Advisory Committee on Fishery Management

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PART 1

REPORT OF THE NORTH WESTERN WORKING GROUP

ICES Headquarters, Copenhagen, Denmark

3-10 May 1995

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International Council for the Exploration of the Sea

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1 INTRODUCTION

1.1 Participants

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1.2 Terms of Reference

The North Western Working Group (Chairman: Dr S.A. Schopka, Iceland) met at ICES Headquarters from 3-10 May 1995 to:

a. assess the status of and provide catch options for 1996 for the combined Greenland/Icelandic cod stock;

b. assess the status of and provide catch options for 1996 for the stocks of redfish in Sub-areas V, VI, XII, and XIV, Greenland halibut in Sub-areas V and XIV, saithe in Division Va and Division Vb, and cod and haddock in Division Vb;

c. for those stocks and/or fisheries where data permit, provide the information required for ACFM to give advice or guidance on:

   i) medium-term management objectives (in terms of spawning stock biomass and mortality rates) and options;

   ii) the appropriateness of controls on catch (or landings) and fishing effort;

   iii) the potential for multispecies and multi-annual catch options;

d. 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;

e. update the 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;

In addition to this at its Thirteenth Annual Meeting in November 1994 NEAFC requested ICES to:

a) provide quantitative information on the distribution, migration and stock-identification of the *Sebastes mentella* stocks;

b) provide advice on whether - for management purposes - "Oceanic" *S. mentella* and the "Deep sea" *S. mentella* caught in pelagic trawls can be considered as one stock;

c) provide advice on the medium-term consequences of setting catches at 5-155 of the estimated spawning stock biomass of "Oceanic" *S. mentella*;

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

In addition to the above terms of reference, ICES was requested in a letter dated 18 April 1995 from the Government of the Faroe Islands to evaluate the effects of the implementation of the following fixed TACs on Faroe demersal stocks:

a) Faroe Plateau cod: A fixed TAC of 7,000 t for each year up to and including 1998; in addition an alternative TAC of 8,500 t starting in the Quota year 1 September 1994-31 August 1995.

b) Faroe haddock: A fixed TAC of 6,200 t for each year up to and including 1998.

c) Faroe saithe. A fixed TAC of 42,000 t for each year up to and including 1998.

ICES was also asked to consider the effects of other levels of fixed TACs on the probability of reaching the minimum biologically acceptable levels of spawning stock biomass. These have been defined by ACFM as 40,000 t for haddock and 52,000 t for cod.

The Working Group was requested to prepare the appropriate forecasts to enable ACFM to address these requests.

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 yield of cod, haddock and saithe for Faroese fleet categories. For all categories there has been a decreasing trend in the cod and haddock fisheries, while for saithe the fishery in the most recent years has been rather stable. Jiggers have increased their catches of saithe mainly by increasing the effort, Table 2.1.4. The effort from the single trawlers have decreased and for pairtrawlers < 1000 HP as well.

As can be seen in the tables the fishery at the Faroes may be considered a multi-fleet and multi-species fishery. The long liners fish cod and haddock while trawlers fish all three species. On Figure 2.1.1 to 2.1.4 different plots regarding the demersal fishery in the Faroe area 1985-1994 are shown.

Characteristics for the plots are the decreasing trends in catches (Figure 2.1.1 and Figure 2.1.2) and in catch per unit effort (Figure 2.1.3 and Figure 2.1.4). The total demersal catches have decreased from 120,000 t in 1985 to 65,000 t in 1994. The decrease is mainly due to lower catches of cod, haddock and saithe. The catches have decreased for both trawlers and long liners. A slight increase can be seen in the catches from 1993 to 1994 and for some categories an increase in catch per unit effort.

In 1977 an EEZ was introduced in the Faroe area, (Figure 2.1.5). This gave the Faroese authorities the opportunity and the responsibility of the utilisation of the fish resources in the Faroe area. 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 and Faroe Saithe. The quota year starts 1 September and ends 31 August the following year. The Faroe Plateau cod quota for 1994/95 is 8,500 t, the haddock quota is 6,200 t and the saithe quota 42,000 t. The quota for Faroe Bank cod is set to 1,000 t.

The law stipulates that quotas should only be changed "...if the Fisheries Laboratory finds that the biological conditions have significantly changed from those present last time the quotas were set".

2.2 Faroe Plateau Cod

2.2.1 Trends in landings

The nominal landings of cod (1985-1994) 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. Since then, the catches have steadily decreased to the point where only 5,700 t were taken in 1993. This was the lowest catch on record. In 1994 the catches increased to 9,000 t, however.

In recent years, statistics for the Faroese fishery in that part of Sub-division IIa (Figure 2.1.5) 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 and 1994, however. Also included are the French catches of Faroe Plateau cod in 1989 and 1990 as reported to the Faroese authorities.

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 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 1994 for the long liners, trawlers and jiggers. The catch rates have steadily decreased until 1992 while in 1993 and 1994 an increase is seen. The 1987 year class became available for the long liners in 1989 as 2 year old and the catch rates increased. Preliminary information from the fishery during the first months of 1995, indicates higher catch rates than in the same period in the last 4 years.

2.2.2 Catch-at-age

Catch in numbers-at-age in 1994 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 Faroe Plateau were raised using the overall Faroese age composition. The catch-at-age in number in recent years was revised according to updated fishery statistics.

2.2.3 Mean weight-at-age

Mean weight-at-age data for 1994 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 1994 showed a discrepancy of 1 %.

Data on the mean weight-at-age by year are available in the ICES database from 1978. It has been shown (Jakupsstovu and Reinert, 1994) that the mean weight-at-age have steadily decreased over the last three decades, Figure 2.2.2. Since 1991 an increasing trend has been observed. Information on the mean weight-at-age in the 1st quarter in 1995 do not show an increasing trend compared to the same period in 1994.

2.2.4 Maturity-at-age

The proportion of mature cod by age are given in Table 2.2.6. Data are available back to 1983. The data were obtained during the Faroese groundfish surveys carried out in the spawning period (March).

2.2.5 Stock assessment

2.2.5.1 Tuning and estimates of fishing mortality

Eight catch and effort series were available for tuning the VPA. One series is derived from annual Faroese groundfish surveys initiated in 1983. 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. The R/V Magnus Heinason, has been used in the survey each year. Three cruises each year, with approximately 50 trawl stations in each, have been conducted between February and the end of March. From 1992, the February-cruise was moved to the autumn. 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.
From 1992, one third of the trawl stations are fixed stations. Since the 1993 survey all stations were fixed stations. The standard abundance estimates is the stratified mean catch per hour calculated using smoothed age/length keys.

The other catch and effort series available are obtained from long liners and trawlers. 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 were over a certain level. The same series were available and used by the North Western Working Group in 1994.

To look for possible differences in the behaviour of the tuning data each series are scaled to an average of 100 on each age group, Figure 2.2.3. Differences are seen for the not fully recruited ages (age groups 2 and 3) and in 1991 for age group 4. For the other ages the trend shows similar behaviour.

A Separable VPA with terminal F of 0.6 on age 5 and terminal S of 1.00 was carried out to check for catch data outliers, Table 2.2.7. Based on the matrix of residuals it was concluded that the catch at age data show a consistent pattern.

For each series independently Laurec-Shepherd *ad hoc* tuning run without shrinkage were made to examine the catchability residuals. The results are presented in Figure 2.2.4. The plots are used to look for changes in catchability. Trends in catchability are seen in the series from the single trawlers > 1000 HP and from pair trawlers < 1000 HP and pair trawlers > 1000 HP. These fleets were removed from the assessment. In addition age group 2 were removed from the remaining commercial series and age group 3 from the single trawlers 400-1000 HP. The final tuning data series are given in Table 2.2.8 to Table 2.2.12.

An initial XSA tuning based on the remaining tuning data was then made. The age at which catchability is assumed independent of year class strength was set to 8, the oldest true age group-1. Other settings was as default. The age group 2 is only included in the groundfish surveys series. By looking at the regression statistics fleet by fleet for the ages with catchability dependent on year class strength all the first age regression slopes appear to be independent of year class strength. If the tuning data for the first ages include survey data Darby and Flatman (1994) recommend that the first age is treated as recruits - catchability dependent of year class strength.

Following this the assessment was re-run with catchability dependent on stock size for age group 2. The age at which catchability is assumed independent of age was set to the penultimate true age - age 8. The log catchability means for all fleets are plotted against age in Figure 2.2.6. to find at which age the catchability is independent of age. Except for the longliners > 100 GRT the log catchabilities are becoming stable at age 5 and 6. Following the recommendations by Darby and Flatman (1994) the age at with catchability is independent of age was set to age 6.

Retrospective analysis of the fishing mortality were made using the XSA tuning assuming catchability dependent on stock size for age group 2 and catchability independent of age for age group 5, 6, 7, and 8 respectively and older. Analysis were made with different shrinkage (s.e. = 0.5 and s.e.= 0.3) and where the survivor estimates were shrunk towards the mean F of the final 3 or 5 years. The results of the analysis are shown in Figure 2.2.7 and Figure 2.2.8. It was decided to use the XSA with shrinkage of s.e.= 0.5 and the catchability independent of age 6 and older. The results from the tuning are given in Table 2.2.13.

The estimated fishing mortalities are shown in Table 2.2.14 and in Figure 2.2.9.A. The average F for age groups 3 to 7 in 1994 is estimated at 0.69 compared to $F_{(3-7)}$= 0.48 in 1993. The average fishing mortality is far above F_{max}. (F_{max}.= 0.31).

2.2.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.2.15. A summary of the VPA, with recruitment set at 2 years old, and biomass estimates are given in Table 2.2.16 and in Figure 2.2.9.B. The stock-recruitment relationship is presented in Figure 2.2.11. The assessment confirms the poor recruitment observed in the Faroe Plateau cod stock since 1984. Due to this continuous poor recruitment and the high fishing mortalities, the spawning stock biomass has steadily declined since 1984. In 1994 it is estimated at 25,000 t which is an relatively high increase compared to the biomass in 1993. The increase is partly due to a very high proportion of mature for ages 2 and 3 in 1994, Table 2.2.6.

2.2.6 Predictions of catch and biomass

2.2.6.1 Short-term prediction

In the short-term predictions the estimates of the year classes 1990 and older were used as they are estimated in the final VPA. The year classes 1991 to 1994 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 2.2.17. The output of the RCT3 prediction of recruitment program is given in Table 2.2.18. In recent years the recruitment to the Faroe Plateau cod stock has been poor. Based on this, the average of the 1984 to 1990 year classes, as estimated from VPA (7.5 millions at an age of 2), was used as input for the 1995 year class.

The input data for the short-term prediction are given in Table 2.2.19. The same exploitation pattern, as estimated from the final VPA, was used in the short term predictions. A trend of an increased growth rate since 1991 was observed (Figure 2.2.2). Preliminary information from 1. quarter 1995 compared with the same period in 1994 do not indicate any further increase in the mean weights. Therefore it was decided to used the most recent observed mean weights (from 1994) as input parameter for 1995-1997. The proportion mature as seen in the Faroese groundfish surveys in 1995 was used for 1995 while for 1996 and 1997 the average of the maturity ogive for 1983 to 1995 was used.

Two short term predictions were made. In the first case the predictions was based on a TAC constraint for 1995 of 7,000 t, which correspond to the fixed TAC on which the Government of the Faroe Islands decided to follow as rebuilding strategy for the Faroe Plateau cod. The other prediction was based on a TAC constraint in 1995 of 8,500 t, which correspond to the adopted catch quota for the quota year from 1 September to 31 August.

The results of the short-term predictions are shown in Table 2.2.20, (A and B) and in Figure 2.2.10.D. The spawning stock in 1995 is estimated at 16,000 t, which is well below the 1994 level. In 1996 it increased to 23,000 t. The drop in 1995 is partly due to the relatively low estimated proportion of mature for ages 3, 4 and 5 in 1995. The total stock biomass do not show the same drop in 1995 as the spawning stock.

Since recruitment in recent years has been poor, the stock biomass is not expected to increase substantially in the forthcoming years.

2.2.6.2 Medium-term prediction model and input data

Upon request from the Faroese Government, the Working Group considered the medium-term effect of implementing a catch limit of either 7,000 or 8,500 t 1995-1998.

This required first fitting the Ricker stock-recruitment curve given in Figure 2.2.11. This relationship was used for the 1995 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 (1995) 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 2.2.12 and Figure 2.2.13. A stock-crash is not observed in any of 100 the simulations. The recovery is, however, quite slow and the target of 52,000 t is unlikely to be met in 1998. The estimated probability of this is lesser than 5 %.

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.

2.2.6.3 Long-term prediction

The input data for the yield-per-recruit calculations (long-term predictions) are given in Table 2.2.21. As input for the fishing exploitation pattern, the estimated exploitation pattern for the years 1961-1994 from the final VPA was used. As input for mean weight-at-age the average for 1978 to 1994 was used and for the proportion of mature-by-age groups, the average for the years 1983 to 1994 was used as input.

The output from the yield-per-recruit calculations is shown in Table 2.2.22. and in Figure 2.2.10.C. $F_{0.1}$ and F_{max} are calculated to be 0.15 and 0.31, respectively. These values should be compared with the present average fishing mortality in 1994 of 0.69. From Figure 2.2.14, showing the spawning stock biomass per recruit relationship, the values of F_{med}=0.38 and F_{high}=1.26 were estimated.

2.2.7 Management considerations

The assessment of the Faroe Plateau cod presented in this report has revealed that the stock size is at a very low level. Since 1988, the recruitment has almost totally failed. Due to the poor recruitment, the catches have decreased substantially in recent years. The spawning stock biomass is also at a very low level. By continued fishing at the current level, the probability of stock recovering in the next few years is reduced.

2.2.8 Comments on the assessment

The assessment is based on one tuning series from the annual Faroese groundfish surveys (1983-1994) as well as on five commercial catch/effort series (1985-1994). The distribution of the log catchability residuals from the groundfish surveys series may indicate a limitation on the usefulness of the series for tuning the VPA. Due to the substantial decrease of catches in recent years, the amount upon which the tuning series from the commercial fleet categories are based, have declined as well.

Although there might be some reservations on the quality of the data used for the tuning of the VPA the present assessment is found to be in accordance with the general understanding regarding the situation of the Faroe Plateau cod stock.

2.3 Faroe Bank Cod

2.3.1 Trends in landings and effort

Total nominal landings of the Faroe Bank cod from 1984 to 1994 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 380 t in 1993. In 1994 the catches increased to 700 t.

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 1994 to 31 August 1995 a fixed quota of 1,000 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.

Figure 2.3.1 show catch per unit effort (kg/day) of cod on Faroe Bank for two categories of long liners. 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 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. In recent years, 1991-1994, an increasing trend in catches has been observed although they still remain low. This year the groundfish surveys did not cover the Faroe Bank.

The length distribution in the long line fishery in 1993 and during the spring in 1994 and 1995 are shown in Figure 2.3.3. During the spring in 1995 the catches mainly consisted of fish between 45-80 cm. In the same period in 1994 the catches also consisted of fish large than 85 cm.

2.3.3 Management considerations

The data presented indicate that the stock still remains at a low level of abundance.

2.4 Faroe Haddock

2.4.1 Landings and trends in the fishery

Official 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 have since decreased to a very low level in 1993 and 1994 below 4,000 t (Table 2.4.1). Officially reported catches 1981-1992 from the Faroe Bank have varied between 500 and 1,600 t, but dropped in 1993 and 1994 to only 300 t and 350 t, respectively. 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, have 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 IIa close to the boundary with Sub-Division Vb (see Figure 2.1.5), are included in the assessment (Table 2.4.1).

Faroese vessels have taken almost the entire catch in recent years. Figure 2.4.1 show the Faroese catches since the early 1980s by fleet category. The proportion of the catch taken by trawlers has decreased steadily in recent years, in particular in the case of single trawlers; however, in 1993 and 1994 the proportion increased again due to the decline in the other fleets catches. Pair trawlers and long liners took most of the catches in these years even if the catch by long liners below 100 GRT has declined since 1989. Due to poor catches and bad economic conditions, the effort of most fleets have decreased during the most recent years (Table 2.1.4). In addition, a 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 out in 1993 and 1994 (Figure 2.4.2), and for the trawler fleets an upward tendency is observed in these years (Figures 2.4.3-2.4.4).

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. Samples from the two areas were combined as they are believed to belong to the same stock. Samples from each fleet category were disaggregated by season and raised by the proportional catches to give the 1994 catch at age in numbers for each fleet (Table 2.4.3). Catches of some minor fleets have been included under others. 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 single (otter board) trawlers greater than 1000 HP. The Norwegian long liners were assumed to have the same age distribution as the Faroese long liners 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.

2.4.3 Weight at age

Mean weight-at-age data are provided for the Faroese fishery (Table 2.4.5). The sum-of-products check for 1994 was 1.0. Figure 2.4.5 show that the mean weights-at-age for most age groups, which were declining since the mid-1980s, did stabilise at a low level for 2-3 years and increased again in 1993 and 1994. The growth by each of the 1975-1992 year classes (Figures 2.4.6-2.4.9) also show the increased growth in these years. The increase in growth seem to continue in 1995 as the mean weights at age for the commercial landings in the 1st quarter of 1995 are considerably higher than the corresponding weights in the 1st quarter of 1994 for all ages except the 2 years old. The same increase in growth was seen in the 1995 Faroese groundfish survey as compared to the 1994 survey (Reinert, WD no. 22).

2.4.4 Maturity at age

Maturity-at-age data were available from the Faroese Groundfish Surveys 1982-1995 (Table 2.4.6). 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. For the years prior to 1982 average maturity at age from the surveys were adopted.

2.4.5 Assessment

2.4.5.1 Tuning and estimates of fishing mortality

At the 1994 meeting of the North Western Working Group (Anon. 1994a), catch and effort data from the Faroese Groundfish Surveys in 1983-1993 and from seven commercial fleets for the period 1985-1993 were used for tuning of the VPA. The estimates of catches in numbers per age per trawl hour in the surveys were 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. The diagnostic output from the initial XSA-run using default values in general turned out with high variability in the log catchability residuals, high CV's and rather poor regression statistics for most fleets. However, XSA runs based on several combinations of years, fleets and ages, where the most noisy data were omitted, did all produce terminal F-values in the same order of magnitude. Therefore, it was decided to present the tuning series with the most data in.

This year the catch and effort data from the same 8 fleets as used in 1994 have been further analysed. As suggested in the VPA vers. 3.1 user guide from Lowestoft (Darby, C.D. and S. Flatman, 1994), a Separable VPA was firstly carried out for the years 1985-94 to test for catch data outliers. Besides some high residuals for the youngest age and the first few years in the series, no conspicuous patterns could be identified (See W.D. no. 22).

The next step was to carry out Laurec-Shepherd *ad hoc* tuning runs, without shrinkage, for each of the 8 fleets independently, in order to screen the fleet data sets. The plots of the Log Catchability Residuals for each fleet are shown in Figures 2.4.10-2.4.17 and the actual residual values together with some diagnostic statistics are given in Reinert, W.D. no. 22. Some key values are given below for each fleet.

<u>Long liners < 100 GRT</u>. This fleet accounted for over 15% of the total landings in 1994 but has during the 1980s and early 1990s accounted for 30-50% of the landings. No trend in catchability can be seen from the slope and SE of the log catchabilities, SIGMA values are acceptable except for age 2, the raised F-values seem far to high. The residual plot (Figure 2.4.10) do not reveal any trends in catchability, but the residuals for especially age 2 and to a lesser degree ages 7-8 are high indicating that these age groups should be omitted from the series.

<u>Long liners > 100 GRT</u>. About 25% of the total landings derived from this fleet in 1994 compared to about 15% during the 1980s. The slopes and SE of log catchabilities reveal no trends, the SIGMA values are high except for ages 4-6, the raised F's are very small except for ages 6-8. The residuals (Figure 2.4.11) are high for some ages especially in the beginning of the series. There are signs of changes in catchability for most ages, especially from 1987 onwards. The series is questionable may be except for the ages 4-6.

<u>Groundfish survey - Magnus Heinason.</u> The survey is a stratified trawl survey and was described in the 1993 report of the North Western Working Group (Anon., 1993). No clear trends can be seen from the slopes and SE but the SIGMA's are very high, about 0.5 for ages 2-5 and exceeding 1.0 for ages 6-8. The raised F'values are all very small. The residual plots (Figure 2.4.12) show no obvious trend with time in the catchabilities but the residuals for some ages and some years are very high, especially for ages 6-8 which should be excluded from the series.

<u>Single (otter board) trawlers < 400 HP</u>. The fleet accounted for about 8% of total landings in 1994. Except for age 2, the slopes and SE indicate a possible trend in catchability, CV's are all high (>>0.5). The residual plot (Figure 2.4.13) show changes in catchabilities with two possible levels, in the middle of the 1980s and in the beginning of the 1990s, respectively. The residuals are high for most ages. This series should not be used for tuning.

<u>Single (otter board) trawlers 400-999 HP</u>. This small fleet accounted for only 2% of the landings in 1994. The slope and SE could indicate a possible trend in catchability, CV's are high, especially for ages 2-3. The residual plot (Figure 2.4.14) could also indicate a possible trend in catchability, and the residuals are high for many ages. The series is doubtful for tuning, but the ages 5-7 could be used from 1988 onwards.

<u>Single (otter board) trawlers > 1000 HP</u>. The fleet accounted for about 3% of the landings in 1994, most of the effort is directed at redfish, blue ling and other deepwater species. The slope and SE indicate a possible trend and the other CV's are very high (> 0.9 for all ages). The residual plot (Figure 2.4.15) show large residuals for most ages and changes in catchabilities during the period. This series should not be used for tuning.

<u>Pair trawlers < 1000 HP</u>. The fleet accounted for about 10% of the 1994 landings. The slope and SE point to a trend in catchability and the other CV's are very high. The residual plot in Figure 2.4.16 shows changes in catchabilities during the period, and the residuals are high. This series should not be used for tuning.

Pair trawlers > 1000 HP. More than 25% of total landings 1994 derived from this fleet. The slope and SE indicate a trend in catchability and other CV's are very high for most ages. The raised F's are unreliable small. The residual plot (Figure 2.4.17) show a clear trend up to about 1990 and the residuals are high for most ages. If used for tuning, only ages 5-7 from 1988 onwards should be held in the series.

Based on this analysis it was decided to investigate the performance of 3 versions of the available catch and effort data for tuning: 1) the original 8 fleets with all data included, 2) a very strict exclusion of noisy fleets and ages/years resulting in only 3 fleets with a few ages/years included, and 3) a more gentle revision giving 5 fleets (see Tables 2.4.7-2.4.11 for details of these fleets). Retrospective analysis of Laurec-Shepherd tuning (Figures 2.4.19-2.4.21) gave the best pattern for the tuning series using 5 revised fleets.

Before real XSA tunings were carried out, an initial XSA run was made using all available fleets, full age ranges and standard default settings, with the ages at which catchability is independent of year class strength and age, respectively, to age 9 as recommended by Darby, C.D. and S. Flatman, 1994, in order to select the age at which the catchabilities of all fleets are independent of year class strength. The slopes were tested if they were significantly different from 1.0. This was the case for one fleet only for age 2 (Single trawlers > 1000 HP) and for another fleet for ages 3-5 (Longliners < 100 GRT). However, the tuning data include survey data and it is recommended at least to use the first age as recruits in such cases. Retrospective analysis with different ages gave the best pattern with age 2 as depending on year class strength.

