
91	59	4.09	0.20	0.32	2.47		
92	114	4.74	0.17	0.09	0.32		
93	196	5.28	0.19	0.10	0.31		
94	83	4.42	0.26	0.41	2.36		
95	149	5.01	0.37	0.13	0.13		

Table 3.3.19

Cod in the Iceland Grounds (Fishing Area Va)

Prediction with management option table: Input data

Year: 1996

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	195000.00	0.2000	0.0400	0.0850	0.2500	1059.000	0.0610	1356.000
4	86828.000	0.2000	0.3080	0.1800	0.2500	1662.000	0.1450	1955.000
5	30547.000	0.2000	0.6070	0.2480	0.2500	2629.000	0.2087	2775.000
6	54322.000	0.2000	0.7700	0.2960	0.2500	3973.000	0.3193	3945.000
7	28745.000	0.2000	0.8430	0.3820	0.2500	5030.000	0.4197	5028.000
8	5732.000	0.2000	0.9400	0.4370	0.2500	6368.000	0.5245	6655.000
9	1690.000	0.2000	0.9860	0.4770	0.2500	7446.000	0.5091	7431.000
10	309.000	0.2000	0.9850	0.4770	0.2500	9268.000	0.4344	9148.000
11	276.000	0.2000	0.9980	0.4770	0.2500	11138.000	0.3545	11041.000
12	181.000	0.2000	0.9900	0.4770	0.2500	12748.000	0.3545	12910.000
13	129.000	0.2000	0.9950	0.4770	0.2500	14302.000	0.3545	14494.000
14	42.000	0.2000	1.0000	0.4770	0.2500	16500.000	0.3545	16199.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 1997

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	85000.000	0.2000	0.0370	0.0850	0.2500	1059.000	0.0610	1356.000
4	.	0.2000	0.2220	0.1800	0.2500	1662.000	0.1450	1862.000
5	.	0.2000	0.4850	0.2480	0.2500	2410.000	0.2087	2642.000
6	.	0.2000	0.7040	0.2960	0.2500	3666.000	0.3193	3675.000
7	.	0.2000	0.8330	0.3820	0.2500	5074.000	0.4197	5102.000
8	.	0.2000	0.9260	0.4370	0.2500	6364.000	0.5245	6321.000
9	.	0.2000	0.9720	0.4770	0.2500	7446.000	0.5091	7431.000
10	.	0.2000	0.9700	0.4770	0.2500	9268.000	0.4344	9148.000
11	.	0.2000	0.9950	0.4770	0.2500	11138.000	0.3545	11041.000
12	.	0.2000	0.9810	0.4770	0.2500	12748.000	0.3545	12910.000
13	.	0.2000	0.9900	0.4770	0.2500	14302.000	0.3545	14494.000
14	.	0.2000	1.0000	0.4770	0.2500	16500.000	0.3545	16199.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 1998

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	150000.00	0.2000	0.0330	0.0850	0.2500	1059.000	0.0610	1356.000
4	.	0.2000	0.1370	0.1800	0.2500	1662.000	0.1450	1862.000
5	.	0.2000	0.3630	0.2480	0.2500	2410.000	0.2087	2594.000
6	.	0.2000	0.6320	0.2960	0.2500	3511.000	0.3193	3600.000
7	.	0.2000	0.8230	0.3820	0.2500	4888.000	0.4197	4866.000
8	.	0.2000	0.9120	0.4370	0.2500	6394.000	0.5245	6367.000
9	.	0.2000	0.9580	0.4770	0.2500	7446.000	0.5091	7431.000
10	.	0.2000	0.9550	0.4770	0.2500	9268.000	0.4344	9148.000
11	.	0.2000	0.9930	0.4770	0.2500	11138.000	0.3545	11041.000
12	.	0.2000	0.9710	0.4770	0.2500	12748.000	0.3545	12910.000
13	.	0.2000	0.9850	0.4770	0.2500	14302.000	0.3545	14494.000
14	.	0.2000	1.0000	0.4770	0.2500	16500.000	0.3545	16199.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Notes: Run name : MANSAS01
Date and time: 04MAY96:20:44

Table 3.3.20

Cod in the Iceland Grounds (Fishing Area Va)