A new XSA was run using age 2 as depending on year class strength in order to select the age at which catchability is independent of age. The resulting mean log catchabilities are plotted in Figure 2.4.18. Although all fleets do not show the same pattern, catchability seem to become nearly constant at age 6 (The same age was determined from the S-values in the Separable VPA using different runs).

XSA-runs were then made using the three versions of tuning series, default settings were chosen except for the above selected "catchability ages". The retrospective analysis gave again in this case the best pattern for the series with 5 revised fleets (Figures 2.4.22-2.4.24), and compared to the Laurec-Shepherd tuning, the XSA seem more appropriate in this case. Different levels of shrinkages and other settings in the XSA were then tested with retrospective analysis of which some are presented in Figures 2.4.25-2.4.33 and other in Reinert, W.D. no. 22. The best retrospective pattern was derived from the XSA run with 5 revised fleets, shrinkage = 0.5 and default settings in general, and the Working Group decided to adopt this run. Table 2.4.12 shows the diagnostic outputs from the XSA.

The fishing mortalities from the final XSA run are given in Table 2.4.13 and Figure 2.4.34A. Up to 1991 there was an increase in fishing mortality during the most recent years. 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 spawning season of cod, 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. A slight increase in mean F is noted from 1993 to 1994.

2.4.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.4.14 and a summary of the "VPA" with the biomass estimates is given in Table 2.4.15 and Figure 2.4.34B. The spawning stock biomass has decreased from over 60,000 t in 1985 to 17,000 t in 1993. This is the lowest on record in the history of analytical assessment of haddock in Faroese waters. However, this decline in the spawning stock started 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 weight at age seems, however, to have increased again from 1993 onwards (Figure 2.4.5 - 2.4.9), and the most recent recruitment indices are very 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 2.4.19, and an overview of how these data are derived is shown in Table 2.4.16.

The year classes up to 1991 inclusive are from the final VPA while the 1992-94 year classes at age 2 were predicted using the RCT3 program. As input for RCT3, stratified mean-catch-per-hour of age groups 1-4 in the Faroese groundfish survey 1985-95 were used (Table 2.4.17). The output from the RCT3 is given in Table 2.4.18. It should be noted, that the estimate of the seemingly large 1994 year class is sensitive regarding the numbers of years in the survey and the number of points used for regression. When using 5 points for the regression, the 1994 year class estimate will be some 5 million. higher than using default 3 points, and when using the whole survey series back to 1983, the 1994 year class estimate is nearly doubled compared to the default run. But the CV's also increased considerable, and the Working Group decided to use the default run. The 1992 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 years old in 1991-93. The 1995 year class at age 2 was estimated as the average of the 2 years old in 1986-94.

The exploitation pattern used in the prediction was derived from the 1994 fishing mortality from the final VPA.

Based on samples from commercial landings and from survey samples in the 1st quarter of 1995 compared to the samples for the same period in 1994 it is seen, that the mean weight at age for all age groups except for age 2 still are increasing. The mean weights-at-age in the stock and catch 1995 were therefore calculated by adding the annual growth by age group in 1992-94 to the observed weights at age in 1994. The mean weight at age in 1996 and 1997 are calculated in the same way except that the average annual growth is added to the mean weight at age in 1995 and 1996, respectively. The formula for the annual growth is given in Table 2.4.16. Mean weight at age for the two years old in each of the years 1995-97 were calculated as the average weight at age for age 2 in 1992-94.

The maturity ogive for 1995 is based on samples from the Faroese Groundfish Surveys 1995. Maturity ogives for 1996-1997 are calculated as mean values for the period 1993-1995.

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 1995-2004. The input data for the risk analysis are similar to those used in the short-term prediction, i.e. the estimated 1995 maturity ogive and mean weight at age, and terminal F's, natural mortalities, spawning stock and recruitment values from the final VPA. The first step was to fit a Ricker stock-recruitment curve to the stock-recruitment data (Figure 2.4.37). This relationship was applied for the year classes from 1995 onwards. Simulations were then performed by assuming random (log normal) recruitment relationship and (log normal) uncertainty in the current (1995) stock estimate. Three different approaches were made: The catches taken each year were simply fixed 1) at a specified level, i.e. the actual quota on 6,200 t, 2) as 1/3 of the spawning stock biomass and 3) at a constant level which would allow the spawning stock biomass to rebuild to 40,000 t in 1998.

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 2.4.21. Mean weights-at-age are averages for the 1977-1994 period. The maturity ogives are averages for the years 1983-95. 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(age 3-7) equal to 1.0. In the input table the values are rescaled again to the Fbar(age 3-7) long term average.

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 2.4.22 and Figure 2.4.35C. F_{max} and $F_{0.1}$ are indicated here as 0.53 and 0.18, respectively. This estimate of F_{max} is much higher than the 1994 estimate and the difference is due to the very flat topped yield curve. The estimate will be sensitive to changes in recruitment and growth. From Figure 2.4.36, showing the recruit/spawning stock relationship, and from Table 2.4.22, F_{med} and F_{high} were calculated to be 0.22 and 0.66, respectively.

2.4.6.3 Projections of catch and biomass

2.4.6.3.1 Short-term prediction

The results of the short-term prediction are shown in Table 2.4.20 and Figure 2.4.35D. Assuming that the TAC of 6,200 t will be taken in 1995, the reference F has to increase to 0.31. If this reference F is applied for 1996, the spawning stock biomass will increase from 19,000 t in 1995 to 45,000 t in 1997.

2.4.6.3.2 Medium-term prediction

The results of the risk analysis also indicate that the spawning stock biomass will increase. With a fixed quota of 6,200 t the spawning stock biomass most likely will continue to increase during the model period (Figure 2.4.39) but the target level of 40,000 t in 1998 will not be reached. The biomass will most likely stabilise at a level below 40,000 t, when the quota is set to 1/3 of the spawning stock biomass (Figure 2.4.38). If the quota is fixed each year and the target spawning stock biomass in 1998 is set to 40,000 t, the annual catches could be about 4,300 t.

It should be noted, however, that the Ricker-curve do not fit well for the stock-recruitment data (Figure 2.4.37), and the continued increase in mean weight at age, as estimated for the short term prediction, has not been accounted for in the present model. The predicted good 1993 and 1994 year classes have not been applied to the model.

2.4.7 Management considerations

The present assessment confirms that the spawning stock biomass still is 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 over the long term average although the stock-recruitment plot (Figure 2.4.36) indicate, that spawning stock sizes below 40,000 t only have produced small year classes. Thus it should be advisable to allow the stock to rebuild above this level. The adopted annual TACs of 6,200 t for haddock could be appropriate in this respect.

2.4.8 Comments on the assessment

Last year several new fleets were added to the tuning series and existing fleets were revised. This year the tuning data have been further analysed and revised, and the number of fleets has been reduced. It shall be mentioned that the 1994 index of the strength of the 1993 year class has been recalculated, and the above average size of this year class is confirmed by the 1995 survey. CV's for the survey and for some of the commercial series are still high, but the catch-at-age data seem to be reliable.

2.5 Faroe Saithe

2.5.1 Landings and trends in the fishery

Landings of saithe from the Faroese grounds (Division Vb) were stable at around 40,000 - 45,000 t in the period 1985-1989 (Table 2.5.1). Since the record high catches of about 60,000 t in 1990 catches have steadily decreased and were about 33,000 t in 1993 and 1994. According to preliminary statistics for the first quarter of 1995 total landings were about 10,500 t compared to about 7,900 t in 1994.

With the introduction of the 200 miles EZ in 1977 saithe has, for all practical purposes, only been fished by Faroese vessels. A majority of the catches are caught by trawlers and some by jiggers. All other vessels only have small catches of saithe as by-catch.

In the last ten years many single trawlers have switched to pair trawling and an increasing part of the catches are caught by larger vessels. Except for larger pair trawlers the effort of the trawlers have generally speaking decreased with a considerable drop in days at sea for the smaller trawlers.

The level for effort of the small trawlers was in 1994 about 30-40% of the 1985 level. In 1994 the effort of the large single trawlers was some 60% of the 1985 level. During the last 10 years the effort of the larger pair trawlers more than doubled from about 3,000 to a summit of about 7,600 days in 1991 and then declined to about 5,300 days in 1994.

In terms of CPUE there has been a general downwards trend for single trawlers in the last ten years. For larger single trawlers from about 2.5 t/day to about 0.5 t/day whereas for the smaller single trawlers the drop was from about 1.25 t/day to 0.25 t/day. In the last ten years the CPUE for smaller pair trawlers has varied between about 1.4 t/day to 2.8 t/day and for larger pair trawlers the range of CPUE has lied between 2.5 t/day to 3.5 t/day. For both groups of pair trawlers there has been an increase in CPUE since 1992.

Jiggers, on the other hand, have increased their effort substantially from about 3,000 days to some 10,000 days in the last 10 years and except for one year of the last ten CPUE has varied between 0.3-0.5 t/day. Since 1991 there has been a downwards trend in CPUE for this fleet category.

Catches and effort are shown by fleet categories for the period 1985-1994 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.

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 statistic 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 where combined. Finally the numbers were raised by the foreign catches.

Catch at age data in 1993 were revised according to the final catch statistics. Catch in numbers at age in 1994 reflects the age composition in the Faroese catches for that year (Table 2.5.4).

2.5.3 Weight at age

Through the recorded period 1960-1994 mean weight at age has varied considerably, *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 generally high and dropped to a low level in the years 1990-1991. Since then mean weights have been increasing except for age 5 and 6 in 1994.

The SOP for 1994 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 1983-1994 and were updated for the last year (Table 2.5.6). Due to poor sampling in 1988 the proportion mature for this year was calculated as the average of the first neighbouring years. In 1994 the values for proportion mature were unrealistically high probably caused by biased sampling and it was decided to use the 1993 values for 1994. In the period 1960-1982 the values are average for the period 1983-1992.

An attempt was made to fit a general linear model to the data but as it did not depict the variation between years the model was not accepted (Nicolajsen, WD no 21).

2.5.5 Stock assessment

2.5.5.1 Tuning and estimation of fishing mortality

Data from the bottom trawl survey were not suited for the tuning of this stock. Only one tuning data series was used in the assessment. The series extends back to 1982 and consists of data from 8 pair trawlers greater than 1000 HP (Cuba trawlers) which specialise in fishery on saithe and account for 5,000-8,000 t of saithe each year, Table 2.5.7. In the 1993 Working Group report (Anon., 1993) a description is provided as to how and why this particular series was chosen.

The log catchability residuals from the Laurec-Shepherd tuning for age 4-8 is presented in Figure 2.5.3 and shows that all values are below 1.0. The overall impression is that the graphs indicate a downwards trend over the period.

An XSA run was made with the tuning data with the same run parameters as last year. 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 1960-1994 in Table 2.5.9. The average fishing mortality for age groups 4-8 was 0.41 in 1994.

The corresponding retrospective analysis for age 4-8 is presented in Figure 2.5.4 and shows a reasonably good convergence for the last 4 years whereas 1990 is an outlier.

2.5.5.2 Stock estimates and recruitment

In historical terms the spawning stock biomass has in 1992-1994 been in its lowest range ever recorded even if recruitment seldom has been below 20 millions since 1980, Figure 2.5.5B. A summary of recruitment, total biomass, spawning stock biomass etc. for the period 1960-1994 is given in Table 2.5.12.

Stock in numbers at age as estimated by the VPA is presented in Table 2.5.10. The high numbers in the stock in 1986-1990 are due to very good recruitment. Mean number of recruits as 3 year old in the period 1980-1989 is about 33 million. The recruits in 1991 are about 26 million, a little below the 1980s mean whereas the recruits in 1992 are about half of the average level. Though it might be early days yet indications are that the 1990 year class is above the average of 1980-1989.

Spawning stock biomass is given in Table 2.5.11 and Figure 2.5.5B. The spawning stock biomass is starting to pick up from its all time low in 1992 of about 60,000 t to about 70,000 t in 1993 and 1994.

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 2.5.13 and input data for the yield per recruit calculations are given in Table 2.5.15. Stock in numbers up to year class 1989 are from the final VPA whereas for the 1990-1994 year classes the mean recruitment for the 1975-1989 year classes was used. The number at age 4 and 5 in 1995 was calculated by using fishing mortalities for the preceding periods of these year classes.

In the short term prediction (prediction with management options) the mean weight at ages 4-8 were predicted using mean weight in 1994 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 1992-1994. For 1996 and 1997 the mean weights were calculated by adding mean weight increase to the value for the previous year. The weight of age 3 in 1996 and 1997 are the mean of 1992-1994. In the long term prediction (yield per recruit) mean weight for 1960-1994 was used.

In the short term prediction the observed maturity ogive from the Faroese bottom trawl survey in 1995 was used for that year and for 1996 and 1997 the mean of 1983-1995 was used. This long term mean was also used in the long term prediction.

In the short term prediction the exploitation pattern was taken from 1994 in the final VPA. In the long term prediction the exploitation pattern was the average of exploitation patterns for 1960-1994 which were scaled by Fbar (age 4-8) before the average was calculated.

In the medium term prediction (Risk analysis) the input parameters stock in numbers, mean weight at age, proportion mature and exploitation pattern were based on the 1994 values.

2.5.6.2 Biological reference points

The yield per recruit and spawning stock biomass per recruit curves are presented in Figure 2.5.6C. Compared to the fishing mortality level in age groups 4-8 in 1994 of 0.41, the reference values for F_{max} is 0.41 and $F_{0.1}$ is 0.17. F_{med} and F_{high} were estimated to 0.28 and 0.52, respectively, (Table 2.5.16, Figure 2.5.6C and Figure 2.5.7). The average fishing mortality for age 4-8 in 1994 thus coincides with F_{max}.

2.5.6.3 Projection of catch and biomass

Results from prediction with management option are presented in Table 2.5.14 and Figure 2.5.6D. If catches reach the proposed TAC of 42,000 t the F-value is estimated to 0.51 in 1995 and about 0.49 in 1996. The spawning stock biomass will for the period 1995-1997 lie between 80,000-90,000 t with the suggested TAC level.

The Risk analysis was based on a Ricker stock-recruitment model fitted to the spawning stock biomass and recruitment data for year 1961 and 1991 is shown in Figure 2.5.8. A quota of 42,000 t is imposed on the model and the results are shown in Figures 2.5.9. These indicate that a most likely scenario is a spawning stock biomass of 100,000-120,000 t or more and there is a 5% chance that the spawning stock biomass will drop below about 50,000.

Results from the yield per recruit estimates are shown in Table 2.5.15 and Figure 2.5.5C.

2.5.7 Management considerations

The spawning stock biomass is still at a low level even if mean weight at age and maturity ogive has changed in favourable directions. This may be some of the reasons for the slight increase in spawning stock biomass. With a 42,000 t TAC the stock will be stable, however, it is more likely that catches in 1995 will be about 30,000-35,000 t and some minor increase in spawning stock biomass might be expected.

Even if the spawning stock recruitment relationship shows an inverse relationship (Figure 2.5.7) this probably only reflect one side of the matter as there is no information on this relationship in the lower ranges of spawning stock biomass values.

2.5.8 Comments on the assessment

The used tuning series has a trend and this might have some adverse effect on the assessment. Still, the mean fishing mortality of age groups 4-8 is in good accordance with the effort values for large pair trawlers in the period 1985-1994, Figure 2.5.10.

As data from the bottom trawl survey do not correlate with recruitment calculated by the VPA, there is no data series available that could provide an estimate of the level of recruitment in the most recent years. This is not unexpected as young saithe inhabit shallow waters in their first three years or so. Ways of acquiring such data will be discussed at the Saithe Study Group meeting in May-June 1995.

The problem of the high sampling variation which is introducing noise into the data on maturity has not yet been solved , but a generalised linear model which, among other things, takes into account number of specimens in the samples has been proposed.

In the Risk analysis the proposed model for the stock-recruitment is base on a limited interval of spawning stock biomass values in the high range of possible stock size values, thus an uncertain extrapolation has to be done into the lower range of the stock values where no information on the nature of its recruitment is available.

The question of saithe migration was not tackled by the Group though there is an awareness of this problem. It is necessary to know more about the extent of such migrations before it can be stated if it is of any significance to the state of the stock and the assessment.

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 young 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.

3.2 Icelandic Saithe

3.2.1 Trends in landings

Landings of saithe from Iceland grounds (Division Va) have been fluctuating without a trend between 58.000 and 70.000 t in the period 1981-1986 (Table 3.2.1). During 1987-1989, annual landings were around 80.000 t. In 1990, landings increased by more than 20% to 98.000 t and in 1991 the catches were 103.000 t. Since 1991 landings have decreased again to the 1981-1986 level. Preliminary reported landings for 1994 are 66.000 t compared to 73.000 t expected by the Working Group last year.

3.2.2 Catch in numbers

Minor changes were made to the age composition of 1993 as more age readings became available for 1993 and to account for revised total landings. Data from bottom trawl and gillnets, which represented 94% of the Icelandic landings in 1994, were used to calculate the catch at age of the total landings used as input for the VPA (Table 3.2.2). Compared to last years prognosis a higher proportion of age group 4 and lower for the age groups 5 were observed in the 1994 landings. As no recruitment indices are available for this species these year-classes were assumed in the last year`s assessment to be of the long term average size. An increasing proportion of the catches have been taken in gillnets for the last two years 28% and 32% in 1993 and 1994 respectively, compared to 14-20% in 1988-1992.

3.2.3 Mean weight at age

Weight-at-age data were available for the Icelandic landings in 1994 (Table 3.2.3). Decreased mean weight at age was observed in 1994 for age groups 4 to 6 and an increase in other age groups with the exception of age group 10 of the abundant 1984 year class.

The prediction for weights at age in 1994 for age groups 4-9, were significantly better than a prediction based on simple averages (SSE = 0.65 for the multiple regression compared to SSE = 2.91 for simple mean).

3.2.4 Maturity at age

In 1994 an increase in the proportion mature at age was observed for age groups 4 to 7 (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. 1993a), 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 1980-1997 (Tables 3.2.4 and 3.2.5 and Figure 3.2.1). The maturity at age prior to 1980 are derived from Anon. (1979).

3.2.5 Stcok 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 pattern 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. The second data set was based on trawlers 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 tried with XSA based on the two different fleets. Tuning diagnostics are relatively poor in both cases (Tables 3.2.7 and 3.2.8). The resulting mean F in 1994 for age groups 4-9 from those runs was 0.31 using the trawlers effort data and 0.29 using the trawlers CPUE data. At the 1993 Working group meeting retrospective analysis were made for 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. The XSA was the second most consistent and ended up with a slightly higher estimates of reference F in the final year. Based on these results and that the catch at age data for Icelandic Saithe seem to be relatively consistent (reflected in the low standard deviations of the log F's from the TSA) the TSA using only catch at age data was adopted by the Group again this year to estimate the fishing mortality in the final year. The resulting reference F's are somewhat lower ($\overline{F}_{4-9}$ =0.27) (Table 3.2.9) than from the XSA runs and have a relatively low standard errors for the most relevant age groups.

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. The results of this run are given in Tables 3.2.10 - 3.2.12 and Figures 3.2.2.A and 3.2.2.B.

3.2.5.3 Spawning stock and recruitment

The spawning stock biomass is shown in Figure 3.2.2.B and Table 3.2.12. After a decline from 1970-1979, the spawning stock biomass was at the level of about 160-185000 t in 1980-1989 and increased to 213.000 t in 1990 and has been about 215 - 220.000 t since 1991. The estimated spawning stock biomass in the beginning of 1994 is 210.000 t.

Estimates of recruitment at age 3 are plotted in Figure 3.2.2.B. Recruitment has fluctuated in recent years without any clear trend. The 1983, 1984 and 1985 year-classes are all well above the 1967-1987 long-term averages (about 40 million). The 1984 year-class is the highest on record about 120 million. All year-classes after 1985 are well below mean size except for the 1990 year-class which is now estimated above the average (56 million).

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

3.2.6.1.1 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 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. The regression analysis only showed significant relationships for these age groups. For other age groups the mean weight at age were averaged over the 1992 to 1994 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 1980-1994 were used.

It is assumed that the fishing mortalities in 1995 will be the same as in 1994 with resulting catches of about 61,000 t.

For long-term yield and spawning stock biomass per recruit, the exploitation pattern was taken as the average of the fishing mortalities during 1980-1994 from the standard VPA run. Averages over 1980-1994 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).

3.2.6.2 Biological reference points

The yield- and spawning stock biomass-per-recruit (age 3) curves are shown in Figure 3.2.3.C.

Compared to the 1994 fishing mortality level of $\overline{F}_{4-9}$ = 0.27, the reference values for $F_{\max}$ and $F_{0.1}$ are 0.44 and 0.19 (Table 3.2.16) respectively. From Figure 3.2.4 showing the recruit/spawning stock relationship and Figure 3.2.3.C showing the spawning stock biomass-per-recruit relationship F_{med} = 0.28 and F_{high} = 0.86 were estimated.

3.2.6.3 Projections of catch and biomass

Based on the input data given in 3.2.6.1, options for 1996 were calculated and are given in Table 3.2.14 and Figure 3.2.3.D.

As can be read from the prediction table (Table 3.2.14), the same fishing mortalities in 1995 as in 1994 will result in a total catch of about 61,000 t in 1995. The resulting stock size in the beginning of 1996 will be about 385,000 t which is about the same as in the beginning of 1995. The spawning stock biomass in the beginning of 1996 will be similar to that in 1995, i.e. about 195,000 t. The same reference F in 1996 compared to 1994 will result in a yield of 65,000 t, and both total and spawning stock in 1997 will be at about the same level as in the three previous years. Higher fishing mortalities in 1996 will lead to a decline in both total and spawning stock biomass and correspondingly, if the F's are lowered from that level, stock sizes will increase by 1997.

3.2.7 Management considerations

The stock seems to be in a fairly stable state, the reference F values have been slightly over $F_{0.1}$ but below F_{max} in recent years. Increasing effort from the present level will not lead to gains in the long run.

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. The tuning data derived from commercial trawlers reflect the nature of the fishery and the shoaling behaviour of the saithe and do not seem to be appropriate for the purpose of tuning the VPA.

3.3 Icelandic Cod (Division Va)

3.3.1 Groundfish survey design

Icelandic Groundfish Survey 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, standardised, 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 summarised 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.

3.3.2 Trends in landings and effort

In the period 1978-1981 landings of cod increased from 320,000 t to 469,000 t 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 1994 catch of only 179,000 t is the lowest catch level since 1942.

Effort on cod in 1994 decreased compared to 1993 due to further reduction in quota and a diversion of the effort towards other stocks. However catch rates of the trawler fleet showed only a minor increase. CPUE data for commercial trawlers are used as tuning indices in section 3.3.6.1. Further, landings and CPUE data are used for generating effort measures for assessment verification in section 3.3.10.

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, hand 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 3.3.2. For the longer VPA runs the catches at age in numbers in Anon. (1976) 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 3.3.3).

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 3.3.4. 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 1994, 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 3.3.5.

3.3.5 Maturity at age

As in Anon. (1992b), maturity at age is based on samples from the commercial fleets in the months January-May. It has been pointed out that using data collected throughout the year may bias the proportion mature in various ways (Stefánsson, 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.