19:17 Saturday, May 4, 1996

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4026	851398	379349	170000	0.0000	0.0000	859637	423145	0	1126003	555928
.	.	.	.	.	0.0500	0.0201	.	420282	10872	1113655	542827
.	.	.	.	.	0.1000	0.0403	.	417445	21562	1101516	530100
.	.	.	.	.	0.1500	0.0604	.	414632	32075	1089584	517735
.	.	.	.	.	0.2000	0.0805	.	411844	42413	1077854	505722
.	.	.	.	.	0.2500	0.1007	.	409081	52580	1066322	494048
.	.	.	.	.	0.3000	0.1208	.	406341	62580	1054984	482705
.	.	.	.	.	0.3500	0.1409	.	403626	72416	1043836	471680
.	.	.	.	.	0.4000	0.1610	.	400934	82091	1032874	460965
.	.	.	.	.	0.4500	0.1812	.	398266	91607	1022096	450550
.	.	.	.	.	0.5000	0.2013	.	395621	100970	1011497	440425
.	.	.	.	.	0.5500	0.2214	.	392999	110180	1001073	430581
.	.	.	.	.	0.6000	0.2416	.	390400	119242	990821	421010
.	.	.	.	.	0.6500	0.2617	.	387824	128159	980738	411703
.	.	.	.	.	0.7000	0.2818	.	385270	136932	970821	402653
.	.	.	.	.	0.7500	0.3020	.	382738	145565	961065	393850
.	.	.	.	.	0.8000	0.3221	.	380228	154061	951469	385288
.	.	.	.	.	0.8500	0.3422	.	377740	162422	942029	376960
.	.	.	.	.	0.9000	0.3624	.	375274	170651	932741	368857
.	.	.	.	.	0.9500	0.3825	.	372828	178750	923603	360973
.	.	.	.	.	1.0000	0.4026	.	370404	186723	914613	353302
.	.	.	.	.	1.0500	0.4227	.	368001	194570	905766	345838
.	.	.	.	.	1.1000	0.4429	.	365618	202295	897061	338572
.	.	.	.	.	1.1500	0.4630	.	363256	209901	888494	331501
.	.	.	.	.	1.2000	0.4831	.	360915	217389	880064	324617
.	.	.	.	.	1.2500	0.5033	.	358593	224761	871767	317916
.	.	.	.	.	1.3000	0.5234	.	356291	232020	863600	311391
.	.	.	.	.	1.3500	0.5435	.	354009	239168	855562	305038
.	.	.	.	.	1.4000	0.5637	.	351747	246207	847649	298851
.	.	.	.	.	1.4500	0.5838	.	349504	253140	839860	292825
.	.	.	.	.	1.5000	0.6039	.	347280	259967	832193	286956
.	.	.	.	.	1.5500	0.6241	.	345075	266692	824644	281238
.	.	.	.	.	1.6000	0.6442	.	342889	273315	817211	275668
.	.	.	.	.	1.6500	0.6643	.	340721	279840	809893	270241
.	.	.	.	.	1.7000	0.6844	.	338572	286267	802687	264952
.	.	.	.	.	1.7500	0.7046	.	336441	292599	795591	259798
.	.	.	.	.	1.8000	0.7247	.	334328	298837	788603	254775
.	.	.	.	.	1.8500	0.7448	.	332233	304983	781721	249878
.	.	.	.	.	1.9000	0.7650	.	330156	311039	774943	245105
.	.	.	.	.	1.9500	0.7851	.	328097	317006	768267	240451
.	.	.	.	.	2.0000	0.8052	.	326054	322887	761692	235913
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSAS01
Date and time : 04MAY96:20:44
Computation of ref. F: Simple mean, age 5 - 10
Basis for 1996 : TAC constraints