The maturity at age data are given in Table 3.3.6.

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 (in time) maturity at age for the years 1955-1972.

3.3.6 Stock Assessment

3.3.6.1 Tuning data

Commercial trawler CPUE data were analysed as described in Stefánsson (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 1990-1994.

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. south-west, south-east and northern areas (Table 3.3.7).

The Icelandic groundfish survey data (Pálsson *et al.*, 1989) are used as part of the assessment. The basic data are age-disaggregated (Pálsson and Stefánsson, 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, Annex I in last year`s Report of the Working Group (Anon.1994a). Indices are calculated for each of the three areas separately, age groups 1 to 14 and for the years 1985-1995.

To use the latest (1995) survey information in the XSA VPA tuning method, the 1995 survey abundance indices were shifted back in time by approx. three months i.e. to December 1994. The same applies to abundance indices for the other survey years.

The resulting indices are given in Table 3.3.8 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 (Stefánsson 1992) which were applied to this stock earlier (Anon, 1992b, 1993a and 1994x) can estimate migration for a given year and age. As in the last years report, the XSA method was used, but. XSA is not implemented such as to estimate, or account, for migrations. There is a way to handle this:

XSA uses cohort-analysis to project, or back calculate, each cohort:

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

were N is stock size, 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 the beginning of the year. The total catch of 5 years old cod 1989 is estimated at 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

Extensive retrospective analysis was carried out for the XSA method at last years working group meeting for choosing the appropriate tuning fleets. These tests resulted in the use of the Groundfish Survey (1984-93) and short trawlers CPUE series (1988-93). The same approach was used this year, and the Groundfish Survey (1984-1994) and short CPUE series (1990-94) were used as tuning fleets in the XSA. To analyse the XSA method retrospectively with these tuning fleets, longer trawlers CPUE series were used (1985-94). The retrospective pattern for the average fishing mortality of 5-10 years old, the stock biomass of 4-14 years old and the recruitment (age 3) is given in Figure 3.3.1, along with the estimates from the XSA run using the shorter version of the CPUE series.

Retrospective analysis was also performed for XSA tuned with the longer trawlers CPUE series alone, the results indicated systematic underestimation of fishing mortality (– increasing catchability through time). When the Groundfish Survey was accommodated with the 1985-94 CPUE series in the XSA tuning (Figure 3.3.1), the retrospective pattern stabilised a little from using the Survey alone.

The fishing mortalities from a traditional VPA, using the terminal fishing mortalities from the final XSA (Groundfish Survey and short CPUE series), are given in Table 3.3.10. The fishing mortality reached a peak in 1988, decreased in 1989, but then increased to another peak in 1993. Due to further restriction of the cod quota effort dropped in the second half of 1994 and fishing mortality decreased correspondingly for 1994.

3.3.6.4 Stock and recruitment estimates

The resulting stock size in numbers at age and spawning stock biomasses from the final VPA are given in Tables 3.3.11-12. In the stock numbers table, only the recruitment (age 3) in 1994 and 95 were estimated using the RCT3 program as described in Section 3.3.8.4 (XSA showed a good retrospective pattern for recruitment estimation, Figure 3.3.1).

The current spawning stock at spawning time and recruitment levels must be considered in relation to historical sizes. These are based on a longer time series. In this VPA (cohort analysis, rather), data for the period 1983-1992 are as before. The migration estimates of 39 and 7 million immigrants of the 1973 year class in 1980 and 1981, respectively are taken from the last 1993 ADAPT assessment (Anon. 1993a). 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. The resulting SSB and recruitment estimates are given in Table 3.3.13 (and Figure 3.3.2) along with average fishing mortalities and juvenile biomass (immature). 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 interaction is the cod-capelin connection (Pálsson, 1983) 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 e.g. by Magnússon and Pálsson (1991b) and Stefánsson *et al.* (1994a). Results from these studies have been used in the medium-term predictions in Section 3.3.8.6. The biological and mathematical bases for simulations are described in detail in Stefánsson *et al.* (1994b) and are multispecies extensions of the methods used in Baldursson *et al.* (1993). The cod-capelin interaction is used in the short-term prediction in Section 3.3.8.5, based on the results in Steinarsson and Stefánsson, (1991).

A number of fleets operate in Division Va. The primary gears are described in Section 3.3.3 but data has been compiled to operate with a finer seasonal split and methodology has been developed to perform appropriate smoothing of age-length distributions in order to compute catches in numbers at age by region, season and gear class (Jóhannesson and Stefánsson, 1994, Anon. 1994a and Anon. 1994b).

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 class, region and season. Such data for cod were available to the 1994 meeting of the group and consisted 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 short-term predictions, it is essential to take into account potential changes in mean weights at age due to environmental conditions.

Table 3.3.14 gives the size of the capelin stock on 1 January each year. 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 1995-1998. For 1996 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 1991-1994 is used.

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. 1994b). The maturity at age is at record high levels at present, 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 1995 based on January-March samples indicate continued high maturity at age in 1995. The approach taken is therefore to use the 1994 values for 1995 and a somewhat longer-term (1986-1992) average for 1998. For the purpose of obtaining an orderly development of trends in the maturity at age, linear interpolation between the 1995 and 1998 values was used for 1996 and 1997. Thus, the average used for 1998 now includes one of the recent years with a high proportion mature.

The exploitation pattern used for the short-term predictions was taken as the average of the years 1992-1994 from the VPA.

3.3.8.2 Medium-term prediction model and input data

Medium-term predictions (risk analyses) were done for the Icelandic cod stock. These results represent a multispecies continuation of the work in Baldursson *et al.* (1993). After some modifications to input parameters, as given in Table 3.3.21 and different emphases on the catch control laws used, the Working Group used the models for medium-term predictions as described in this subsection.

The model used incorporates the cod, capelin and shrimp stocks where interactions between the stocks are as described by other authors and used earlier by the Group (Anon. 1994a). In particular, cod predate on capelin and since capelin is a major food item for cod, it is taken to affect cod growth as in Steinarsson and Stefánsson (1991). An *ad hoc* model is used for the effect of the cod on the stock size of capelin. This is done by scaling natural mortality of capelin pre-recruits by the size of the spawning stock of cod from the value obtained by Vilhjálmsson (1994).

Cod also predate on shrimp and a simple biomass model is used to project the shrimp biomass forward in time given the catch, the predation by cod and recruitment which is also related to the cod stock, all basically as described in Stefánsson *et al.* (1994b). Since shrimp plays a lesser role than capelin as a food item for cod, it is assumed not to affect cod growth.

Other items in the biology are fairly standard in that the initial stock size of cod is as estimated in this Working Group report but a CV of 15% is used to reflect the uncertainty in the stock estimate and the CV on the recruitment is 20%, 25% and 30% for year classes 1991-1993, respectively. The stock-recruitment curve used for future prediction for cod is of the Ricker form, with cannibalism by juvenile cod, as described in e.g. Bogstad *et al.* (1993) and 35% CV as estimated from the stock-recruitment plot. The estimated parameters are given in Table 3.3.21 and the resulting stock-recruitment plot is given in Figure 3.3.2 and further discussed in Section 3.3.8.7.

Stocks are driven forward in time with random (independent lognormal, CV=35%, as estimated from the data from the VPA) recruitment about this relationship. The cod stock-recruitment relationship itself is not fixed, but the parameters are taken to come from a multivariate Gaussian distribution, reflecting the uncertainty in the relationship. The average relationship is given in Figure 3.3.2. Density dependent growth is incorporated in the model by taking the predicted weight at age from the cod-capelin interaction and assuming that mean weight at age is at this level when the SSB is below 500 thousand t and that it will be reduced by 30% when the SSB reaches one million t, based on indications in Schopka (1994).

The capelin stock is driven forward by random (independent lognormal) recruitment, with a periodicity of 5-9 years intended to reflect the natural stock-crash probabilities of the capelin stock.

The current *de facto* management strategy for shrimp is close to fishing a quota which keeps the shrimp biomass at the current level. This can thus be taken as a fixed strategy. The current strategy for capelin is to leave 400 thousand t for spawning and this is used as the management strategy in the model. This does not specify how the capelin catches should be allocated to seasons and that allocation is likely to affect the amount of predation possible by the cod. It turns out, however, that the actual allocation of capelin catches to season has little effect on the overall results and hence the approach taken was to assume a fixed proportion of the available capelin catch was taken in each season.

The cod is not harvested with a well-defined harvesting strategy, although the actual management decisions in recent years can be modelled and compared to alternate strategies. For example, the intended quota allocations in the years 1994-1995 result in about 175 thousand t in total catches. Since there is considerable reluctance to reduce catches from the current level, this may possibly be taken to be a minimum acceptable catch level for future years, and this can be compared to alternative strategies.

It follows that the current management strategy may be modelled by assuming that attempts will be made to attain a minimum catch, *Qmin*, even at low stock sizes whereas the catch will be increased as the stock size increases. A stabilising strategy would be to put a "ceiling" on total catches and this ceiling is taken to be 450 thousand t. The only remaining item that needs to be selected in order to obtain a fully defined rule is the slope, *Qslop*, of the catch control laws to be tested. Figure 3.3.3 shows an example where the slope is taken to be 0.22. In last year's report (Anon. 1994a) the input to the procedure was taken to be the biomass in the previous year, i.e. to determine the quota for 1996, the 4+ biomass in the beginning of 1995 was used. This rule has now been modified slightly so that the average of the 1995 and 1996 biomass values are used. This has the virtue that the biomass input into the procedure reflects the biomass at the start if the fishing year which starts on September 1 and thus reduces the bias involved when the stock is on an increasing or decreasing trend. Naturally this approach has the drawback that one of the biomass values in the average is a projected biomass value.

The interpretation of the minimum catch may need to be emphasised: It is not possible to recommend a strategy which has a minimum catch, since e.g. modelling errors may be such that the stock is or ends up near the intersection of the minimum catch and the steady-state curve, in which case collapse probabilities will be close to 50%. Thus the inclusion of a minimum catch rule is solely a simple way to model realistically alternative management measures, whereas any catch control law which might possibly be recommended must lead to a zero quota as the stock goes to zero.

This results in possible tests of several different strategies, with varying long-term aims as reflected in the slope and varying short-term concerns as reflected in the minimum catch.

A ceiling is put on the fishing mortalities in order to avoid fishing mortalities which cannot be inflicted by the fleet. Thus, if the stock is at a very low level, catches are restrained by bounding the fishing mortality by 1.5. This leads to declining catches as well as a depleted stock at high exploitation. A "stock collapse" is defined to have occurred in these computations when the spawning stock biomass is below 100 thousand t in the final year of a simulation.

The selection pattern is taken to be the same as in the short-term predictions.

The proportion mature is somewhat problematic for the medium-term as for shorter time scales. Since the medium-term simulations carry from the short into the long-term, the proportion mature needs to be similar to the short-term values in the immediate future. On the other hand, the values should either be random or converge to a long-term average in the more distant future. The approach taken is to start with the current high values in 1995 and to use linear interpolation to the considerably lower long-term values, but over a sufficiently long time frame (1995-2002) that the short-term results are similar to those obtained in the short-term prediction.

3.3.8.3 Long-term prediction input

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) 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 typical yield-per-recruit calculations.

Mean weight and maturity at age have been predicted as the average over the years 1973-1991.

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

Naturally, any stock-recruitment relationship will affect yield-potential calculations and this is not taken into account in the yield-per-recruit calculations.

3.3.8.4 Recruitment

The modified Gamma-Bernoulli (G-B) method (Anon., 1994a) 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 3.3.15. As an input to the RCT3 program age groups 1-4 from the survey were chosen.

The size of the year classes 1991-1994 has been estimated using RCT3, with the output as given in Table 3.3.16. The revised recruitment estimates are then discounted with natural and fishing mortalities for use in the predictions.

3.3.8.5 Short term prediction results

Input to the projections is given in Table 3.3.22. Results from projections up to the year 1996 with different fishing mortalities are given in Table 3.3.23.

By fishing at 1994 levels of fishing mortality (F=0.72) in 1996 the spawning stock will decline to the low 1992-1993 level of about 225,000 t.

Continuing fishing in 1996 at the expected 1995 level of fishing mortality (F=0.50) will lead to a decrease in SSB on the short term.

A 15% reduction in fishing mortality from 1995 (to F=0.43) the SSB will stabilize at the 1995 level of 300,000 t. In 1996, catches will stay at the expected 1995 level, of about 165,000 t.

A 35% decrease in fishing mortalities from 1994 (to F=0.33) will increase the SSB to 335,000 t in 1997. This will require an initial catch limit of about 129,000 t.

The average size of the incoming year classes (1986-1993) 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 in the next few years cannot exceed 235,000 t. Since the fishing mortality is currently still above F_{max}, the expected yield is lower. Further, the catches from these year classes have been over this level and hence the expected yield from these year classes in coming years is even lower than this number.

3.3.8.6 Medium term prediction results

It was seen in Anon. (1994a) that using *Qslop* = 0.22 was preferable to higher or lower values in terms of medium-term profits, but this does not have a major effect on the results. In the absence of other recommendations, this value is used throughout in this medium-term prediction. It should be noted that the actual value of the slope only affects management decisions if and when the stock rebuilds so that the effective value of *Qmin* is no longer binding.

Figure 3.3.4 depicts overall results from simulations for the years 1994-2023 for different values of *Qmin* in the catch control law. Given is the probability of stock collapse (i.e. SSB below 100 thousand t in 2023) and the probability that the stock will decline from the present (1995) level in the short term (1997).

Figures 3.3.5-8 show sample time trajectories of catches and SSB values along with several percentiles. These figures clearly illustrate the effect of increasing a minimum catch level, since this will result in increased probability of stock reduction to non-sustainable levels.

3.3.8.7 Long-term prediction results

The yield-per-recruit curve along with biological reference points is given in Figure 3.3.9 (Tables 3.3.19-20).

A plot of the spawning stock biomass and recruitment is given in Figure 3.3.10. When using the period 1955-1993, the reference points F_{med} and F_{high} are about 0.45 and 0.70, respectively, as seen in Figure 3.3.2. Also shown in the same figure is the fitted Ricker curve with cannibalism, as obtained for the steady-state in the medium-term analysis. It is seen that an F_{high} equilibrium does not seem to be available if the stock-recruitment curve is assumed. This contrasts earlier results (Anon. 1994a) 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.

It is seen that the predicted recruitment from the S-R curve at current spawning stock biomass levels of about 150 million individuals is somewhat higher than the average recruitment obtained in recent years.

3.3.8.8 Relating the different predictions

The different types of predictions use different assumptions. For example, the long-term prediction uses a long-term average weight-at-age whereas the short- and medium-term predictions start by using the current values. As a result, these predictions can easily lead to somewhat different interpretations. Figure 3.3.11 combines results from several different types of predictions in a framework similar to the one used for medium-term prediction. The figure gives the medium-term predicted average catch (solid high curve) as well as one possible catch control law (dashed thick line) along with several other pieces of information.

The long-term computations produce a yield-per-recruit value for each level of fishing mortality. This level of fishing mortality also corresponds to a steady-state biomass value in the medium-term computations which gives a recruitment value from the stock-recruitment relationship. The yield-per-recruit can thus be multiplied by an average or expected recruit value in order to produce a predicted yield for each level of biomass. Such a curve is shown in Figure 3.3.11 (thick solid line), corresponding to recruitment at the level predicted from the stock-recruitment relationship using equilibrium corresponding to the current 4+-biomass value. These long-term lines and medium-term lines are thus made to intersect at approximately current biomass values since a similar stock-structure (weights at age, SSB and juveniles) is used in both computations.

The same plot also shows the recent combinations of catches and biomass values as obtained from the VPA (squares). It is seen that the catches and the stock have been declining although the data has been close to the equilibrium curve. This will happen when the stock-recruitment relationship predicts higher recruitment at current stock levels than actually obtained in recent years. If the base-case catch-control law is used in the future, the continued thin dashed line indicates the predicted direction of the yield-biomass pairs, assuming no variability.

3.3.9 Management considerations

Earlier advice for this stock has been based on 40% reduction from the 1992 level of fishing mortality, which is now estimated as having been about 0.82 (Table 3.3.10), so a 40% reduction corresponds to a fishing mortality of about 0.49 in 1996 and thus catches of some 186,000 t (Table 3.3.23).

The inclusion of the stock recruitment relationship has a major effect on the long-term predictions. From Table 3.3.13 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 and the possibility of a stock-recruitment relationship cannot be fully ignored.

Since the expected total yield from the stock is the multiple of the yield per recruit and the number of recruits, it is seen that the expected yield decreases considerably more when the poor recruitment is taken into account than when only Y/R is considered along with average recruitment.

By considering all the different predictions, future options may be summarised as follows:

1. If a reduction of fishing mortality by 40% from the 1992 level is chosen, corresponding to 186,000t catch, then this will lead to a decline in the SSB in the near future;

2. Keeping 1994-1995 catch levels of about 175,000 t into 1996 and beyond, increasing catches later when (if) the biomass increases. This entails a probability of about 5% of stock collapse in the long run, or, equivalently, a downwards revision of this catch limit;

3. Reducing the catches to some 150,000 t (25% reduction in fishing mortality from 1995). In this case the spawning stock is expected to remain stable in the immediate future and there is high probability of a recovery of the stock;

4. A reduction of catches to such levels (about 130,000 t) that the stock biomass will increase with high certainty and begin do so within a few years. Although there is no guarantee that this will bring about improved recruitment, there are several indications that the probability of poor recruitment will be considerably reduced by increasing the SSB. This approach is expected to have medium-term benefits in terms of stability, reduced costs and the same or increased catches whether the stock-recruitment relationship holds or not (Figure 3.3.11).

3.3.10 Comments on the assessment

3.3.10.1 Verification of the assessment

The present assessment indicates that the fishing mortality in 1994 dropped considerably, from 0.94 in 1993 to 0.72 in 1994. This is a 25% decrease in fishing mortality and the projections for 1995 indicate that the trend will continue. The resulting advice depends quite heavily on whether the apparent drop in fishing mortality is a true drop or not. For this reason several alternative views have been considered (Table 3.3.27). This includes the following:

1. Consideration of the CPUE data from trawlers in June-December indicates that the overall CPUE was 0.84 in 1993 and 1.21 in 1994. Since the total landings were 251,000t and 178,000 t in the same years, this indicates that the overall effort expended by the entire fishing fleet changed from 296 in 1993 to 147 in 1994, in trawler-effort units. This corresponds to a reduction by 50% in total effort.
2. Similarly, for trawlers in January-May, the effort reduction is implied to be 44%.
3. The groundfish survey total biomass index implies that the total effort has decreased by 36%.
4. Similar results for gillnets indicate an 12% reduction in total effort.
5. Danish seine results account for only a very small percentage of the catches, but the corresponding inshore CPUE data along with total landings indicate a reduction of total effort by 64%, but preliminary data for 1995 indicate that this may be far too high a value.
6. Preliminary biological sampling data exists for the period January-March, 1995. These data can be extrapolated to the full annual data set by using the same proportions as were observed for the same months in 1993-1994 and then scaling so as to obtain the same predicted total landings as have been estimated. The resulting catch data can be used along with the March survey data to tune a VPA. The survey fleet can in this instance be used at the correct time of year, without any shifting back in time. The results from this VPA indicate that F(5-10) in 1994 is about 0.74, which is about as close to the adopted assessment (0.72) as can be expected.
7. For the year 1995, the assessment predicts F(5-10)=0.54, but the new one implies 0.72, i.e. a considerable deviation. However, the present range used in the average does not quite capture the most important age groups presently in the catches and if the average for ages 4-8 is used, then the adopted assessment indicates F(4-8,94)=0.57 but the new one gives 0.60. For 1995, the adopted gives F(4-8,94)=0.44 but the scaled gives 0.51. Thus the adopted assessment indicates a 33% reduction in fishing mortality but the revised one indicates 15%.

On the whole it is seen that the various independent validations seem to agree quite well with the adopted assessment, at least in directional terms: The apparent reduction in fishing mortality seem quite real.

3.3.10.2 Causes for concern

All short-term results 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 the trends apparent in Figure 3.3.12.

3.3.10.3 Effect of varying natural mortality

Assessment results for different values of natural mortality are given in Table 3.3.24. It is seen by comparing the various results that they are conflicting and it is not at all clear which one of these assessments is closest to the truth, as is seen in Table 3.3.25.

3.3.10.4 Overall picture

Although there are several uncertainties in this assessment, it is quite clear that the stock has been heavily overfished for a long time and the conclusion on the importance of reducing fishing mortalities is quite robust to changes in assumptions.

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.

During the last year's meeting, several VPA runs were carried out and documented in order to review the historical development of the Greenland stock based on a combined assessment of both Greenland and Icelandic cod stocks avoiding migration effects. The Working Group saw no need to repeat this exercise mainly because of the very similar stock situation and a lack of data for catch and size at age for the trawl fishery off Greenland in 1994.

5 COD STOCKS IN THE GREENLAND AREA

5.1 Survey and Research

5.1.1 Groundfish survey of the Federal Republic of Germany

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). In 1994, the only changes made compared with former surveys where those, that a new research vessel Walther Herwig III replaced the old Walther Herwig (II) and slightly smaller doors in the trawl rigging were used to avoid net over spread as demonstrated by underwater observations. 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. Table 5.1.2 and 5.1.3 list the trawl parameters of the survey and the sampling effort by year and stratum, respectively.

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 combined for the years 1982-94. 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 caused by 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 pointing to an eastward migration. During the period 1987-89 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. Last year's (1994) survey coverage was again incomplete for the East Greenland partly due to technical problems. However, indices continued to decline to 600,000 fish and a biomass index of 140 tons at West Greenland, by far the record low values.

5.1.1.2 Age composition

Age disaggregated abundance indices for West, East Greenland and total are listed in Tables 5.1.6, 5.1.7 and 5.1.8, respectively. The year classes 1984 and 1985, which dominated in the stock during 1985-1991 period, are no longer present off West Greenland as is confirmed by the latest observation. In 1994, the stock off West Greenland was found to be mainly composed of the pre-recruiting age groups 1 and 3 years, although being classified as poor. Both year classes 1991 and 1993 contributed 34% and 49% to the stock abundance, respectively. This poor recruitment does not indicate any recovery from the severely depleted status of the stock in the near future. Based on the recent survey results long term prospects are also very pessimistic in the view of low abundance of mature fish (6 years and older).

5.1.1.3 Mean weight at age

Mean weight of the age groups 1-10 years for West, 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 1982-94. 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 levels 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 Greenland trawl survey

A stratified-random trawl survey was carried out by Greenland in East and West Greenland waters during July-October 1994, using the chartered trawler M/tr PAAMIUT (722GRT). The area covered extended from 59°N to 72°30'N at West Greenland and from 59°N to 68°N at East Greenland from the 3 nm-line off the coast down to a depth of 600 m. The number of hauls per stratum was generally allocated proportionally to stratum size. The main purpose of the survey was to estimate shrimp abundance, and hence the haul density was higher in the shrimp fishing areas off West Greenland than off South and East Greenland. The same stratification scheme was used as in previous surveys (Anon. 1993). A total of 244 hauls were made within the 200 nm zone of Greenland (Figure 5.1.5).