Table 3.3.22

12:05 Wednesday, May 8, 1996

Cod in the Iceland Grounds (Fishing Area Va)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.016	23665.436	2.404	18396.950	2.287	17499.720
0.0500	0.0500	0.131	817.577	4.574	19274.757	2.005	14194.209	1.868	13174.603
0.1000	0.1000	0.225	1282.011	4.232	16083.737	1.702	11171.707	1.556	10130.672
0.1500	0.1500	0.293	1541.157	3.962	13724.420	1.469	8964.369	1.320	7953.245
0.2000	0.2000	0.345	1681.168	3.746	11948.841	1.286	7326.591	1.138	6369.195
0.2500	0.2500	0.386	1752.276	3.568	10588.356	1.141	6091.677	0.995	5196.883
0.3000	0.3000	0.419	1783.777	3.421	9527.126	1.023	5145.407	0.881	4314.256
0.3500	0.3500	0.446	1792.757	3.296	8684.744	0.927	4408.723	0.789	3638.383
0.4000	0.4000	0.468	1789.175	3.189	8004.767	0.846	3826.314	0.713	3112.260
0.4500	0.4500	0.488	1778.818	3.096	7447.109	0.778	3359.051	0.649	2696.218
0.5000	0.5000	0.505	1765.039	3.014	6982.948	0.720	2978.923	0.596	2362.302
0.5500	0.5500	0.520	1749.764	2.942	6591.305	0.671	2665.643	0.550	2090.556
0.6000	0.6000	0.533	1734.083	2.877	6256.708	0.627	2404.332	0.511	1866.542
0.6500	0.6500	0.545	1718.602	2.818	5967.602	0.589	2183.948	0.477	1679.681
0.7000	0.7000	0.556	1703.640	2.765	5715.246	0.556	1996.192	0.447	1522.114
0.7500	0.7500	0.566	1689.353	2.717	5492.943	0.526	1834.754	0.420	1387.932
0.8000	0.8000	0.575	1675.802	2.672	5295.497	0.499	1694.777	0.397	1272.633
0.8500	0.8500	0.584	1662.998	2.631	5118.832	0.475	1572.480	0.376	1172.748
0.9000	0.9000	0.592	1650.919	2.593	4959.711	0.453	1464.890	0.357	1085.570
0.9500	0.9500	0.599	1639.530	2.557	4815.536	0.434	1369.640	0.340	1008.966
1.0000	1.0000	0.606	1628.791	2.524	4684.200	0.415	1284.830	0.324	941.237
1.0500	1.0500	0.613	1618.657	2.492	4563.978	0.399	1208.920	0.310	881.016
1.1000	1.1000	0.619	1609.086	2.463	4453.444	0.384	1140.649	0.297	827.192
1.1500	1.1500	0.625	1600.036	2.435	4351.410	0.370	1078.978	0.286	778.858
1.2000	1.2000	0.630	1591.470	2.409	4256.879	0.357	1023.042	0.275	735.262
1.2500	1.2500	0.635	1583.351	2.384	4169.004	0.345	972.120	0.264	695.781
1.3000	1.3000	0.640	1575.647	2.361	4087.067	0.334	925.600	0.255	659.893
1.3500	1.3500	0.645	1568.327	2.338	4010.451	0.323	882.966	0.246	627.157
1.4000	1.4000	0.649	1561.364	2.317	3938.621	0.313	843.776	0.238	597.199
1.4500	1.4500	0.654	1554.733	2.297	3871.117	0.304	807.651	0.231	569.701
1.5000	1.5000	0.658	1548.411	2.277	3807.535	0.296	774.265	0.224	544.390
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDSAS01
Date and time : 05MAY96:13:49
Computation of ref. F: Simple mean, age 5 - 10
F-0.1 factor : 0.1947
F-max factor : 0.3562
F-0.1 reference F : 0.1947
F-max reference F : 0.3562
Recruitment : Single recruit

Table 3.3.21

12:05 Wednesday, May 8, 1996

Cod in the Iceland Grounds (Fishing Area Va)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.2000	0.0279	0.0850	0.2500	1074.000	0.0600	1307.000
4	.	0.2000	0.0958	0.1800	0.2500	1619.000	0.3300	1835.000
5	.	0.2000	0.2784	0.2480	0.2500	2437.000	0.6100	2600.000
6	.	0.2000	0.5391	0.2960	0.2500	3587.000	0.8600	3590.000
7	.	0.2000	0.7703	0.3820	0.2500	4959.000	1.0500	4859.000
8	.	0.2000	0.8991	0.4370	0.2500	6322.000	1.1600	6242.000
9	.	0.2000	0.9540	0.4770	0.2500	7784.000	1.1600	7733.000
10	.	0.2000	0.9691	0.4770	0.2500	9526.000	1.1600	9533.000
11	.	0.2000	0.9944	0.4770	0.2500	11512.000	1.1600	11425.000
12	.	0.2000	1.0000	0.4770	0.2500	13007.000	1.1600	13264.000
13	.	0.2000	1.0000	0.4770	0.2500	14797.000	1.1600	15073.000
14	.	0.2000	1.0000	0.4770	0.2500	17503.000	1.1600	17425.000
Unit	Numbers	-	-	-	-	Grams	-	Grams

Notes: Run name : YLDSAS01
Date and time: 05MAY96:13:49