The survey gear used was a Skjervoy 3000/20 trawl with a bobbin groundrope and a new double-bag 20 mm mesh size codend. The trawl doors were of the type 'Perfect'. Standard hauls were of 60 min. duration with a towing speed of 2.5 knots. Trawling was restricted to the daytime. Cod abundance was calculated by the swept area method in which tow length was calculated from GPS registrations and wing-spread was taken as the average of Scanmar width measurements (20.7 m). At West Greenland total abundance and biomass was estimated to be 0.2 million fish and 57 t, respectively. For the East Greenland area the total abundance index was estimated to be 1.5 million fish equivalent to a biomass index of 362 t (Table 5.1.12).

The 1994 estimates in West Greenland offshore waters are the lowest recorded in this trawl survey commenced in 1988. Off East Greenland the biomass estimate was in the same order of magnitude as in 1993, but the abundance was higher, indicating larger catches of small fish in 1994. The indices are however based on very few observations. The continuing decrease in the cod stock abundance is consistent with the results from the German survey and the absence of the cod directed trawl fishery.

5.1.3 West Greenland young cod survey

During June-July 1994 Greenland carried out a gill-net survey on young cod in 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 33 mm 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 old 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 time series is shown in Table 5.1.13.

The 1984 and 1985 year classes, which are considered to have drifted from Iceland to Greenland, show high abundance at age 2 in all areas. For the southern area, no other year classes of any significance have been observed since then. This pattern of year class occurrence resembles that which has been found offshore indicating the Icelandic origin of cod in this area. Inshore spawning is well documented in the central area and in the northern area. Independent fluctuating recruitment in these areas has persisted since the disappearence of the 1984 and 1985 year classes and presumably derives from more or less self-sustained local spawning populations. A decreasing tendency in abundance at age 2 is however observed in the inshore stocks. In the central area, recruitment in the recent years appeared to be poor, and the 1992 year-class appears to be almost non-existent. In the northern area, the 1991 and the 1992 year classes are also poor.

5.2 Trends in Catch and Effort

The fisheries in West Greenland have traditionally been composed of an offshore trawl fishery and an inshore fishery mostly using poundnets (Table 5.2.1). Over the last decade, the fishery in West Greenland has fluctuated substantially. At the start of the 1980s the fishery yielded annual catches of 50,000 to 60,000 t followed by a decline to a low of 5,000 t in 1986. With the recruitment of the exceptional 1984 year class to the exploitable stock, the landings increased to 112,000t in 1989. Thereafter the catches declined to 6,250 t in 1992, mainly because of an effort reduction in the offshore fishery directed towards groundfish, which has been non-existent since the spring of 1991. Catches in 1993 and 1994 amounted to only 1,925 t and 2,115 t (Table 5.2.2), respectively. The low inshore catches are due decreasing catch rates and a general decline in the local inshore fishing effort directed to cod.

Cod in East Greenland waters have been mostly taken by trawlers, either in the directed cod fishery or as a by-catch in the redfish fishery. Both of these fisheries are to some extent mixed fisheries which take place on the offshore banks and along the slopes of the East Greenland shelf from Dohrn Bank to Cape Farewell. In addition, there is a long-line fishery offshore and a small inshore fishery at Angmagsalik. Catches in East Greenland fluctuated during the period 1976-82, but decreased sharply from 27,000 t in 1982 to 2,000 t in 1985. In the period from 1986 to 1989, catches increased steadily from 5,000t to 16,000t. Combining the TAC for West and East Greenland, reflecting the change in stock distribution, caused the catch to double and reached 33,000 t in 1990 at East Greenland. Since then the nominal catches have declined and amounted to only 437 t in 1994 (Table 5.2.3). Greenland, UK (England and Wales) and UK (Scotland), Norway, Germany and Faroe Islands accounted for 16%, 67%, 10%, 5% and 2%, respectively.

It is important to note that total catch figures for West and East Greenland, especially in 1991-94, 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.

5.3 Assessment

5.3.1 Catch in numbers

In West Greenland, 11 samples from poundnet landings were used to convert the total inshore catch into numbers at age. Sampling in 1994 was difficult to perform due to the low catch levels. Seventy percent of the catch was broken down by samples to the respective fishing area and month; the remaining catch had to be converted to numbers at age using samples taken from other areas or months. Catches were dominated by age groups 4 and 5 (79% and 16% of the total catch in numbers, respectively, Table 5.3.1). Catch in numbers for the inshore stock component was reevaluated back to 1982 and is given in Table 5.3.2 in order to form a data base for a separate inshore assessment in coming years.

Total catch in numbers for all gears and West, East Greenland and aggregated for Greenland are listed in Tables 5.3.3, 5.3.4 and 5.3.5, respectively.

There is no information available on length and age composition of the offshore trawl catches off West and East Greenland based on biological samples for 1994. This is due to the low effort. Consequently, respective tables could not be updated. The age composition of German catches landed as fresh fish in Bremerhaven and Cuxhaven (fish market sampling) were computerised and re-evaluated on a quarterly basis for the periods 1953-89 and 1955-93 for West and East Greenland, respectively. Commercial samples collected directly on board of trawlers are yet only included before 1993. The process to make also the trawler data available is ongoing. Age 3-12+ compositions, mean ages and standard deviations are illustrated in Figures 5.3.1 and 5.3.2. These alternative data sets indicated stable conditions until the early 60-s with mean ages varying at 8-10 years and significant reductions in the mean age for West and East Greenland since then, indicating that during the last 25 years the stock structure was mainly composed of few single year classes, predominantly of those which were born in 1973 and 1984.

Weights-at-age for West Greenland cod were based on samples from commercial inshore fisheries (Table 5.3.1). The overall mean weight was derived by weighting by catch from the various areas and months. The mean weight of the important age groups (5 and 6) was approximatly the same level as in 1992, but low compared to the long term mean.

Weight-at-age as used by the Working Group are listed in Tables 5.3.6, 5.3.7 and 5.3.8 for West, East Greenland and total. Only the figures for West Greenland were updated because of the lack of data for East Greenland.

Alternative mean weight-at-age calculations derived from German fish market sampling as described in chapter 5.3.1 are presented in Figures 5.3.3 and 5.3.4 for West and East Greenland, respectively. During the late 1950s, the fish size at age 5-8 years increased and remained at a high level for both West and East Greenland until the middle of the decade of the 1960s. While data for West Greenland became rare, the size of cod at ages 5-8 years taken off East Greenland was very small during the early 1970s and 1980s. These results coincide significantly with cold periods observed for the same periods. The relationship between mean weight-at-age and temperature should be considered in case of future predictions.

5.3.2 Assessment of stock size and fishing mortalities

In the last assessments of cod off Greenland the Working Group has experienced considerable difficulty. The main problem has been the sudden decrease of the dominant 1984 year class from Greenland waters in 1990. This has led to a situation in which a large proportion of the catches is taken in the inshore areas off West Greenland. As year class strength in these areas differs considerably from that observed offshore, it was impossible to calibrate VPAs with survey indices from the offshore areas. After catches declined recently to very low numbers, the Working Group tried last year to estimate the historical development of this stock by different VPA formulations. A traditional VPA attributed the dramatic decrease in stock abundance to the fishing mortality, the FBAR for 1991-93 exceeded 1.1 for all age groups >3 and <11 years.

In view of a very similar situation for 1994, i. e. extremely low catches both in- and offshore and a lack of indications for stock recovery as derived from the surveys, the Working Group considered an update of the last year's exercise as unnecessary. The Working Group appreciated the ongoing process to split the catch and size-at-age data into in- and offshore cod stock components, so separate VPAs can be carried out after completion of required data in the near future.

5.4 Management Considerations

The German survey data confirmed the severely depleted status of the cod stock off Greenland. Most recent estimates indicate a 99% decrease in abundance and biomass indices as compared to the 1988 values. Very low indices derived from the Greenland trawl and inshore surveys underline the evidence of these results. The trends in the fisheries are consistent with this picture as the directed cod fishery failed offshore since 1991. Since then, cod has mainly been taken inshore and as by-catches in the redfish or shrimp fisheries. The offshore stock may, therefore, be considered almost non-existent at the present time. Further, no pre-recruiting year classes of any importance have been observed which explains the lack of any stock recovery in the most recent years.

Short-term prospects for the offshore stock component and directed cod fisheries cannot be more pessimistic. Future catches taken as by-catches by the extended shrimp or redfish fisheries will substantially increase the probability of stock extinction and should therefore be minimised to the lowest possible level. No fishing should take place until a substantial increase in recruitment and biomass is evident.

The inshore fishery exploiting possibly self-sustained local fjord populations off West Greenland has historically been small. The inshore stock component has never been assessed separately. In view of the low recruitment indices derived from the young cod survey in 1994, no significant changes from the recently low catch level amounting to 2.000 t (historically 5,000-10.000t) may be expected.

6 GREENLAND HALIBUT IN SUB-AREAS V AND XIV

6.1 Trends in Landings and Fisheries

Total annual catches in Divisions Va and Vb and Sub-area XIV are presented for the years 1981-1994 in Tables 6.1-6.4. During the period 1982-1986, catches were stable at about 31,000-34,000 t. In the years 1987-1989 catches increased to about 61,000 t, followed by a decrease to about 39,000 t in 1990, 38,000 t in 1991, and 35,000 t in 1992. The catches increased to 41,000 t in 1993, but decreased to about 37,000 t in 1994. 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. In 1994 the Faroe Islands reported catches of about 5,000 t taken in Division Vb.

6.2 Trends in Effort and CPUE

New indices of CPUE for the Icelandic trawl fleet were estimated for the period 1985-1994 (Table 6.5). These indices are estimated using the GLIM-statistical package. A multiplicative model, taking into account changes in the Icelandic trawl catch due to ship, statistical square, month and year effects, provides an annual CPUE index for Greenland halibut. All hauls with Greenland halibut exceeding 50% of the total catch were included in the CPUE estimation. These indices were used to estimate the total effort from the total catch.

The effort Series shows a similar trend now as last year (Table 6.5). The effort increased up to 1989, and then dropped somewhat the next 2 years. Since then it has again been increasing, reaching a maximum in 1994.

6.3 Catches in Numbers

The catches in number at age were updated to final catch figures for 1994 using:

a) Icelandic catch-at-age data from trawl fishery in all areas (V and XIV). Data on length distribution from the Faroese trawl fishery in area Vb indicated a similar distribution as in the Icelandic trawl fishery in area Va. Consequently the Faroese trawl catches were combined with the Icelandic data and the same key used on both.
b) Icelandic catch-at-age data from longline fishery in area Va.
c) length data from Faroese tanglenet fishery in Vb, using Norwegian/Greenland age-length key obtained from a trial gillnet fishery in area XIVb.
d) Greenland catch-at-age data from longline catches in area XIV obtained from an age-length-key from the same area.

Catches are raised to the total catch for each year (Table 6.6). The length-weight relationship used was $W = 0.01758 * L^{2.84387}$ for a-c and $W=2.47*10^{-6}*L^{3.348}$ for d.

6.4 Weight at Age

The mean weights at age in the catch are shown in Table 6.7. These estimates were derived using Icelandic and Greenland data. The average weight of 5-year olds in 1992 was estimated from the mean of 1980-1991 (Anon. 1993). 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 was available for the years 1982-1984 and 1991-1994, based on samples from 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 6.8) (Anon. 1992). 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.

6.6 Stock Assessment

6.6.1 Tuning and estimates of fishing mortalities

The 1994 tuning was made with the effort indices from 1985-1994. Only the ages 7-14 are used in the tuning. Data on ages 5, 6, 15 and 16 seem to be unreliable.

Natural mortality was assumed to be 0.15. The proportions of F and M before spawning are both set to 0. Estimates of total effort (with weighted regressions) from Table 6.5 were used to tune the VPA. The XSA tuning method was used following the results of the retrospective analysis made by members of NW Working Group in 1994. A shrinkage of 0.5 was used in the tuning (Tables 6.9-6.10, and Figure 6.1).

6.6.2 Spawning stock and recruitment

The recruitment shows a decrease from 40 millions in 1980 to 29 millions in 1983. In 1985 it reached 43 millions, decreasing to 30 millions in 1989. The 1990 recruitment is 33 millions and below average in 1991 and 1992. In 1994 the recruitment was 29 millions (Table 6.11). Spawning stock biomass and a VPA summary table are given in Table 6.12.

6.7 Prediction of Catch and Biomass

6.7.1 Input data

The input data for the short term prediction are given in Table 6.13. Annual recruitment of 33.5 million at age 5 in 1995 is based on the average recruitment for the years 1980-1994. Stock numbers by age in 1995 are, apart from the 5 years old, taken directly from the XSA run. Mean weights are the average by age for 1992-1994. The maturity is the same as in former assessment, average 1991-1993, since the 1993 values are used for 1994. The prediction is based on a status quo situation. The same F is used for 1995 as in 1994.

The Y/R calculation uses the average number of 5 year old fish during 1980-1994. The same period is used to estimate weight by age.

6.7.2 Biological reference points

$F_{0.1}$ was estimated to be 0.19 and F_{max} = 0.47 (Tables 6.15 and 6.16). Due to inadequate sexual maturity at age data for this stock, it was not considered meaningful to calculate F_{med} and F_{high}.

6.7.3 Projections of catch and biomass

Table 6.14 and Figure 6.2 show the results of the predictions. At the beginning of 1995, the total stock is estimated to be about 180,000 t, and the spawning stock to just below 60,000 t. The prediction shows that if the fishing effort does not change from 1995 to 1996, the stock level will remain at the 1995 level (180,000 t). This is the lowest stock level estimated over the last 15 years. The catches will go down, 33,000 t in 1995 and 32,000 t in 1996. To keep up the catch level of the past few years, the F's have to be increased further, up to about 0.61, a 25% increase.

A 20% reduction in fishing mortality (F=0.41) in 1996, which gives about 26,000 t catch, will give a stock of about 190,000 t, and a SSB still under 60,000 t in the beginning of 1997. The stock size would still be lower than it was during the last decade.

A 40% reduction in fishing mortality, to F=0.31, in 1996 would give a catch about 21,000 t in 1996, a stock size level of about 195,000 t, and a SSB of 62,000 t.

6.8 Management Considerations

The Greenland halibut stock is now on a low level. The fishing mortality level is close to the F_{max} level. Regulations are recommended and a considerable reduction of catches is needed to rebuild the stock.

6.9 Comments on the Assessment

The use of only one commercial fleet for tuning is a cause of concern because of possible changes in catchability. No recruitment indices are available, so a mean of a certain number of years has to be used in the prediction.

Information about the length composition of the Faroese tanglenet fishery was now used for the first time using an age-length key from the Norwegian/Greenland trial gillnet fishery in area XIV. Additionally an age-length key was now available on the longline fishery in area XIV, which was used to split up the corresponding catches from this area.

All these new data are an improvement from former assessments and this work needs to be further strengthened. Data on maturity by age are still notoriously unreliable. Some steps must be taken to improve the sampling of this data. The ageing methods are discussed in the next paragraph. Studies of recruitment and the pre-recruits of Greenland halibut are obviously a prerequisite for sound management advice.

6.10 Age Reading Work Shop

Data on an exchange of Greenland halibut otoliths were provided the Working Group (Working paper no. 13 this meeting). The exchange was made by Greenland Fisheries Research Institute, which had the 1993 otolith samples age determined at the Institute of Marine Research, Bergen, Norway, because of the lack of an age reader at the Greenland institute.

100 otoliths, already age determined in Norway, covering the length interval 15 to 105 cm, were randomly chosen and sent to the Department of Fisheries and Oceans, St John's, Newfoundland, for age determination by a Canadian age reader. The results of this exchange revealed systematic differences between the two age readers, and inconsistency in the interpretation of annuli. These discrepancies could partly be explained by the use of two different methods.

The Working Group experienced that at least four different methods are in use at the laboratories of the participating nations. Further, there was a general agreement that there are severe difficulties related to the age determination of Greenland halibut, mainly due to interpretation of the annuli. The Working Group recommends that exchange programs between the different laboratories should be continued and extended to include more nations. A workshop on age determination of Greenland halibut should be established in the near future.

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

7.1 Species and Stock Identification

In the northeast Atlantic there are at least three species of redfish: *Sebastes viviparus*, *S. marinus* and *S. mentella*. These three species are common along the Norwegian coast, in the Barents Sea, at the Faroes, Iceland, East Greenland and in the Irminger Sea. In the Irminger Sea the *S. mentella* is split into two types: the oceanic *S. mentella* (oceanic redfish) and the deep-sea *S. mentella* (deep-sea redfish). These two types have been considered as two separate stocks (Anon., 1990 and Anon., 1992). In 1991 the deep-sea redfish was discovered in the Irminger Sea, far from the continental shelves. Until then it was considered to have its main distribution along the continental slopes in the region , similar to that of *S. marinus*. In the Irminger Sea the oceanic redfish is most common in depths from 100 to 350 nm. during summer and autumn while the deep-sea redfish is most common below 500 nm. 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 overlapping in the depth distribution of the two types of *S. mentella*. (Magnússon, 1983; Magnússon *et al.*, 1995)

The north-western Working Group has considered the *S. marinus* in East Greenland, Iceland and the Faroes as one stock. Also the deep-sea *S. mentella* in the continental slope region of this area is considered one stock unit. The Working Group has, therefore, to 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.

It is not yet obvious whether the deep-sea *S. mentella* discovered in 1991 in the Irminger Sea in similar depths as in the continental slope areas belongs to the "slope component" or it should be looked upon as a separate stock unit.

In the latest years, particularly in 1993 and 1994 catches of deep-sea *S. mentella* in the Irminger Sea have increased but are reported as oceanic redfish. There are, at the moment, no ways in separating the two types in the catches. Iceland has taken steps which hopefully will enable separation of these two stocks in the catches of the Icelandic fleet in the future. NEAFC is also asking countries participating in this fishery to report catch in depth-intervals and by gear type.

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 1994 (approximately 125,000 t) excluding the catch figures from the oceanic *S. mentella* fishery, was almost the same as in 1993 (124,000 t).

The reported landings of oceanic *S. mentella* were about 107,000 t. Thus the total catch of redfish in the area amounts to about 232,000 t in 1994 compared to 238,000 t in 1993.

In Division Va (Iceland), the total landings amounted to about 112,000 t including approximately 17,000 t of oceanic *S. mentella.* Apart from the oceanic *S. mentella* landings the catches in Division Va have remained relatively stable since 1988: 92,000–97,000 t (Tables 7.2.1–7.2.2).

In Division Vb (Faroes) (Tables 7.2.3–7.2.4) the biggest catches were taken in 1986 (21,000 t). Since then the catches decreased steadily to about 12,000 t in 1990 but increased again to about 15,000 and 16,000 t in 1991 and 1992. Since then the catches decreased to about 10,000 t in 1993 and to 9,000 t in 1994. Decline in catches since 1993 is reported for all countries fishing in this area.

Landings from Sub-area VI have been of minor importance in recent years (Tables 7.5.2–7.2.6).

Landings from the traditional stocks (*S. marinus* and deep-sea *S. mentella*) in Sub-area XIV were at the lowest level in 1989 with about 3,000 t. The highest landings were reported in 1981 almost 45,000 t. Since 1989 the catches increased, particularly in the two last years with about 17,000 t in 1993 and 20,000 t in 1994. But the total landings (including oceanic *S. mentella*) were highest in 1986 (96,000 t) but were about 54,000 t in 1994. The lowest total catches from this area since 1978 was in 1984 approximately 18,000 t (Tables 7.2.9-7.2.10).

7.2.2 Splitting of the catches

In 1993, an attempt was made to split the redfish catches in Division Va into *S. marinus* and *S. mentella.* A new attempt was made this year for the years 1992-1994, based on a modified version of the last years method. A description of the new approach is presented as a working paper to the Working Group (Sigurdsson and Johannesson WD. no 5).

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).
2. Landing statistics from Germany.
3. Information on landed products from freezing trawlers.
4. Logbook data.
5. Official landings.

Splitting of catches from freezing trawlers: In the freezing fleet the products are usually labelled according to species. Reliable data on this issue are available for 1993 and 1994, and assuming that the species composition is the same in spliced and unsplitted catches, the catches were split according to the products. For 1992, the same method are used as for the fresh fish trawlers.

Splitting of the catches from the fresh fish trawlers:

i. For each year: The catches from the 3-year period were pooled into rectangles (15 min. latitude by 30 min. longitude) and scaled to the total unsplitted catch of the two species for each rectangle. Catches taken by other gears are included (about 2% of total catch). This means that it is assumed that the distribution of catches not reported in logbooks are the same as the reported catches. All catches and hauls taken by the freezing trawlers are excluded as well as hauls taken in trips where the trawlers landed in Germany.
ii. For each strata and each year: The samples taken are 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 were done according to depth and captain experience.

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

The splitting values (%) between *S. marinus* and deep sea *S. mentella* for the years 1992-1994, as well as the results from 1994, are given in the following text table:

	Results from 1995 (%)		*Results from 1994 (%)*	
Year	*S. marinus*	*S. mentella*	*S. marinus*	*S. mentella*
1991			50.76	49.24
1992	54.00	46.00	58.50	41.50
1993	46.96	53.04	48.69	51.31
1994	40.40	59.60		

Although there are some differences in the overlapping year, the Working Group decided to use the new splitting also for this year in spite of the difference.

In Sub-area XIV (East-Greenland) the landings of Germany, Greenland, and Japan for 1992 - 1994 have been split between *S. marinus* and deep-sea *S. mentella* according to the German trawl survey at East-Greenland. The Russian catches in 1994 where allocated to deep sea *S. mentella* according to the results of a German survey in the area where the Russian fleet where fishing.

For Division Vb and Sub-area VI the splitting are based on biological information to the Working Group, information from coast guard and/or log-books. The results of the splitting from 1992 - 1994 in all areas are shown in Tables 7.2.11-7.2.13.

7.2.3 CPUE

Results from analysis of CPUE data from Icelandic trawlers, based on depth was presented in Sigurdsson (WD. no.6). As early as in 1978, Magnússon and Magnússon (1978) stressed that the proportion of *S. marinus* and *S. mentella* is highly dependant on the depth in which the catches are taken, and that the redfish catches at deeper layers than 500 m, were >80% *S. mentella.* Also, percentages of *S. mentella* in shallower waters than 450 m were less than 20% in the SW area where most of the catches were taken. These results are confirmed in samples taken by the Marine Research Institute (MRI) and the Icelandic Catch Supervision (ICS) in the period 1988 - 1995. This indicates that CPUE in redfish can be split to CPUE in *S. mentella* and *S. marinus*, by depth.

Therefore, the CPUE for different depth intervals was calculated for 11 selected trawlers for 1980-1993 and for the whole bottom trawl fleet from 1986-1994.

The results for the whole fleet are given in Figure 7.2.1 -7.2.2. The CPUE indices are computed by simple aggregations of tows with at least a given percentage of redfish in each tow. Figure 7.2.1 corresponds to 10% and Figure 7.2.2 to 50%. The results for the whole fleet, as well as the specially selected fleet are similar; showing that it does not matter choosing depth of more than 500, or more than 550 m. Knowing that *S. marinus* is rarely caught at deeper water than 500 m the Working Group assumed that these results reflect to CPUE in *S. mentella.*

Similarly, the Working Group assumed that the redfish fishery at shallower waters than 500 m, the CPUE reflects to CPUE in *S. marinus.* Since the CPUE from the 11 specially selected trawlers showed an increasing trend in the period from 1983 to 1991 while the survey index of the Icelandic groundfish survey of the fishable stock shows a decreasing trend from 1986, the results from the whole fleet was chosen. The CPUE (at depth < 500 m) from the whole fleet shows similar declining trend as the groundfish survey indices.

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 since 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 to 1984. Values were high in 1985, 1987, 1990, 1991 and 1992.

Although the indices in 1986 and 1989 were slightly below the 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). Since 1992 the indices have been below the overall average of 14.8.

7.3.1.2 Icelandic ground fish survey

The Icelandic groundfish survey, which covers the 0-500 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 point scatter using a generalised 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 recruitment failure in recent years. The length distributions also illustrate the diminishing number of big fish in the latest years and the recruitment of probably two year-classes (1985 and 1990).

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). Juvenile redfish (<17 cm) were classified as *Sebastes spp.* due 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, small-sized redfish were more abundant and in 1993, this component overcrowded 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 reoccur frequently and might indicate growth increments of the 0-group, 1 and 2 years old fish.

7.3.1.4 Greenland trawl survey

Juvenile redfish are caught both off West and East Greenland during the Greenland trawl survey commenced in 1992 and directed towards shrimp. The survey design covers the depth range 0-600 m and is described in chapter 5.1.2. The data from 1992 were recalculated to compensate for the change in 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. In the latter case there is an increase in biomass index off East Greenland from 1992 to 1993 (33,000 to 81,000 tons) followed by a decrease to 49,000 t in 1994 (Table 7.3.4 and Fig. 7.3.6). In the same period, the abundance indices are 725 millions, 1.7 billion and 1.4 billion fish, respectively.

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, which is in good agreement with the findings of the German survey.

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. The extend of this by-catch and discarding of small redfish assumes to be considerable especially at West Greenland.

As the reliability of the log-books from the commercial shrimp fishery is uncertain on discarded fish, the Working Group recommends that survey data collected in important shrimp fishing areas should be analysed in order to quantify the amount of redfish by-catch, and that further investigations on this matter should be continued in 1995.

7.3.3 Regulations of small redfish at East- and West Greenland

Present regulations concerning by-catch in the Greenland shrimp fishery legalises by-catch to be 10 % of the total catch per each haul by weight. In 1994 a new arrangement was implemented by observers on board the vessels 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 trawl fishery where a directed cod and redfish fishery took place in the seventies.

Trial fishery 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 in 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). 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 *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;

-Minimum fish size in the catch.

7.4 Age-based production model

An age-based production model (EXCEL spreadsheet) was set-up for the *S. marinus* stock in ICES Division Va and the oceanic *S. mentella* stock in the Irminger Sea following the same lines as in the Report from the Methods Working Group (Anon. 1995a, chapter 3.4). For the latter stock, a similar approach has been taken during the last three year's assessment (e.g., Anon. 1993).

The basic assumption made is that the initial stock size (set to be in 1977) was an equilibrium stock composed of age groups from a constant number of recruits. This initial stock is thus computable based on knowledge of the number of recruits and the annual natural mortality. Projections of the stock 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 idea behind the model is that the projection of the fishable stock from 1977 onwards should match either independent acoustic estimates or an index series from a groundfish survey. The model should further match the given annual catches (by calculating the fishing mortalities necessary to produce the catches) and the length distribution of these. Iterations were then made with different constant recruitment levels to make the best fit (minimising 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 constant to 0.05.

Theoretical aspects of harvesting strategies relating to redfish species have been considered by the Long-Term Management Measures Working Group, LTMMWG (Anon. 1995b), as presented in Magnusson (1995). The present meeting considered such models for formal harvesting strategies and concluded that this approach shows considerable potential and work along these lines should be continued under the auspices of ICES via the LTMMWG and the North Western Working Group

The approaches considered at the LTMMWG were more abstract and on a longer time-scale than usually done at ICES. The approach taken at this meeting was therefore to consider a shorter time scale and a more direct link to the fisheries on the three *Sebastes* stocks. The results for various harvesting strategies are shown for each stock in chapters 8-10.

8 SEBASTES MARINUS

8.1 Landings and Trends in the Fisheries

The total catch of *S. marinus* in Division Va and Vb and in the Sub-areas VI and XIV has decreased from about 130,000 t in 1982 to about 42,000 t in 1994 (Table 8.1.1). This decline of about 68% in this period has been continuous with few exceptions. Considering the last 5 years development the catches have decreased from about 67,000 t in 1990 to about 42,000 t in 1994 or about 36%. Decline in the catches from the early or mid eighties has been reported from both Divisions and Sub-areas (Table 8.1.1).

The greatest *S. marinus* catches are taken in Division Va, there the catches have declined from about 63,000 t in 1990 to approximately 39,000 t in 1994 i.e. about 39% during this 5 year period. The decline in the catch in 1994 is probably partly due to area closures imposed on the fishery by Iceland in order to reduce the catches of *S. marinus* (Table 8.1.1). The length distribution in the Icelandic landing in 1992-1994 are shown in Figure 8.1.1

In Division Vb the catches were highest in 1985 about 9,000 t but declined steadily to about 2,400 t in 1990. They have since then remained at that level of 2,100-2,400 t except in 1992 when the catch was about 3,400 t (Table 8.1.1). The length distribution from the Faroes catches is shown in Figure 8.1.2

In Sub-area VI the catches were highest in 1987, almost 600 t, but have declined since then to a level of 100 t during the two last years (Table 8.1.1).

In Sub-area XIV the catches have showed greater variations 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 (84%). In the period 1984 to 1988 they varied between 1,200-5,000 t. In 1989 they were down to 685 t, i.e. 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 but have since then been about 1,100–1,700 t (Table 8.1.1.).

8.2 Assessment

8.2.1 Trends in CPUE and survey indices

Figure 8.2.3 shows the Icelandic groundfish survey abundance index for *S. marinus* and CPUE index. The 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 results seem to indicate that the CPUE and survey data show both the same peaks and troughs and are highly correlated (Figure 8.2.4). However, the slope of the survey based line is considerably steeper from 1990 than the one from the CPUE data in the last years. This is likely to be a reflection of increased catchability of the trawlers.

In summary, the Icelandic groundfish survey as well as the CPUE data seems to indicate a considerable decline (65% and 42%, respectively) in fishable biomass of *S. marinus* since 1986.

Abundance, biomass indices and length composition 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). Only redfish (>=17 cm) were separated to *Sebastes marinus* L. and included in the calculations.

For the period 1982-94, 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 8.2.5 and 8.2.6. 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 million to 325 million fish and 440,000 t to 140,000 t during 1982-1985. Since 1986, an almost continuous reduction in survey biomass by 94 % from 300,000 t to 25,000 t in 1993 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. In 1987 and 1993, abundance indices amounted to 610 million and 66 million, respectively. 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 to non-recognisable parts. 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, East Greenland and aggregated to total in Figures 8.2.7 and 8.2.8, respectively (see also Rätz, WD no. 2). 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

Results from Division Va of computing TAC values corresponding to different reductions in real effort, as used earlier by the Working Group are given Sigurdsson and Stefánsson (WD no.7).

The groundfish survey indices (U) may possibly be assumed to be related to overall biomass (B) by a simple multiplicative relationship ($U=kB$). If catches in 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 *status-quo* effort.

The time series of survey index, catches and deduced effort index is given in Table 8.2.4 and Figure 8.2.9, along with the projection for 1994 assuming constant effort. The effort in 1994 has decreased by 22% from 1993, mainly because of area closures within area Va.

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 7.4 and listed in Table 8.2.5. 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 Bertanlanffy model and (3) the natural mortality. 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) minimising the difference between the abundance indices from the Icelandic groundfish survey on the fishable stock from 1985-95 and the models estimated fishable stock and (2) the difference in the observed cumulative length distribution in the catches, from 1987-94, 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 mortalities, and finally, (c) the cumulative plots of length distributions.

The catch prognosis in Figure 8.2.10 (1995-2001) are simply derived by assuming a catch of 28000 t in 1995 and setting the average fishing mortality for 1997-2001 equal to the average of 1986-90, but going to this lower value in two steps by going half-way in 1996.

8.3 Management considerations

The *S. marinus* stock seems to be at a low level and fishable biomass seems to have decreased considerably according to the Icelandic groundfish survey and the CPUE data, but recruitment failure does not seem to have occurred. If the stock size is to increase, it is likely that effort will have to be reduced from the present record high levels. There have been considerable changes in catchability in recent years. Given these changes and the variability in survey data, 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 can be obtained in the long run by expending only half of the current effort.

Also from the age-based model, the *S. marinus* stock in Va seems to be at a low level and fishable biomass may have decreased to about 30% of the 1985-level, or 15% of the 1977-level.

It is important to reduce effort from the present level since this level does not seem sustainable. Although the effort has decreased in 1994, the results from last Icelandic groundfish survey indices showed no improvement on the previous ones. Also, the fact that CPUE has decreased in a same magnitude, it may be feasible to bring on this effort reduction further by e.g. taking an initial 25% reduction and then further reductions if no improvement is seen in the Icelandic groundfish survey and CPUE.

Since *S.marinus* in Sub-areas V and XIV is treated as one unit stock, it is the opinion of the Working Group to give some specific advice 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 and reduce the fishing effort.

Since recommendations have been given 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 *SEBASTES MENTELLA* DEEP-SEA

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 within the range of 30,000 to 60,000 t.

In 1990 the catch was 44,000 t, reached 67,000 t in 1991, decreased slightly in 1992 (62,000 t) but has increased rapidly since then and was about 82,000 t in 1994, i.e. the annual catch has almost doubled 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 1994 was about 57,000 t, the highest on record. In the 1980s the catches varied from 10,000-40,000 t, but were mostly around the average of 21,000 t during that period (Table 9.1.1). The increase in the catch has mainly taken place during the two previous years and has doubled since 1990 i.e. from 28,000 t to 57,000 t. This increase in the catch coincides with the introduction of big 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 1992-1994 are shown in Figure 9.1.1.

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 been down to almost the half of the 1991 catch, a reduction of about 47% (7,000 t in 1994) (Table 9.1.1). The length distribution from the Faroese catches are shown in Figure 9.1.2.

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

In Sub-area XIV the annual catches have varied considerably. In the beginning of the 1980s the landings were at the level of 10,000-15,000t, decreased then to the level of 6,000 t in 1987-1992 and increased to 19,000 t in 1994, i.e. to the same level as in 1981 (Table 9.1.1).

Almost one third (6,600 t) of the total 1994 catch in Sub-area XIV was taken by Russian trawlers along the continental slope of East Greenland during the period April-July in accordance with an agreement between Greenland and Russia.

9.2 Assessment

9.2.1 Trends in CPUE and survey indices

Trends in CPUE for deep-sea *S. mentella* in Division Va are described in Sigurdson (WD no.6). In the period from 1986 - 1989 CPUE was stable. Since 1990, there has been a strong declining trend in CPUE (Figure 9.2.1). The decline corresponds to a reduction from a stable level of about 950 before 1990 to the current level of about 500, i.e. a reduction of about 47%.

It should be noted that these data reflect only the state of 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 over 55,000 t. This may be taken as a strong indication that the stock in this area cannot sustain the present level of catches.

Abundance, biomass estimates and length structures 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). 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 9.2.1 and 9.2.2, broken down by stratum at West and East Greenland, and illustrated in Figures 9.2.2 and 9.2.3. An increasing trend is evident for both abundance and biomass indices. Especially in 1991 and 1993, when the survey area was completely covered, this species was found to be very abundant with 970 million and 1,400 million fish and 290,000 and 230,000 t, 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 9.2.4 and 9.2.5. Since 1985, juveniles (<25 cm) contribute significant portions and dominate 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.

9.2.2 State of the stock and catch projections

A possible method for computing effort as well as a TAC corresponding to different reductions in effort for deep sea *S. mentella* is described by Sigurdsson and Stefánsson (WD no.7). This is similar to the method in 8.2.1, although for the deep-sea *S. mentella,* a CPUE index is used as the survey index which is only available from the Icelandic groundfish survey and does not cover the distribution of the deep-sea *S. mentella*. The time series of CPUE index, catches in area Va and deduced effort index are given in Table 9.2.3. In the last years, the CPUE has decreased drastically, the catches have increased and the effort has increased by a factor of 3 since 1989-1990.

The development of the stock in 1992-1994 has corresponded to a certain annual decline in CPUE, from 585 through 550 down to 471. If the same rate of decline is assumed to continue, a predicted CPUE value for 1995 will be about 423 in Division Va.

9.3 Management Considerations

The above results seem to indicate that the present level of effort in the deep-sea *S. mentella* fishery in Va is not sustainable for the stock. Reduction towards effort levels during the time period when the CPUE was stable would imply a reduction of effort from the present 120 to about 40, i.e. by 2/3.

If this is taken in two steps, a 1/3 reduction in effort in 1996 from the 1994 level and the above prediction of CPUE would imply a TAC in 1996 of about 35,000t for Va.

According to German survey data there is a great depletion of the adult stock (over 30 cm) in Sub-area XIV. Latest years exploitation targeting on small fish will not lead to stock recovery nor catch improvement in the 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.

10 *SEBASTES MENTELLA*, OCEANIC

10.1 Landings and Trends in the Fishery on Oceanic S. *Mentella*

The fishery on oceanic S. *mentella* started in 1982 by the Russian fleet. Bulgaria, former GDR, Poland joined to Russia from 1984. The international catches during the first period increased from the 60,000-70,000 t and reached 105,000 t in 1986. Since 1987 the decreasing of total catches was observed. Landings reached a minimum level in 1991 (24,700 t). The main reason a decrease in the catches was a reduction in fishing effort (mainly - Russian effort). In 1992 the number of countries, participating in oceanic S. *mentella* fishery, increased. The total catches increased during 1992-1994 from about 59,000 t to 107,000 t respectively. In 1994 trawlers of 11-12 countries took part in this fishery. Several countries have not yet reported their 1994 catches. Resuming similar catches for those countries as in 1993 the total catch in 1994 is likely to be about 125,000 t.

In 1982-1992 the fishery was carried out during April-August. In 1993-1994 the fishing season was prolonged considerably. In 1993 it finished in October. In 1994/1995 one trawler continued the fishery during the winter months. The fleets participated in this fishery have developed the fishing technology. Most trawlers are using big trawls (like "Gloria"-type), and are increasingly working in greater depths (500-800 m).

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 the period from 1985-1992 the catches in Sub-area XIV dominated (47,000-88,000 t). In 1993 and 1994 the landings from Sub-area XII were again in majority with 71,000 and 56,000 t each year respectively. Length distribution of oceanic *S. mentella* from 1992-1994 based on Icelandic surveys and landings from the Icelandic fleet is given in Figure 10.1.1.

In Division Va the fishery started in 1992 with about 2,000 t but increased particularly in 1994 to almost 17,000 t (Table 10.1.1 - 10.1.2).

In 1994 about 52 % of total catches (55,500 t) of oceanic *S. mentella* were taken in Sub-area XII in 1994. The weight of Sub-area XIV decreased from 62 % in 1993 to 32 % (34,500 t) in 1994 and in Division Va the 1994 catch amounted to 15 % (16,700 t) of the total catch.

The CPUE of the Russian BMRT-type vessels increased from 0.6 t/h in 1992-1993 to 1.7 t/h in 1994. In Table 10.1.3 the CPUE for Russian and Norwegian fleets are given, but were not used for the assessment purposes. The main reasons are changes in gears, fishing pattern etc.

10.2 Assessment

10.2.1 Acoustic assessment

Since last year's meeting of the North Western Working Group, results from three acoustic surveys on oceanic *S. mentella* have been made available. These are the results from a German trial acoustic survey in 23-29 April 1994, the joint Icelandic-Norwegian survey in 24 June - 17 July 1994, and an Icelandic survey in 7-21 March 1995. The German survey was first of all a methodical one, and the Icelandic March-survey was restricted to within the Icelandic EEZ to assess the part of the stock within the zone at that time of the year. Of the surveys mentioned, it is therefore only the results from the joint Icelandic-Norwegian survey which can be used as an acoustic assessment of the fishable stock. The stock size in the area surveyed (down to 500 meters) was estimated to be about 2.2 million t (Magnusson *et al.* 1994).

At no time was the expected area of distribution of the redfish covered completely, although it is believed that the major part down to 500 meters depth was covered in 1994. In order to compare the results from the 1994 June-July survey with the results from the acoustic surveys in 1991 and 1992, the echo abundance obtained in 1994 within the areas common to the 1991 and 1992 surveys was calculated (Reynisson 1995). The abundance measured in 1994 is only 1.6% lower than the corresponding figure from 1991, and 1.6% higher as compared to 1992. These comparisons thus show consistency in the estimates. No account has here been taken of possible biological differences in the fish, neither within different areas, nor from year to year. These results also correspond to the Russian survey in 1993 which estimated the biomass to be 2.5 million t keeping in mind that this survey may not have covered the area as synoptic as the 1994 survey.

In June-July the geographical distribution pattern is very similar from year to year, though linked to hydrographical conditions, e.g., temperature, influx of colder water deriving from greater depths. Research surveys since 1982 have not shown any changes in mean length and weight of fish living shallower than 500 meters.

Pelagic *S. mentella* living 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-weight relationship, length at first maturity) has not yet been assessed acoustically.

Stock trajectories for oceanic *S. mentella* are fully dependant on the best available acoustic estimate. Especially in periods with great increase in fishing effort from year to year, it is necessary to frequently conduct acoustic surveys. This is especially important now, also since more experience about the capability of the rather new trajectory model to monitor the stock is needed.

10.2.2 Stock and catch trajectories for oceanic *Sebastes mentella*

The input parameters, fixed or estimated, to the model are listed in Table 10.2.1. The length-weight relationship was taken from the 1994 survey results. The same selection pattern was assumed for the fishery and the survey. The unfixed parameters were estimated as to minimise (1) the discrepancy between the observed length distributions 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 10.2.1 - 10.2.2. The fishing mortalities on the fully recruited age groups, i.e., above age 20, at present are estimated to be about 0.05. The age-length distribution generated by the model also resembled age-length keys presented to the Working Group.

Scenario 1

Projections of spawning stock biomass (about 97% mature) and catches have been made up to 2010. 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 110,000 tin 1995 down to 75,000 t in 2010. In the short term (until 2001), the stock will be reduced to 60% of the 1982-level when fishing 5% of the standing fishable biomass annually, or down to 44% and 31% if the annually catches are taken as 10% or 15%, respectively, of the fishable biomass measured at the beginning of each year.

Scenario 1: (Figure 10.2.2)
Final stock biomass as percentage of the estimated virginal stock biomass.

	Catch as percentage of fishable biomass		
Year	5%	10%	15%
2001	60	44	31
2010	51	31	20

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 10.2.3)
Final stock biomass as percentage of the estimated virginal stock biomass.

	Catch as percentage of fishable biomass		
Year	5%	7.5%	10%
2001	59	49	40
2010	50	37	27

Scenario 3

A scenario is also presented with a constant catch of 150,000 t each year prior to 1999, and a catch in later years set to a certain percentage (5-10%) of the fishable biomass in the beginning of the 5-year period. The results are shown in the text-table below.

Scenario 3: (Figure 10.2.4)

Final stock biomass as percentage of the estimated virginal stock biomass.

	Catch as percentage of fishable biomass after 1999		
Year	5%	7.5%	10%
2001	53	52	50
2010	47	37	28

These predictions clearly relate to the generic evaluation of management strategies, which are sometimes considered in more general settings (Anon. 1995b). 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.

10.3 Management considerations

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 above 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, only the 5% catch-level could be recommended.

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.

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 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 support the recommendation by the Study Group on Redfish Stocks (Anon. 1995a) to conduct an acoustic survey in 1996. Future time scaling of monitoring the stock by surveys is dependent on the results from the 1996 survey and the development of the fishery. In order to achieve 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 is necessary.

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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

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

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

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

Table 2.2.1 Faroe Plateau (Sub-division Vb1) COD. Nominal catches (tonnes) by countries, 1985-1994, as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Denmark	-	8	30	10	-	-	-	-	-	
Faroe Islan	39,422	34,492	21,303	22,272	20,535	12,232	8,203	5,938	5,524	8,724
France [2]	29	4	17	17	-	43	-	318	-	
Germany	5	8	12	5	7	24	16	12	+	
Norway	28	83	21	163	285	124	89	41	61	36
Engl. and	-	-	8	-	-	-	1	79	186	
UK (Scotl	-	-	-	-	-	-	-	-	-	283 [4]
Total	39,484	34,595	21,391	22,467	20,827	12,423	8,309	6,388	5,771	9,043

1) Provisional data

2) Sub-division Vb2 included. Quantity unknown 1989-1991 and 1993.

3) Catches included in Sub-division Vb2

4) Reported as Vb.

Table 2.2.2. Nominal catch (tonnes) of COD in sub-division Vb_1 (Faroe Plateau) 1985-1994, as used in the assessment

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994[1]
Officially reported	39,484	34,595	21,391	22,467	20,827	12,380	8,309	6,388	5,771	9,043
Faroese catches in IIA within Faroe area jurisdiction				715	1,229	1,090	351	154		
French catches as reported to Faroese authorities					12	17				
Total used in the assessment	**39,484**	**34,595**	**21,391**	**23,182**	**22,068**	**13,487**	**8,660**	**6,542**	**5,771**	**9,043**

1) Provisional data

Table 2.2.3. Catches of Faroe Plateau cod by different faroese fleet categories in percent. The total catches are given in the last row (gutted weigth).

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Open boats	16	9	10	3	4	4	4	3	2	3
Longliners < 100 GRT	27	15	15	14	29	36	32	26	16	13
Single trawlers < 400 HP	7	5	6	5	6	5	7	7	15	10
Gillnett	1	1	1	3	3	1	2	0	0	1
Jiggers	4	3	3	8	9	8	8	7	9	19
Single trawl 400-1000 HP	8	6	7	7	6	4	3	2	4	3
Single trawl > 1000 HP	11	8	8	7	6	4	5	4	4	5
Pair trawl < 1000 HP	12	30	26	25	11	7	8	12	14	8
Pair trawl > 1000 HP	6	15	14	16	8	10	13	21	22	24
Longliners > 100 GRT	7	5	10	13	18	20	17	13	13	14
Others	1	1	1	0	1	1	1	5	1	1
Total catch, gutted tonnes	35,420	31,052	21,698	21,914	20,742	11,900	7,846	5,196	4,957	7,654

Table 2.2.4

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

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

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

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

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
2,	852,	1337,	1609,	1529,	878,	402,	328,	875,	723,	2161,
3,	3230,	970,	2690,	3322,	3106,	1163,	757,	1176,	3124,	1266,
4,	2564,	2080,	860,	2663,	3300,	2172,	821,	810,	1590,	1811,
5,	1416,	1339,	1706,	945,	1538,	1685,	1287,	596,	707,	934,
6,	363,	606,	847,	1226,	477,	752,	1451,	1021,	384,	563,
7,	155,	197,	309,	452,	713,	244,	510,	596,	312,	452,
8,	48,	104,	64,	105,	203,	300,	114,	154,	227,	149,
9,	63,	33,	27,	11,	92,	44,	179,	25,	120,	141,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	97,	91,
TOTALNUM,	8691,	6666,	8112,	10253,	10307,	6762,	5447,	5253,	7284,	7568,
TONSLAND,	24856,	21027,	25174,	30279,	35670,	29037,	26151,	20437,	22381,	24581,
SOPCOF %,	103,	103,	107,	101,	110,	120,	114,	109,	101,	106,

Continued

Table 2.2.4 (Cont'd)

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

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

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	2584,	1497,	425,	555,	575,	1129,	646,	1139,	2149,	4396,
3,	5689,	4158,	3282,	1219,	1732,	2263,	4137,	1965,	5771,	5234,
4,	2157,	3799,	6844,	2643,	1673,	1461,	1981,	3073,	2760,	3487,
5,	2211,	1380,	3718,	3216,	1601,	895,	947,	1286,	2746,	1461,
6,	813,	1427,	788,	1041,	1906,	807,	582,	471,	1204,	912,
7,	295,	617,	1160,	268,	493,	832,	487,	314,	510,	314,
8,	190,	273,	239,	201,	134,	339,	527,	169,	157,	82,
9,	118,	120,	134,	66,	87,	42,	123,	254,	104,	34,
+gp,	150,	186,	9,	56,	38,	18,	55,	122,	102,	66,
TOTALNUM,	14207,	13457,	16599,	9265,	8239,	7786,	9485,	8793,	15503,	15986,
TONSLAND,	36775,	39799,	34927,	26585,	23112,	20513,	22963,	21489,	38133,	36979,
SOPCOF %,	94,	93,	93,	100,	98,	106,	104,	100,	97,	97,

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	998,	210,	257,	509,	2237,	243,	190,	209,	114,	573,
3,	9484,	3586,	1362,	2122,	2151,	2849,	446,	465,	758,	788,
4,	3795,	8462,	2611,	1945,	2187,	1481,	2130,	476,	569,	1061,
5,	1669,	2373,	3083,	1484,	1121,	852,	615,	932,	210,	532,
6,	770,	907,	812,	2178,	1026,	404,	300,	360,	311,	125,
7,	872,	236,	224,	492,	997,	294,	141,	135,	91,	176,
8,	309,	147,	68,	168,	220,	291,	92,	55,	31,	39,
9,	65,	47,	69,	33,	61,	50,	52,	30,	21,	23,
+gp,	80,	38,	26,	25,	9,	26,	24,	35,	24,	16,
TOTALNUM,	18042,	16006,	8512,	8956,	10009,	6490,	3990,	2697,	2129,	3333,
TONSLAND,	39484,	34595,	21391,	23182,	22068,	13487,	8660,	6542,	5771,	9043,
SOPCOF %,	95,	96,	96,	101,	98,	99,	106,	99,	102,	101,

Table 2.2.5

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

Table 2 Catch weights at age (kg)

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

Table 2 Catch weights at age (kg)

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
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,	1.0292,	1.0308,	1.0706,	1.0121,	1.1028,	1.2014,	1.1380,	1.0923,	1.0106,	1.0634,

Continued

Table 2.2.5 (Cont'd)

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

Table 2 Catch weights at age (kg)

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	1.0600,	1.0600,	.6800,	1.1120,	.8970,	.9270,	1.0800,	1.2800,	1.3380,	1.1950,
3,	1.8900,	1.8900,	1.1700,	1.3850,	1.6820,	1.4320,	1.4700,	1.4130,	1.9500,	1.8880,
4,	2.9200,	2.9200,	1.8710,	2.1400,	2.2110,	2.2200,	2.1800,	2.1380,	2.4030,	2.9800,
5,	4.0700,	4.0700,	2.6670,	3.1250,	3.0520,	3.1050,	3.2100,	3.1070,	3.1070,	3.6790,
6,	5.3000,	5.3000,	3.5880,	4.3630,	3.6420,	3.5390,	3.7000,	4.0120,	4.1100,	4.4700,
7,	6.5800,	6.5800,	4.7680,	5.9270,	4.7190,	4.3920,	4.2400,	5.4420,	5.0200,	5.4880,
8,	7.8500,	7.8500,	5.9180,	6.3480,	7.2720,	6.1000,	4.4300,	5.5630,	5.6010,	6.4660,
9,	9.0800,	9.0800,	5.4480,	8.7150,	8.3680,	7.6030,	6.6900,	5.2160,	8.0130,	6.6280,
+gp,	10.2700,	10.2700,	6.0030,	12.2990,	13.0420,	9.6680,	10.0000,	6.7070,	8.0310,	10.9810,
SOPCOFAC,	.9395,	.9273,	.9337,	.9964,	.9843,	1.0584,	1.0408,	1.0003,	.9695,	.9685,

Table 2 Catch weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	.9050,	1.0990,	1.0930,	1.0610,	1.0100,	.9450,	.7790,	.9890,	1.1550,	1.1940,
3,	1.6580,	1.4590,	1.5170,	1.7490,	1.5970,	1.3000,	1.2710,	1.3640,	1.7040,	1.8430,
4,	2.6260,	2.0460,	2.1600,	2.3000,	2.2010,	1.9590,	1.5700,	1.7790,	2.4210,	2.6130,
5,	3.4000,	2.9360,	2.7660,	2.9140,	2.9340,	2.5310,	2.5240,	2.3120,	3.1320,	3.6540,
6,	3.7520,	3.7860,	3.9080,	3.1090,	3.4680,	3.2730,	3.1850,	3.4770,	3.7230,	4.5840,
7,	4.2200,	4.8990,	5.4610,	3.9760,	3.7500,	4.6520,	4.0860,	4.5450,	4.9710,	4.9760,
8,	4.7390,	5.8930,	6.3410,	4.8960,	4.6820,	4.7580,	5.6560,	6.2750,	6.1590,	7.1460,
9,	6.5110,	9.6990,	8.5090,	7.0870,	6.1400,	6.7040,	5.9730,	7.6190,	7.6140,	8.5640,
+gp,	10.9810,	8.8150,	9.8110,	8.2870,	9.1560,	8.6890,	8.1470,	9.7250,	9.5870,	8.7960,
SOPCOFAC,	.9491,	.9612,	.9642,	1.0061,	.9773,	.9897,	1.0601,	.9879,	1.0215,	1.0140,

Table 2.2.6

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

Table 5 Proportion mature at age

YEAR,	1961,	1962,	1963,	1964,
AGE				
2,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,
4,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
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,

Continued

Table 2.2.6 (Cont'd)

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

Table 5 Proportion mature at age

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.6300,	.4000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.7100,	.9600,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9300,	.9800,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9400,	.9700,
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,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	.0000,	.0000,	.0000,	.0600,	.0500,	.0000,	.0000,	.0600,	.2500,	.7200,
3,	.5000,	.3800,	.6700,	.7200,	.5400,	.6800,	.7200,	.5000,	.7300,	.8900,
4,	.9600,	.9300,	.9100,	.9000,	.9800,	.9000,	.8600,	.8200,	.7800,	.9800,
5,	.9600,	1.0000,	1.0000,	.9700,	1.0000,	.9900,	1.0000,	.9800,	.9100,	.9900,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9600,	1.0000,	1.0000,	.9900,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	1.0000,	1.0000,	1.0000,	.9800,
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

Title : Cod in the Faroe Pla (run: SEPVPA/SPP)

At 8-May-95 14:48:47

Separable analysis
from 1985 to 1994 on ages 2 to 9
with Terminal F of .600 on age 5 and Terminal S of 1.000

Initial sum of squared residuals was 56.991 and
final sum of squared residuals is 5.501 after 38 iterations

Matrix of Residuals

Years,	1985/86,	1986/87,	1987/88,	1988/89,	1989/90,	1990/91,	1991/92,	1992/93,	1993/94,	TOT,	WTS,
2/ 3,	-.341,	-1.066,	-.695,	-.133,	.627,	.228,	.179,	-.468,	-.565,	-.001,	.295,
3/ 4,	.023,	.138,	.074,	.217,	.162,	.100,	.014,	-.347,	.070,	-.002,	.956,
4/ 5,	-.339,	.147,	.340,	.082,	-.035,	-.032,	.226,	.006,	-.166,	-.001,	.760,
5/ 6,	-.346,	.082,	.000,	-.254,	-.128,	-.015,	-.195,	.165,	.172,	-.001,	.842,
6/ 7,	.052,	.246,	.004,	-.015,	-.093,	-.182,	-.091,	.287,	.078,	-.001,	1.000,
7/ 8,	.527,	-.033,	-.322,	-.105,	-.238,	-.198,	-.068,	.260,	.243,	-.001,	.558,
8/ 9,	.650,	-.514,	.122,	.132,	.047,	.381,	.122,	-.247,	-.305,	-.001,	.435,
TOT ,	.001,	.001,	.001,	.001,	.000,	-.001,	-.002,	-.002,	-.001,	-1.334,	
WTS ,	.001,	.001,	.001,	.001,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
F-values,	.7643,	.6724,	.4969,	.6988,	.9334,	.7910,	.6224,	.6153,	.4573,	.6000,

Selection-at-age (S)

,	2,	3,	4,	5,	6,	7,	8,	9,
S-values,	.1015,	.4295,	.8398,	1.0000,	1.1511,	1.2101,	1.1296,	1.0000,

Run title : Cod in the Faroe Pla (run: SEPVPA/SPP)

At 8-May-95 14:48:48

Traditional vpa Terminal populations from weighted Separable populations

Fishing mortality residuals

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	-.0110,	-.0429,	-.0211,	-.0031,	.1059,	.0232,	-.0075,	-.0199,	-.0159,	.0000,
3,	.0273,	.0685,	.0129,	.0536,	.0449,	.0822,	.0118,	-.0773,	.0167,	.0433,
4,	-.1336,	.0576,	.0626,	-.0062,	-.0272,	-.0277,	.1267,	.0244,	-.0182,	.0138,
5,	-.1503,	.0295,	-.0108,	-.1419,	-.1299,	-.0187,	-.0216,	.0551,	.0324,	.0968,
6,	.0315,	.0488,	-.0163,	-.0330,	-.0934,	-.1274,	-.0203,	.1742,	-.0315,	-.0773,
7,	.1891,	.0021,	-.1114,	-.0520,	-.0873,	-.0791,	-.0456,	.0583,	.0257,	-.1427,
8,	.2833,	-.2059,	.0283,	.0678,	.0207,	.1680,	.0700,	-.0205,	-.0894,	-.1485,
9,	-.0085,	-.1565,	.0549,	-.0532,	-.0146,	-.0181,	-.0844,	.0116,	.1400,	.0562,

Table 2.2.8

Cod in the Faroe Plateau (Fishing Area Vb1)

R/V Magnus Heinason (Groundfish surveys) (code: FLT12)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1983	100	4.71	25.92	17.84	14.41	5.28	1.46	0.51	0.08
1984	100	10.85	21.84	16.19	5.08	3.29	1.31	0.01	0.00
1985	100	4.16	42.96	15.46	6.21	1.31	1.57	0.60	0.00
1986	100	0.91	26.69	94.23	26.49	11.13	5.45	3.52	1.07
1987	100	1.27	20.20	46.50	65.71	10.28	1.12	1.49	0.10
1988	100	1.97	12.65	16.62	12.84	14.27	2.75	0.72	0.18
1989	100	4.45	6.02	10.06	8.24	4.05	6.61	0.66	0.09
1990	100	2.62	6.38	15.22	13.78	4.36	5.45	3.70	0.62
1991	100	2.54	3.52	12.22	3.15	1.50	0.51	0.12	0.23
1992	100	1.48	2.10	4.72	18.10	3.94	1.26	0.65	0.13
1993	100	0.41	4.48	2.32	1.63	3.29	1.18	0.44	0.12
1994	100	2.58	1.58	4.56	2.43	0.68	1.02	0.20	0.00

Table 2.2.9

Cod in the Faroe Plateau (Fishing Area Vb1)

Longliners > 100 GRT (code: FLT35) (Catch: Thousands) (Effort: fishing days)

Year	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

Table 2.2.10

Cod in the Faroe Plateau (Fishing Area Vb1)

Single trawlers 400-1000 HP (code: FLT32) (Catch: Thousands) (Effort: fishing days)

Year	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

Table 2.2.11

09:17 Thursday, May 4, 1995

Cod in the Faroe Plateau (Fishing Area Vb1)

Single trawlers < 400 HP (jan-dec) (code: FLT44) (Catch: Thousands) (Effort: fishing days)

Year	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

Table 2.2.12

09:17 Thursday, May 4, 1995

Cod in the Faroe Plateau (Fishing Area Vb1)

Longliners < 100 GRT (jan-dec) (code: FLT45) (Catch: Thousands) (Effort: fishing days)

Year	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	7279	165	139	47	12	16	3	2

Lowestoft VPA Version 3.1

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Table 2.2.13

Extended Survivors Analysis

Cod in the Faroe Pla (run: EXPLVPA/V11)

CPUE data from file /users/fish/ifad/ifapwork/wg_109/cod_farp/FLEET.V11

Catch data for 34 years. 1961 to 1994. Ages 2 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT12: R/V Magnus H,	1983,	1994,	2,	9,	.200,	.300
FLT32: Single trawle,	1985,	1994,	4,	9,	.000,	1.000
FLT35: Longliners > ,	1985,	1994,	3,	9,	.000,	1.000
FLT44: Single trawle,	1985,	1994,	3,	9,	.000,	1.000
FLT45: Longliners < ,	1985,	1994,	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 29 iterations

Regression weights

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

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
2,	.066,	.025,	.029,	.068,	.201,	.106,	.061,	.051,	.039,	.082
3,	.355,	.356,	.224,	.352,	.449,	.426,	.288,	.206,	.263,	.416
4,	.508,	.623,	.478,	.577,	.759,	.647,	.663,	.571,	.419,	.721
5,	.616,	.703,	.486,	.555,	.799,	.777,	.619,	.699,	.536,	.904
6,	.929,	.832,	.556,	.777,	.984,	.773,	.704,	.949,	.531,	.726
7,	1.183,	.852,	.497,	.799,	1.071,	.883,	.687,	.824,	.670,	.662
8,	1.331,	.628,	.641,	.892,	1.104,	1.153,	.781,	.637,	.445,	.693
9,	1.013,	.728,	.694,	.761,	1.018,	.820,	.641,	.638,	.536,	.708

Continued

Table 2.2.13 (Cont'd)

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9
1985	1.73E+04	3.51E+04	1.05E+04	4.01E+03	1.41E+03	1.39E+03	4.64E+02	1.13E+02
1986	9.38E+03	1.32E+04	2.02E+04	5.19E+03	1.77E+03	4.55E+02	3.49E+02	1.00E+02
1987	9.93E+03	7.49E+03	7.59E+03	8.85E+03	2.10E+03	6.32E+02	1.59E+02	1.52E+02
1988	8.59E+03	7.90E+03	4.90E+03	3.85E+03	4.45E+03	9.88E+02	3.15E+02	6.85E+01
1989	1.36E+04	6.57E+03	4.55E+03	2.25E+03	1.81E+03	1.68E+03	3.64E+02	1.06E+02
1990	2.67E+03	9.08E+03	3.44E+03	1.74E+03	8.29E+02	5.54E+02	4.70E+02	9.87E+01
1991	3.58E+03	1.97E+03	4.86E+03	1.47E+03	6.56E+02	3.13E+02	1.88E+02	1.21E+02
1992	4.66E+03	2.76E+03	1.21E+03	2.05E+03	6.49E+02	2.66E+02	1.29E+02	7.03E+01
1993	3.25E+03	3.62E+03	1.84E+03	5.59E+02	8.34E+02	2.06E+02	9.54E+01	5.59E+01
1994	8.01E+03	2.56E+03	2.28E+03	9.88E+02	2.68E+02	4.02E+02	8.62E+01	5.01E+01

Estimated population abundance at 1st Jan 1995

	.00E+00	6.04E+03	1.38E+03	9.08E+02	3.28E+02	1.06E+02	1.70E+02	3.53E+01

Taper weighted geometric mean of the VPA populations:

	8.85E+03	7.15E+03	4.86E+03	2.57E+03	1.29E+03	6.18E+02	2.50E+02	1.07E+02

Standard error of the weighted Log(VPA populations) :

	.8242	.8483	.7809	.7853	.7846	.7002	.7074	.6187

Continued

Fleet : FLT12: R/V Magnus H

Age	1983	1984
2	.05	.67
3	.26	-.02
4	-.10	-.40
5	-.46	-.86
6	-.34	-1.00
7	-.48	-.83
8	-.48	-4.31
9	-2.00	99.99

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	.23	-1.47	-1.03	-.20	.62	1.41	1.05	-.03	-1.61	.28
3	.02	.52	.77	.29	-.25	-.52	.38	-.49	.00	-.65
4	-.65	.54	.78	.21	-.17	.49	-.07	.35	-.82	-.28
5	-.85	.36	.68	-.10	.05	.82	-.53	.91	-.24	-.32
6	-1.15	.74	.42	.05	-.26	.54	-.31	.73	.20	-.19
7	-.89	1.39	-.61	-.09	.33	1.20	-.65	.45	.60	-.21
8	-.72	1.16	1.09	-.26	-.44	1.04	-1.56	.47	.33	-.29
9	99.99	1.24	-1.56	-.15	-1.21	.73	-.51	-.53	-.41	99.99

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	-11.1891	-10.3061	-10.0197	-10.1546	-10.1546	-10.1546	-10.1546
S.E(Log q)	.4574	.4989	.6146	.5949	.7695	1.4208	1.0836

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	1.51	-1.262	14.68	.42	12	1.04	-12.76

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	.88	.797	10.90	.84	12	.41	-11.19
4	.89	.590	10.10	.77	12	.46	-10.31
5	.90	.419	9.80	.69	12	.58	-10.02
6	1.12	-.428	10.52	.60	12	.70	-10.15
7	1.53	-.938	12.07	.27	12	1.18	-10.09
8	1.00	.000	10.39	.16	12	1.48	-10.39
9	-8.56	-1.205	-46.98	.00	9	8.13	-10.59

Continued

Fleet : FLT32: Single trawle

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	-.01	.61	.33	-.18	.17	-.58	-.38	.10	.25	-.19
5	-.10	.41	.08	-.23	-.14	-.96	.10	.17	.18	.49
6	.28	.16	-.44	.03	-.05	-.53	.28	.26	-.29	.33
7	.07	.09	-.54	.08	.21	-.48	.38	.41	-.13	.12
8	.07	-.15	-.30	.02	.07	-.21	-.04	-.05	-.56	.06
9	-.51	.04	-.24	-.21	.26	-.39	.33	.56	.01	.61

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	-10.6805	-10.6343	-10.5628	-10.5628	-10.5628	-10.5628
S.E(Log q)	.3547	.4162	.3230	.3271	.2389	.3962

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	.88	.907	10.40	.89	10	.32	-10.68
5	1.05	-.236	10.77	.78	10	.46	-10.63
6	1.14	-.842	11.05	.84	10	.37	-10.56
7	1.05	-.259	10.74	.81	10	.36	-10.54
8	.90	.946	10.17	.93	10	.19	-10.67
9	1.89	-1.329	15.88	.23	10	.71	-10.50

Continued

Table 2.2.13 (Cont'd)

Fleet : FLT35: Longliners >

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	No data for this fleet at this age									
3	-.42	-.77	-1.75	.14	.71	.45	-.10	-.27	.46	1.14
4	-.54	-.60	-.67	-.01	.48	.18	.30	.03	.51	.01
5	-.44	-.35	-.54	-.12	.33	.33	.10	-.09	.38	.17
6	-.19	-.22	-.11	-.24	.44	.31	-.03	-.18	.23	-.12
7	.33	-.06	.33	.08	.54	.63	.15	-.06	.32	.06
8	.51	-.24	.80	.58	.83	.90	.44	-.11	.30	.63
9	.33	-.21	.71	.80	.81	.62	.24	.03	.18	.59

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	-11.5487	-10.8668	-10.5767	-10.2306	-10.2306	-10.2306	-10.2306
S.E(Log q)	.8211	.4254	.3334	.2477	.3446	.6261	.5602

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	1.51	-.996	13.01	.35	10	1.24	-11.55
4	1.51	-2.346	12.16	.74	10	.52	-10.87
5	1.53	-4.351	12.09	.90	10	.29	-10.58
6	1.03	-.233	10.32	.91	10	.27	-10.23
7	.87	1.263	9.53	.93	10	.20	-10.00
8	.88	.667	9.22	.80	10	.35	-9.76
9	.92	.258	9.37	.57	10	.34	-9.81

Continued

Table 2.2.13 (Cont'd)

Fleet : FLT44: Single trawle

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	No data for this fleet at this age									
3	-.20	.03	.30	.01	.26	.32	-.08	-.70	.14	-.07
4	-.74	-.45	.17	-.02	.19	.39	.42	-.26	-.08	.16
5	-.68	-.79	-.11	-.30	.13	-.26	.49	.25	.29	.64
6	-.30	-1.00	-.57	.01	.23	-.48	.55	.63	.30	.30
7	-.39	-1.01	-1.34	-.35	.50	-.54	.27	.57	.33	.27
8	-.13	-1.13	-1.28	-.42	.39	-.67	.13	.41	.08	.21
9	-1.24	-.94	-1.21	99.99	.58	99.99	-.19	-.37	.37	-.33

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	-10.5709	-10.2310	-10.4256	-10.5369	-10.5369	-10.5369	-10.5369
S.E(Log q)	.3109	.3574	.4705	.5280	.6710	.6474	.7827

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	.91	.754	10.40	.91	10	.29	-10.57
4	1.15	-.840	10.51	.82	10	.42	-10.23
5	1.65	-2.582	12.21	.68	10	.60	-10.43
6	1.44	-1.417	12.10	.59	10	.72	-10.54
7	1.30	-.692	12.00	.42	10	.88	-10.67
8	1.49	-1.007	13.37	.37	10	.90	-10.75
9	3.78	-1.132	28.75	.03	8	2.49	-10.91

Continued

Table 2.2.13 (Cont'd)

Fleet : FLT45: Longliners <

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	No data for this fleet at this age									
3	.39	-.08	-.64	-.03	.37	.25	.06	-.22	-.22	.13
4	.04	.01	-.15	-.52	.29	.07	.42	.32	-.46	-.05
5	.32	.16	-.07	-.59	.23	.40	-.06	.20	-.31	-.20
6	.69	.34	-.08	-.26	.33	.08	-.15	-.15	-.16	-.42
7	1.24	.48	-.41	-.15	.22	.20	-.45	-.13	-.27	-.56
8	1.05	.14	.07	-.04	-.09	.47	-.52	-.38	-.39	-.69
9	.88	-.04	.13	-.09	-1.03	.09	-.55	-.18	-.33	-.54

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	-11.4751	-11.2167	-11.2327	-11.1523	-11.1523	-11.1523	-11.1523
S.E(Log q)	.3088	.3199	.3122	.3247	.5165	.5038	.5334

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	.91	.731	11.23	.91	10	.29	-11.48
4	1.00	-.023	11.23	.87	10	.34	-11.22
5	.93	.503	11.00	.89	10	.31	-11.23
6	.87	1.082	10.61	.90	10	.28	-11.15
7	.71	1.822	9.75	.84	10	.32	-11.17
8	.62	3.629	8.99	.93	10	.20	-11.23
9	.75	.705	9.60	.51	10	.38	-11.35

Continued

Table 2.2.13 (Cont'd)

Terminal year survivor and F summaries :

Age 2 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
FLT12: R/V Magnus H,	7983.,	1.087,	.000,	.00,	1,	.126,	.063
FLT32: Single trawle,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT35: Longliners > ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT44: Single trawle,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT45: Longliners < ,	1.,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean ,	7153.,	.85,,,,				.225,	.070
F shrinkage mean ,	5388.,	.50,,,,				.648,	.092

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6036.,	.40,	.23,	3,	.566,	.082

Age 3 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
FLT12: R/V Magnus H,	641.,	.448,	.313,	.70,	2,	.159,	.747
FLT32: Single trawle,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT35: Longliners > ,	4305.,	.864,	.000,	.00,	1,	.043,	.153
FLT44: Single trawle,	1287.,	.327,	.000,	.00,	1,	.300,	.441
FLT45: Longliners < ,	1579.,	.325,	.000,	.00,	1,	.304,	.373
F shrinkage mean ,	1834.,	.50,,,,				.194,	.328

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1383.,	.19,	.20,	6,	1.043,	.416

Continued

Table 2.2.13 (Cont'd)

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

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT12: R/V Magnus H,	791.,	.339,	.100,	.30,	3,	.129,	.794
FLT32: Single trawle,	750.,	.373,	.000,	.00,	1,	.121,	.824
FLT35: Longliners > ,	990.,	.400,	.171,	.43,	2,	.101,	.678
FLT44: Single trawle,	1055.,	.249,	.011,	.05,	2,	.240,	.647
FLT45: Longliners < ,	802.,	.236,	.083,	.35,	2,	.271,	.787
F shrinkage mean ,	1124.,	.50,,,,				.139,	.617

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
908.,	.13,	.06,	11,	.422,	.721

Age 5 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
FLT12: R/V Magnus H,	208.,	.308,	.242,	.78,	4,	.103,	1.199
FLT32: Single trawle,	478.,	.290,	.120,	.41,	2,	.135,	.696
FLT35: Longliners > ,	413.,	.269,	.139,	.51,	3,	.165,	.773
FLT44: Single trawle,	299.,	.228,	.385,	1.69,	3,	.187,	.959
FLT45: Longliners < ,	247.,	.198,	.080,	.41,	3,	.274,	1.082
F shrinkage mean ,	482.,	.50,,,,				.135,	.692

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
328.,	.12,	.11,	16,	.937,	.904

Continued

Table 2.2.13 (Cont'd)

Age 6 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
FLT12: R/V Magnus H,	110.,	.314,	.180,	.57,	5,	.085,	.707
FLT32: Single trawle,	138.,	.238,	.065,	.27,	3,	.185,	.600
FLT35: Longliners > ,	109.,	.214,	.127,	.59,	4,	.234,	.712
FLT44: Single trawle,	116.,	.239,	.137,	.57,	4,	.135,	.682
FLT45: Longliners < ,	85.,	.190,	.157,	.83,	4,	.252,	.845
F shrinkage mean ,	93.,	.50,,,,				.109,	.796

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
106.,	.11,	.06,	21,	.585,	.726

Age 7 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
FLT12: R/V Magnus H,	184.,	.347,	.185,	.53,	6,	.072,	.623
FLT32: Single trawle,	163.,	.215,	.123,	.57,	4,	.243,	.680
FLT35: Longliners > ,	190.,	.202,	.060,	.30,	5,	.262,	.608
FLT44: Single trawle,	230.,	.274,	.027,	.10,	5,	.106,	.526
FLT45: Longliners < ,	153.,	.204,	.165,	.81,	5,	.201,	.714
F shrinkage mean ,	122.,	.50,,,,				.117,	.836

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
170.,	.11,	.06,	26,	.516,	.662

Continued

Age 8 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
FLT12: R/V Magnus H,	46.,	.420,	.198,	.47,	7,	.046,	.568
FLT32: Single trawle,	36.,	.205,	.071,	.35,	5,	.349,	.682
FLT35: Longliners > ,	46.,	.230,	.128,	.55,	6,	.185,	.571
FLT44: Single trawle,	49.,	.343,	.063,	.18,	6,	.096,	.541
FLT45: Longliners < ,	25.,	.253,	.136,	.54,	6,	.169,	.884
F shrinkage mean ,	27.,	.50,,,,				.155,	.832

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
35.,	.13,	.06,	31,	.477,	.693

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT12: R/V Magnus H,	25.,	.426,	.159,	.37,	7,	.030,	.608
FLT32: Single trawle,	21.,	.197,	.247,	1.25,	6,	.351,	.692
FLT35: Longliners > ,	26.,	.249,	.114,	.46,	7,	.180,	.587
FLT44: Single trawle,	21.,	.359,	.138,	.38,	7,	.092,	.689
FLT45: Longliners < ,	15.,	.263,	.112,	.42,	7,	.178,	.874
F shrinkage mean ,	19.,	.50,,,,				.168,	.749

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
20.,	.13,	.07,	35,	.554,	.708

Continued

Table 2.2.14

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

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

Table 8 Fishing mortality (F) at age

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
2,	.1209,	.0829,	.0789,	.1010,	.1099,	.0530,	.0309,	.0464,	.0657,	.0816,
3,	.2518,	.1969,	.2389,	.2318,	.3063,	.2081,	.1337,	.1477,	.2322,	.1569,
4,	.4498,	.2552,	.2687,	.3949,	.3806,	.3654,	.2225,	.2070,	.3048,	.2046,
5,	.5622,	.4499,	.3442,	.5339,	.4180,	.3409,	.3845,	.2497,	.2813,	.2953,
6,	.6604,	.5016,	.5779,	.4472,	.5709,	.3709,	.5572,	.6058,	.2526,	.3798,
7,	.5305,	.9680,	.5203,	.7132,	.5118,	.6559,	.4651,	.4687,	.3723,	.5331,
8,	.4345,	.8520,	1.0438,	.3331,	.8457,	.4208,	.7528,	.2464,	.3259,	.3053,
9,	.5318,	.6106,	.5556,	.4882,	.5499,	.4339,	.4801,	.3578,	.3092,	.3458,
+gp,	.5318,	.6106,	.5556,	.4882,	.5499,	.4339,	.4801,	.3578,	.3092,	.3458,
FBAR 3- 7,	.4909,	.4743,	.3900,	.4642,	.4375,	.3882,	.3526,	.3358,	.2886,	.3139,

Continued

Table 2.2.14 (Cont'd)

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	.0775,	.0935,	.0482,	.0589,	.0433,	.0547,	.0524,	.0586,	.0992,	.1073,
3,	.3195,	.1725,	.3044,	.1898,	.2632,	.2392,	.2897,	.2229,	.4678,	.3712,
4,	.4361,	.3667,	.4755,	.4307,	.4313,	.3714,	.3411,	.3637,	.5593,	.5803,
5,	.4135,	.5571,	.7540,	.4298,	.5081,	.4344,	.4401,	.3890,	.6516,	.6627,
6,	.4546,	.5169,	.7339,	.4859,	.4922,	.5236,	.5657,	.4093,	.7848,	.4662,
7,	.3505,	.7623,	1.1148,	.5978,	.4493,	.4141,	.7076,	.6958,	1.1054,	.4775,
8,	.4487,	.6433,	.7785,	.5685,	.6924,	.6470,	.5056,	.5731,	.9517,	.5055,
9,	.4236,	.5741,	.7791,	.5065,	.5188,	.4817,	.5161,	.4899,	.8712,	.5458,
+gp,	.4236,	.5741,	.7791,	.5065,	.5188,	.4817,	.5161,	.4899,	.8712,	.5458,
FBAR 3- 7,	.3948,	.4751,	.6765,	.4268,	.4288,	.3965,	.4689,	.4162,	.7138,	.5116,

Table 8 Fishing mortality (F) at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	.0660,	.0251,	.0290,	.0677,	.2012,	.1058,	.0605,	.0509,	.0395,	.0824,
3,	.3547,	.3559,	.2243,	.3523,	.4488,	.4258,	.2881,	.2064,	.2628,	.4158,
4,	.5076,	.6235,	.4783,	.5775,	.7586,	.6470,	.6630,	.5712,	.4194,	.7215,
5,	.6158,	.7033,	.4863,	.5548,	.7988,	.7770,	.6190,	.6986,	.5364,	.9041,
6,	.9291,	.8324,	.5560,	.7775,	.9842,	.7729,	.7038,	.9486,	.5311,	.7258,
7,	1.1829,	.8523,	.4973,	.7993,	1.0714,	.8831,	.6873,	.8242,	.6704,	.6624,
8,	1.3307,	.6276,	.6413,	.8919,	1.1040,	1.1529,	.7812,	.6365,	.4447,	.6929,
9,	1.0130,	.7281,	.6942,	.7610,	1.0176,	.8202,	.6407,	.6378,	.5362,	.7083,
+gp,	1.0130,	.7281,	.6942,	.7610,	1.0176,	.8202,	.6407,	.6378,	.5362,	.7083,
FBAR 3- 7,	.7180,	.6735,	.4484,	.6123,	.8124,	.7012,	.5922,	.6498,	.4840,	.6859,

Table 2.2.15

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

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,
AGE				
2,	12019,	20654,	20290,	21834,
3,	7385,	7042,	12907,	12893,
4,	3747,	3616,	3503,	6986,
5,	2699,	1863,	1825,	1710,
6,	666,	1245,	752,	895,
7,	668,	335,	584,	358,
8,	155,	210,	190,	294,
9,	66,	56,	87,	112,
+gp,	0,	0,	0,	0,
TOTAL,	27403,	35021,	40138,	45083,

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

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
2,	8269,	18565,	23450,	17582,	9325,	8608,	11927,	21318,	12571,	30471,
3,	16037,	5999,	13990,	17744,	13011,	6840,	6684,	9468,	16662,	9638,
4,	7823,	10207,	4034,	9020,	11521,	7842,	4548,	4787,	6688,	10815,
5,	3639,	4085,	6475,	2525,	4976,	6447,	4455,	2981,	3186,	4037,
6,	830,	1698,	2133,	3757,	1212,	2682,	3754,	2483,	1901,	1969,
7,	416,	351,	842,	980,	1967,	561,	1515,	1760,	1109,	1209,
8,	151,	200,	109,	410,	393,	965,	238,	779,	902,	626,
9,	169,	80,	70,	31,	240,	138,	519,	92,	499,	533,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	400,	342,
TOTAL,	37332,	41185,	51103,	52049,	42646,	34083,	33640,	43668,	43918,	59639,

Continued

Table 2.2.15 (Cont'd)

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	38289,	18536,	9989,	10716,	14992,	23448,	13989,	22107,	25159,	47733,
3,	22992,	29010,	13821,	7794,	8271,	11754,	18176,	10869,	17069,	18654,
4,	6745,	13677,	19989,	8346,	5278,	5205,	7576,	11138,	7121,	8753,
5,	7216,	3571,	7760,	10173,	4442,	2807,	2939,	4410,	6339,	3332,
6,	2460,	3907,	1675,	2989,	5419,	2188,	1489,	1550,	2447,	2705,
7,	1103,	1278,	1908,	658,	1505,	2712,	1061,	692,	843,	914,
8,	581,	636,	488,	512,	296,	786,	1468,	428,	283,	228,
9,	378,	304,	274,	184,	238,	121,	337,	725,	198,	89,
+gp,	476,	465,	18,	154,	103,	52,	149,	345,	191,	172,
TOTAL,	80239,	71384,	55922,	41526,	40544,	49074,	47184,	52264,	59648,	82580,

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE											
2,	17266,	9381,	9930,	8591,	13563,	2674,	3576,	4658,	3253,	8005,	0,
3,	35103,	13233,	7490,	7898,	6573,	9080,	1969,	2756,	3624,	2560,	6036,
4,	10536,	20158,	7590,	4900,	4546,	3436,	4857,	1209,	1836,	2282,	1383,
5,	4011,	5193,	8847,	3851,	2252,	1743,	1473,	2049,	559,	988,	908,
6,	1406,	1774,	2104,	4454,	1811,	829,	656,	649,	834,	268,	328,
7,	1389,	455,	632,	988,	1676,	554,	313,	266,	206,	402,	106,
8,	464,	349,	159,	315,	364,	470,	188,	129,	95,	86,	170,
9,	113,	100,	152,	68,	106,	99,	121,	70,	56,	50,	35,
+gp,	136,	80,	57,	51,	15,	51,	55,	81,	63,	34,	34,
TOTAL,	70426,	50723,	36961,	31117,	30906,	18936,	13209,	11867,	10527,	14675,	8999,

Table 2.2.16

Run title : Cod in the Faroe Pla (run: EXPLVPA/V11)

At 6-May-95 17:04:16

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,	31657,	25500,	.8055,	.6059,
1962,	20654,	64307,	29104,	23200,	.7971,	.5226,
1963,	20290,	73668,	27765,	23100,	.8320,	.4944,
1964,	21834,	85299,	37786,	24000,	.6352,	.5017,
1965,	8269,	86578,	47503,	24856,	.5232,	.4909,
1966,	18565,	91054,	60036,	21027,	.3502,	.4743,
1967,	23450,	107765,	56466,	25174,	.4458,	.3900,
1968,	17582,	118648,	66476,	30279,	.4555,	.4642,
1969,	9325,	113003,	78527,	35670,	.4542,	.4375,
1970,	8608,	97926,	75874,	29037,	.3827,	.3882,
1971,	11927,	93135,	67861,	26151,	.3854,	.3526,
1972,	21318,	98297,	57806,	20437,	.3535,	.3358,
1973,	12571,	110407,	65592,	22381,	.3412,	.2886,
1974,	30471,	130176,	79661,	24581,	.3086,	.3139,
1975,	38289,	166275,	82234,	36775,	.4472,	.3948,
1976,	18536,	170594,	96118,	39799,	.4141,	.4751,
1977,	9989,	100654,	77690,	34927,	.4496,	.6765,
1978,	10716,	96053,	73343,	26585,	.3625,	.4268,
1979,	14992,	84909,	57549,	23112,	.4016,	.4288,
1980,	23448,	84714,	46145,	20513,	.4445,	.3965,
1981,	13989,	88035,	46208,	22963,	.4970,	.4689,
1982,	22107,	99628,	55974,	21489,	.3839,	.4162,
1983,	25159,	122738,	98250,	38133,	.3881,	.7138,
1984,	47733,	151664,	115141,	36979,	.3212,	.5116,
1985,	17266,	130705,	84326,	39484,	.4682,	.7180,
1986,	9381,	98785,	73618,	34595,	.4699,	.6735,
1987,	9930,	77615,	61536,	21391,	.3476,	.4484,
1988,	8591,	65647,	51747,	23182,	.4480,	.6123,
1989,	13563,	55864,	37821,	22068,	.5835,	.8124,
1990,	2674,	34103,	26921,	13487,	.5010,	.7012,
1991,	3576,	22239,	17685,	8660,	.4897,	.5922,
1992,	4658,	20853,	14161,	6542,	.4620,	.6498,
1993,	3253,	21877,	16225,	5771,	.3557,	.4840,
1994,	8005,	28422,	25031,	9043,	.3613,	.6859,
Arith. Mean ,	15963,	89706,	57054,	24732,	.4608,	.5102,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.2.17. Faroe Plateau cod.
Input for the predictions using the RCT3-program.

```
Faroe Plateau Cod : Groundfish suveys and O-group surveys data
4  12  2
'Yclass' 'VPA'    'GFAGE2'    'GFAGE3'   'GFAGE4'    'O-GROUP'
1983      17266      416        2669       4650        17100
1984       9381       91        2020       1662         3900
1985       9930      127        1265       1006         4300
1986       8591      197         602       1522         2200
1987      13563      445         638       1222        28900
1988       2674      262         352        472        19200
1989       3576      254         210        232          400
1990       4658      148         448        456         2600
1991        -11       41         158       1299          100
1992        -11      258         741        -11          600
1993        -11      707         -11        -11         6000
1994        -11      -11         -11        -11         4000
□
```

Table 2.2.18. Output from predictions using the RCT3-program.

Analysis by RCT3 ver3.1 of data from file :

rct3inp.dat

Faroe Plateau Cod : Groundfish suveys and 0-group surveys data

Data for 4 surveys over 12 years : 1983 - 1994

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 = 1986

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
GFAGE2	.43	7.17	.06	.984	3	5.29	9.43	.121	.387
GFAGE3	1.23	.12	.45	.531	3	6.40	7.96	1.895	.004
GFAGE4	.47	5.79	.21	.839	3	7.33	9.24	.426	.085
0-GROU	.41	5.78	.01	.999	3	7.70	8.92	.031	.387
					VPA Mean =		9.37	.337	.136

Yearclass = 1987

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
GFAGE2	.60	6.16	.29	.640	4	6.10	9.85	.571	.063
GFAGE3	.66	4.49	.36	.537	4	6.46	8.76	.674	.045
GFAGE4	.55	5.14	.21	.775	4	7.11	9.06	.348	.170
0-GROU	.37	6.15	.07	.971	4	10.27	9.94	.153	.514
					VPA Mean =		9.29	.315	.207

Yearclass = 1988

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
GFAGE2	.51	6.59	.24	.654	5	5.57	9.44	.350	.224
GFAGE3	1.11	1.45	.79	.154	5	5.87	7.97	1.464	.013
GFAGE4	.73	3.90	.37	.453	5	6.16	8.40	.738	.050
0-GROU	.30	6.67	.17	.791	5	9.86	9.63	.266	.38?

Continued

Table 2.2.18 (Cont'd)

						VPA Mean =	9.33	.291	.325

Yearclass = 1989

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
GFAGE2	5.31	-19.56	3.69	.037	6	5.54	9.87	4.928	.009
GFAGE3	1.17	1.06	.72	.504	6	5.35	7.30	1.234	.151
GFAGE4	1.04	1.57	.47	.700	6	5.45	7.25	.888	.291
O-GROU	-23.10	217.79	27.36	.001	6	5.99	79.33	56.778	.000
					VPA Mean =		9.09	.647	.549

Yearclass = 1990

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I	I-----------Prediction			---------I	
GFAGE2	10.46	-47.69	6.59	.013	7	5.00	4.64	8.703	.002
GFAGE3	.94	2.70	.58	.629	7	6.11	8.44	.754	.249
GFAGE4	.83	3.20	.43	.753	7	6.12	8.27	.579	.423
O-GROU	1.22	-1.54	1.88	.138	7	7.86	8.06	2.439	.024
					VPA Mean =		8.95	.685	.302

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	6.84	-27.81	4.03	.031	8	3.74	-2.24	7.284	.002
GFAGE3	.94	2.68	.53	.646	8	5.07	7.46	.771	.202
GFAGE4	.81	3.34	.39	.770	8	7.17	9.15	.487	.506
O-GROU	1.16	-.97	1.65	.158	8	4.62	4.38	2.857	.015
					VPA Mean =		8.88	.659	.276

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	7.05	-28.98	4.15	.029	8	5.56	10.22	5.191	.008
GFAGE3	.95	2.64	.53	.644	8	6.61	8.92	.663	.476
GFAGE4									
O-GROU	1.16	-1.01	1.67	.156	8	6.40	6.44	2.354	.038
					VPA Mean =		8.87	.661	.479

Continued

Yearclass = 1993

Table 2.2.18 (Cont'd)

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	7.31	-30.39	4.29	.028	8	6.56	17.61	6.951	.008
GFAGE3									
GFAGE4									
0-GROU	1.17	-1.05	1.70	.152	8	8.70	9.12	2.137	.087
					VPA Mean =		8.86	.663	.905

Yearclass = 1994

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									
GFAGE3									
GFAGE4									
0-GROU	1.17	-1.09	1.74	.149	8	8.29	8.65	2.210	.083
					VPA Mean =		8.84	.665	.917

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1986	9938	9.20	.12	.12	1.00	8592	9.06
1987	14694	9.60	.14	.20	1.98	13564	9.52
1988	12216	9.41	.17	.16	.91	2674	7.89
1989	4010	8.30	.48	.55	1.30	3576	8.18
1990	4942	8.51	.38	.17	.21	4658	8.45
1991	5660	8.64	.35	.49	2.01		
1992	6734	8.81	.46	.28	.37		
1993	7735	8.95	.63	.56	.79		
1994	6815	8.83	.64	.05	.01		

Table 2.2.19

Cod in the Faroe Plateau (Fishing Area Vb1) 18:37 Tuesday, May 9, 199

Prediction with management option table: Input data

Year: 1995								
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	7735.000	0.2000	0.1700	0.0000	0.0000	1.194	0.0820	1.194
3	5076.000	0.2000	0.5200	0.0000	0.0000	1.843	0.4160	1.843
4	2398.000	0.2000	0.5300	0.0000	0.0000	2.613	0.7220	2.613
5	908.000	0.2000	0.7400	0.0000	0.0000	3.654	0.9040	3.654
6	328.000	0.2000	0.9700	0.0000	0.0000	4.584	0.7260	4.584
7	106.000	0.2000	1.0000	0.0000	0.0000	4.976	0.6620	4.976
8	170.000	0.2000	1.0000	0.0000	0.0000	7.146	0.6930	7.146
9	35.000	0.2000	1.0000	0.0000	0.0000	8.564	0.7080	8.564
10+	34.000	0.2000	1.0000	0.0000	0.0000	8.796	0.7080	8.796
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
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	6787.000	0.2000	0.1800	0.0000	0.0000	1.194	0.0820	1.194
3	.	0.2000	0.6554	0.0000	0.0000	1.843	0.4160	1.843
4	.	0.2000	0.8815	0.0000	0.0000	2.613	0.7220	2.613
5	.	0.2000	0.9577	0.0000	0.0000	3.654	0.9040	3.654
6	.	0.2000	0.9938	0.0000	0.0000	4.584	0.7260	4.584
7	.	0.2000	0.9969	0.0000	0.0000	4.976	0.6620	4.976
8	.	0.2000	1.0000	0.0000	0.0000	7.146	0.6930	7.146
9	.	0.2000	1.0000	0.0000	0.0000	8.564	0.7080	8.564
10+	.	0.2000	1.0000	0.0000	0.0000	8.796	0.7080	8.796
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	7500.000	0.2000	0.1800	0.0000	0.0000	1.194	0.0820	1.194
3	.	0.2000	0.6554	0.0000	0.0000	1.843	0.4160	1.843
4	.	0.2000	0.8815	0.0000	0.0000	2.613	0.7220	2.613
5	.	0.2000	0.9577	0.0000	0.0000	3.654	0.9040	3.654
6	.	0.2000	0.9938	0.0000	0.0000	4.584	0.7260	4.584
7	.	0.2000	0.9969	0.0000	0.0000	4.976	0.6620	4.976
8	.	0.2000	1.0000	0.0000	0.0000	7.146	0.6930	7.146
9	.	0.2000	1.0000	0.0000	0.0000	8.564	0.7080	8.564
10+	.	0.2000	1.0000	0.0000	0.0000	8.796	0.7080	8.796
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : RUN1
Date and time: 09MAY95:18:38

Table 2.2.20

18:37 Tuesday, May 9, 1995

Cod in the Faroe Plateau (Fishing Area Vb1)

A.

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
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
0.6244	0.4283	32019	16010	7000	0.0000	0.0000	36428	24762	0	50386	37549
.	.	.	.	.	0.1000	0.0686	.	24762	1623	48431	35716
.	.	.	.	.	0.2000	0.1372	.	24762	3146	46597	33999
.	.	.	.	.	0.3000	0.2058	.	24762	4577	44878	32392
.	.	.	.	.	0.4000	0.2744	.	24762	5920	43264	30887
.	.	.	.	.	0.5000	0.3430	.	24762	7183	41750	29476
.	.	.	.	.	0.6000	0.4116	.	24762	8371	40327	28153
.	.	.	.	.	0.7000	0.4802	.	24762	9489	38990	26912
.	.	.	.	.	0.8000	0.5488	.	24762	10541	37733	25747
.	.	.	.	.	0.9000	0.6174	.	24762	11532	36551	24654
.	.	.	.	.	1.0000	0.6860	.	24762	12465	35439	23627
.	.	.	.	.	1.1000	0.7546	.	24762	13346	34392	22662
.	.	.	.	.	1.2000	0.8232	.	24762	14176	33405	21755
.	.	.	.	.	1.3000	0.8918	.	24762	14960	32475	20902
.	.	.	.	.	1.4000	0.9604	.	24762	15701	31598	20099
.	.	.	.	.	1.5000	1.0290	.	24762	16400	30771	19344
.	.	.	.	.	1.6000	1.0976	.	24762	17062	29990	18632
.	.	.	.	.	1.7000	1.1662	.	24762	17688	29252	17961
.	.	.	.	.	1.8000	1.2348	.	24762	18280	28555	17328
.	.	.	.	.	1.9000	1.3034	.	24762	18841	27896	16731
.	.	.	.	.	2.0000	1.3720	.	24762	19373	27272	16168
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : RUN1
Date and time : 09MAY95:18:38
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1995 : TAC constraints

18:37 Tuesday, May 9, 1995

Cod in the Faroe Plateau (Fishing Area Vb1)

B.

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
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
0.7950	0.5453	32019	16010	8500	0.0000	0.0000	34629	23108	0	48499	35715
.	.	.	.	.	0.1000	0.0686	.	23108	1506	46678	34013
.	.	.	.	.	0.2000	0.1372	.	23108	2920	44970	32419
.	.	.	.	.	0.3000	0.2058	.	23108	4250	43366	30924
.	.	.	.	.	0.4000	0.2744	.	23108	5500	41859	29523
.	.	.	.	.	0.5000	0.3430	.	23108	6675	40444	28209
.	.	.	.	.	0.6000	0.4116	.	23108	7782	39113	26976
.	.	.	.	.	0.7000	0.4802	.	23108	8824	37862	25818
.	.	.	.	.	0.8000	0.5488	.	23108	9806	36684	24731
.	.	.	.	.	0.9000	0.6174	.	23108	10732	35575	23709
.	.	.	.	.	1.0000	0.6860	.	23108	11605	34531	22748
.	.	.	.	.	1.1000	0.7546	.	23108	12429	33547	21845
.	.	.	.	.	1.2000	0.8232	.	23108	13207	32619	20995
.	.	.	.	.	1.3000	0.8918	.	23108	13942	31743	20195
.	.	.	.	.	1.4000	0.9604	.	23108	14637	30917	19441
.	.	.	.	.	1.5000	1.0290	.	23108	15294	30136	18731
.	.	.	.	.	1.6000	1.0976	.	23108	15916	29399	18061
.	.	.	.	.	1.7000	1.1662	.	23108	16505	28701	17429
.	.	.	.	.	1.8000	1.2348	.	23108	17062	28042	16833
.	.	.	.	.	1.9000	1.3034	.	23108	17591	27417	16270
.	.	.	.	.	2.0000	1.3720	.	23108	18093	26826	15739
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : RUN1
Date and time : 09MAY95:18:38
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1995 : TAC constraints

Table 2.2.21

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	0.1800	0.0000	0.0000	1.062	0.1840	1.062
3	.	0.2000	0.6600	0.0000	0.0000	1.570	0.5780	1.570
4	.	0.2000	0.8800	0.0000	0.0000	2.232	0.8800	2.232
5	.	0.2000	0.9600	0.0000	0.0000	3.029	1.0390	3.029
6	.	0.2000	0.9900	0.0000	0.0000	3.771	1.1750	3.771
7	.	0.2000	1.0000	0.0000	0.0000	4.751	1.3270	4.751
8	.	0.2000	1.0000	0.0000	0.0000	5.784	1.2930	5.784
9	.	0.2000	1.0000	0.0000	0.0000	7.391	1.1630	7.391
10+	.	0.2000	1.0000	0.0000	0.0000	9.572	1.1630	9.572
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YRRUN1
Date and time: 08MAY95:14:30

14:18 Monday, May 8, 1995

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	23173.609	4.311	21602.638	4.311	21602.638
0.0500	0.0500	0.169	769.963	4.675	16690.218	3.477	15137.326	3.477	15137.326
0.1000	0.1000	0.277	1119.253	4.140	12916.530	2.950	11380.750	2.950	11380.750
0.1500	0.1500	0.352	1283.085	3.768	10517.582	2.585	8998.023	2.585	8998.023
0.2000	0.2000	0.408	1358.578	3.492	8893.068	2.316	7388.906	2.316	7388.906
0.2500	0.2500	0.451	1390.078	3.279	7738.024	2.109	6248.499	2.109	6248.499
0.3000	0.2999	0.486	1399.179	3.107	6883.763	1.945	5408.171	1.945	5408.171
0.3500	0.3499	0.514	1396.848	2.966	6230.878	1.810	4768.566	1.810	4768.566
0.4000	0.3999	0.538	1388.810	2.848	5717.822	1.697	4268.184	1.697	4268.184
0.4500	0.4499	0.559	1378.101	2.746	5304.925	1.601	3867.398	1.601	3867.398
0.5000	0.4999	0.577	1366.336	2.658	4965.742	1.518	3539.801	1.518	3539.801
0.5500	0.5499	0.593	1354.370	2.580	4682.124	1.445	3267.280	1.445	3267.280
0.6000	0.5999	0.608	1342.645	2.511	4441.293	1.381	3037.090	1.381	3037.090
0.6500	0.6499	0.620	1331.374	2.449	4234.045	1.324	2840.056	1.324	2840.056
0.7000	0.6999	0.632	1320.649	2.393	4053.609	1.273	2669.435	1.273	2669.435
0.7500	0.7499	0.643	1310.497	2.342	3894.915	1.227	2520.182	1.227	2520.182
0.8000	0.7998	0.652	1300.907	2.295	3754.095	1.184	2388.452	1.184	2388.452
0.8500	0.8498	0.661	1291.855	2.252	3628.154	1.146	2271.271	1.146	2271.271
0.9000	0.8998	0.670	1283.307	2.212	3514.738	1.110	2166.304	1.110	2166.304
0.9500	0.9498	0.677	1275.228	2.175	3411.972	1.078	2071.695	1.078	2071.695
1.0000	0.9998	0.684	1267.585	2.141	3318.344	1.047	1985.949	1.047	1985.949
1.0500	1.0498	0.691	1260.344	2.109	3232.621	1.019	1907.848	1.019	1907.848
1.1000	1.0998	0.697	1253.474	2.079	3153.788	0.993	1836.390	0.993	1836.390
1.1500	1.1498	0.703	1246.949	2.051	3080.999	0.968	1770.745	0.968	1770.745
1.2000	1.1998	0.709	1240.743	2.024	3013.546	0.945	1710.214	0.945	1710.214
1.2500	1.2498	0.714	1234.832	1.999	2950.828	0.924	1654.211	0.924	1654.211
1.3000	1.2997	0.719	1229.197	1.975	2892.335	0.903	1602.233	0.903	1602.233
1.3500	1.3497	0.724	1223.818	1.952	2837.629	0.884	1553.855	0.884	1553.855
1.4000	1.3997	0.729	1218.678	1.931	2786.330	0.866	1508.705	0.866	1508.705
1.4500	1.4497	0.733	1213.762	1.911	2738.112	0.849	1466.464	0.849	1466.464
1.5000	1.4997	0.737	1209.054	1.891	2692.686	0.832	1426.855	0.832	1426.855
1.5500	1.5497	0.741	1204.541	1.872	2649.803	0.817	1389.632	0.817	1389.632
1.6000	1.5997	0.745	1200.213	1.855	2609.240	0.802	1354.582	0.802	1354.582
1.6500	1.6497	0.749	1196.057	1.838	2570.802	0.788	1321.516	0.788	1321.516
1.7000	1.6997	0.752	1192.063	1.821	2534.315	0.774	1290.266	0.774	1290.266
1.7500	1.7497	0.756	1188.222	1.806	2499.623	0.761	1260.682	0.761	1260.682
1.8000	1.7996	0.759	1184.525	1.791	2466.589	0.749	1232.632	0.749	1232.632
1.8500	1.8496	0.762	1180.964	1.776	2435.087	0.737	1205.996	0.737	1205.996
1.9000	1.8996	0.765	1177.531	1.762	2405.006	0.726	1180.668	0.726	1180.668
1.9500	1.9496	0.768	1174.220	1.749	2376.245	0.715	1156.550	0.715	1156.550
2.0000	1.9996	0.771	1171.024	1.736	2348.712	0.705	1133.555	0.705	1133.555
2.0500	2.0496	0.774	1167.937	1.723	2322.324	0.694	1111.605	0.694	1111.605
2.1000	2.0996	0.776	1164.953	1.711	2297.005	0.685	1090.627	0.685	1090.627
2.1500	2.1496	0.779	1162.068	1.699	2272.687	0.675	1070.557	0.675	1070.557
2.2000	2.1996	0.781	1159.275	1.688	2249.307	0.666	1051.335	0.666	1051.335
2.2500	2.2496	0.784	1156.571	1.677	2226.807	0.658	1032.907	0.658	1032.907
2.3000	2.2995	0.786	1153.952	1.666	2205.134	0.649	1015.222	0.649	1015.222
2.3500	2.3495	0.788	1151.412	1.656	2184.239	0.641	998.236	0.641	998.236
2.4000	2.3995	0.790	1148.950	1.646	2164.078	0.633	981.906	0.633	981.906
2.4500	2.4495	0.793	1146.560	1.636	2144.609	0.626	966.193	0.626	966.193
2.5000	2.4995	0.795	1144.239	1.626	2125.795	0.618	951.062	0.618	951.062
2.5500	2.5495	0.797	1141.985	1.617	2107.599	0.611	936.480	0.611	936.480
2.6000	2.5995	0.799	1139.795	1.608	2089.989	0.604	922.417	0.604	922.417
2.6500	2.6495	0.801	1137.665	1.599	2072.935	0.597	908.843	0.597	908.843
2.7000	2.6995	0.803	1135.593	1.591	2056.408	0.591	895.733	0.591	895.733
2.7500	2.7494	0.804	1133.577	1.582	2040.382	0.584	883.063	0.584	883.063
2.8000	2.7994	0.806	1131.614	1.574	2024.832	0.578	870.810	0.578	870.810
2.8500	2.8494	0.808	1129.702	1.566	2009.735	0.572	858.952	0.572	858.952
2.9000	2.8994	0.810	1127.839	1.559	1995.070	0.566	847.471	0.566	847.471
2.9500	2.9494	0.811	1126.023	1.551	1980.817	0.561	836.346	0.561	836.346
3.0000	2.9994	0.813	1124.252	1.544	1966.957	0.555	825.562	0.555	825.562
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YRRUN1
Date and time : 08MAY95:14:30
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.1475
F-max factor : 0.3103
F-0.1 reference F : 0.1475
F-max reference F : 0.3102
Recruitment : Single recruit

Table 2.3.1 Faroe Bank (Sub-division Vb2) COD. Nominal catches (tonnes) by countries, 1985-1994, as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Faroe Islan	2,913	1,836	3,409	2,960	1,270	289	297	122	264	717
France [2]	-	-	-	-	-	-	-	-	-	
Norway	23	6	23	94	128	72	38	32	2	8
Engl. and	-	-	-	-	-	-	-	+	1	
UK (Scotl	25	63	47	37	14	207	90	172	118	- [4]
Total	2,961	1,905	3,479	3,091	1,412	568	425	326	385	725

1) Provisional data

2) Catches included in Sub-division Vb1

3) Sub-division Vb1 included

4) See Table 2.2.1.

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	1981	1982	1983	1984	1985	1986	1987
Denmark	-	-	-	-	-	1	8
Faroe Islands	10,891	10,319	11,898	11,418	13,597	13,359	13,954
France[1]	113	2	2	20	23	8	22
Germany	+	1	+	+	+	1	1
Norway	20	12	12	10	21	22	13
UK (Engl. and Wales)	-	-	-	-	-	-	2
UK (Scotland)[3]	85	1	-	-	-	-	-
United Kingdom							
Total	11,109	10,335	11,912	11,448	13,641	13,391	14,000
Working Group estimate[4,5]	12,233	11,937	12,894	12,378	15,143	14,477	14,882

Country	1988	1989	1990	1991	1992	1993	1994[2]
Denmark	4	-	-	-	-	-	
Faroe Islands	10,867	13,506	11,106	8,074	4,629	3,622	3,675
France[1]	14	-	-	-	164	-	
Germany	-	+	+	+	-	-	
Norway	54	111	94	125	71 [2]	29 [2]	22
UK (Engl. and Wales)	-	-	7	-	71	80	
UK (Scotland)[3]	-	-	-	-	-	-	
United Kingdom							200 [6]
Total	10,939	13,617	11,207	8,199	4,935	3,731	
Working Group estimate[4,5]	12,178	14,325	11,726	8,429	5,476	3,814	4,251

1) Including catches from Sub-division Vb2. Quantity unknown 1989-1991 and 1993.
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, 1981-1994, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987
Faroe Islands	1,103	1,533	967	925	1,474	1,050	832
France[1]	-	-	-	-	-	-	-
Norway	7	1	2	5	3	10	5
UK (Engl. and Wales)	-	-	-	-	-	-	-
UK (Scotland)[3]	14	48	13	+	25	26	45
Total	1,124	1,582	982	930	1,502	1,086	882

Country	1988	1989	1990	1991	1992	1993	1994[2]
Faroe Islands	1,160	659	325	217	338	185	353
France[1]	-	-	-	-	-	-	
Norway	43	16	97	4	23	8	1
UK (Engl. and Wales)	-	-	-	-	+	+	... [1]
UK (Scotland)[3]	15	30	725	287	852	102	... [1]
Total	1,218	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)

Table 2.4.3 Haddock in ICES Division Vb

Catch at age 1994 by fleet category, based on most recent information on catches from the Faroese Statististical Office and ICES official statistics

Age	Open Boats	LLiners < 100GRT	LLiners > 100GRT	S.trawl. < 400HP	S.trawl. 400-999HP	S.trawl. > 1000HP	P.trawl. < 1000HP	P.trawl. > 1000HP	Others	Foreign trawlers	Foreign lliners	Total
1	0	1	0	0	0	0	0	0	0	0	0	1
2	6	127	41	63	26	1	3	4	3	2	1	277
3	2	47	56	22	8	6	12	23	3	9	1	191
4	3	50	96	22	6	13	25	61	7	20	2	306
5	1	25	45	11	3	6	15	32	4	9	1	153
6	3	55	102	27	6	17	42	133	10	25	2	422
7	3	57	106	27	6	15	47	128	12	23	2	428
8	3	51	91	26	7	12	41	121	9	18	2	383
9	1	18	32	8	3	4	14	35	3	6	1	125
10+	2	40	69	19	6	8	32	102	7	12	2	300
Total	26	473	639	226	71	84	232	640	58	125	14	2586
Catch, t	34	632	950	303	88	121	363	1045	94	180	21	3830
Effort,days	2246	7625	2925	2029	677	3825	2120	6227	15243			

Notes: Numbers in 1000'

Catch, gutted weight in tonnes

Others includes netters, jiggers, industry trawlers and other small categories

LLiner = Longliners; S.trawl = Single (otterboard) trawlers; P.trawl = Pair trawlers

Table 2.4.4

Run title : Haddock in the Faroe (run: JR1/TUN)

At 4-May-95 12:42:32

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

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

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

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
2,	1368,	1081,	1425,	5881,	2384,	1728,	717,	750,	3300,	5633,
3,	4286,	3304,	2405,	4097,	7539,	4855,	4393,	3744,	8388,	2899,
4,	5133,	4804,	2599,	2812,	4567,	6581,	4727,	4179,	1236,	3970,
5,	1443,	2710,	1785,	1524,	1565,	1624,	3267,	2706,	2786,	451,
6,	1209,	1112,	1426,	1526,	1485,	1383,	1292,	1171,	916,	976,
7,	673,	740,	631,	923,	1224,	1099,	864,	696,	1051,	466,
8,	1345,	180,	197,	230,	378,	326,	222,	180,	150,	535,
9,	43,	54,	52,	68,	114,	68,	147,	113,	68,	68,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	11,	147,
TOTALNUM,	15500,	13985,	10520,	17061,	19256,	17664,	15629,	13539,	17906,	15145,
TONSLAND,	18479,	18766,	13381,	17852,	23272,	21361,	19393,	16485,	17969,	14763,
SOPCOF %,	94,	109,	102,	103,	108,	103,	99,	98,	98,	97,

Continued

Table 2.4.4 (Cont'd)

Run title : Haddock in the Faroe (run: JR1/TUN)

At 4-May-95 12:42:33

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

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	7337,	4396,	255,	32,	1,	143,	74,	539,	441,	1195,
3,	7952,	7858,	4039,	1022,	1161,	58,	455,	934,	1969,	1561,
4,	2097,	6798,	5168,	4248,	1754,	3724,	202,	784,	383,	2462,
5,	1371,	1251,	4918,	4054,	3341,	2583,	2586,	298,	422,	147,
6,	247,	1189,	2128,	1841,	1850,	2496,	1354,	2182,	93,	234,
7,	352,	298,	946,	717,	772,	1568,	1559,	973,	1444,	42,
8,	237,	720,	443,	635,	212,	660,	608,	1166,	740,	861,
9,	419,	258,	731,	243,	155,	99,	177,	1283,	947,	388,
+gp,	187,	318,	855,	312,	74,	86,	36,	214,	795,	968,
TOTALNUM,	20199,	23086,	19483,	13104,	9320,	11417,	7051,	8373,	7234,	7858,
TONSLAND,	20715,	26211,	25553,	19200,	12424,	15016,	12233,	11937,	12894,	12378,
SOPCOF %,	117,	107,	98,	99,	104,	100,	109,	92,	106,	106,

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	985,	230,	283,	655,	63,	105,	77,	40,	113,	277,
3,	4553,	2549,	1718,	444,	1518,	1275,	1044,	154,	298,	191,
4,	2196,	4452,	3565,	2463,	658,	1921,	1774,	776,	274,	307,
5,	1242,	1522,	2972,	3036,	2787,	768,	1248,	1120,	554,	153,
6,	169,	738,	1114,	2140,	2554,	1737,	651,	959,	538,	423,
7,	91,	39,	529,	475,	1976,	1909,	1101,	335,	474,	427,
8,	61,	130,	83,	151,	541,	885,	698,	373,	131,	383,
9,	503,	71,	48,	18,	133,	270,	317,	401,	201,	125,
+gp,	973,	712,	334,	128,	81,	108,	32,	162,	185,	301,
TOTALNUM,	10773,	10443,	10646,	9510,	10311,	8978,	6942,	4320,	2768,	2587,
TONSLAND,	15143,	14477,	14882,	12178,	14325,	11726,	8429,	5446,	4026,	4251,
SOPCOF %,	106,	101,	102,	97,	100,	102,	106,	105,	104,	100,

Table 2.4.5

Run title : Haddock in the Faroe (run: JR1/TUN)

At 4-May-95 12:42:33

Table 2 Catch weights at age (kg)

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

Table 2 Catch weights at age (kg)

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
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,	.9401,	1.0920,	1.0166,	1.0278,	1.0835,	1.0274,	.9874,	.9795,	.9772,	.9711,

Continued

Table 2.4.5 (Cont'd)

Run title : Haddock in the Faroe (run: JR1/TUN)

At 4-May-95 12:42:33

Table 2 Catch weights at age (kg)

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	.4700,	.4700,	.3110,	.3570,	.3570,	.6430,	.4520,	.7000,	.4700,	.6810,
3,	.7300,	.7300,	.6330,	.7900,	.6720,	.7130,	.7250,	.8960,	.7400,	1.0110,
4,	1.1300,	1.1300,	1.0440,	1.0350,	.8940,	.9410,	.9570,	1.1500,	1.0100,	1.2550,
5,	1.5500,	1.5500,	1.4260,	1.3980,	1.1560,	1.1570,	1.2370,	1.4440,	1.3200,	1.8120,
6,	1.9700,	1.9700,	1.8520,	1.8700,	1.5900,	1.4930,	1.6510,	1.4980,	1.6600,	2.0610,
7,	2.4100,	2.4100,	2.2410,	2.3500,	2.0700,	1.7390,	2.0530,	1.8290,	2.0500,	2.0590,
8,	2.7600,	2.7600,	2.2050,	2.5970,	2.5250,	2.0950,	2.4060,	1.8870,	2.2600,	2.1370,
9,	3.0700,	3.0700,	2.5700,	3.0140,	2.6960,	2.4650,	2.7250,	1.9610,	2.5400,	2.3680,
+gp,	3.5500,	3.5500,	2.5910,	2.9200,	3.5190,	3.3100,	3.2500,	2.8560,	3.0400,	2.6860,
SOPCOFAC,	1.1712,	1.0746,	.9762,	.9947,	1.0385,	1.0017,	1.0870,	.9238,	1.0554,	1.0602,

Table 2 Catch weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	.5280,	.6080,	.6050,	.5010,	.5800,	.4380,	.5470,	.5250,	.7550,	.7540,
3,	.8590,	.8870,	.8310,	.7810,	.7790,	.6990,	.6930,	.7240,	.9820,	1.1030,
4,	1.3910,	1.1750,	1.1260,	.9740,	.9230,	.9390,	.8840,	.8170,	1.0270,	1.2540,
5,	1.7770,	1.6310,	1.4620,	1.3630,	1.2070,	1.2040,	1.0860,	1.0380,	1.1920,	1.4650,
6,	2.3260,	1.9840,	1.9410,	1.6800,	1.5640,	1.3840,	1.2760,	1.2490,	1.3780,	1.5930,
7,	2.4400,	2.5190,	2.1730,	1.9750,	1.7460,	1.5640,	1.4770,	1.4300,	1.6430,	1.8040,
8,	2.4010,	2.5830,	2.3470,	2.3440,	2.0860,	1.8180,	1.5740,	1.5640,	1.7960,	2.0490,
9,	2.5320,	2.5700,	3.1180,	2.2480,	2.4240,	2.1680,	1.9300,	1.6330,	1.9710,	2.2250,
+gp,	2.6860,	2.9220,	2.9330,	3.2950,	2.5140,	2.3350,	2.1530,	2.1260,	2.2400,	2.4230,
SOPCOFAC,	1.0559,	1.0141,	1.0197,	.9695,	1.0025,	1.0195,	1.0635,	1.0496,	1.0361,	.9967,

Table 2.4.6

Run title : Haddock in the Faroe (run: JR1/TUN)

At 4-May-95 12:42:33

Table 5 Proportion mature at age

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

Table 5 Proportion mature at age

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
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,

Continued

Table 2.4.6 (Cont'd)

Run title : Haddock in the Faroe (run: JR1/TUN)

At 4-May-95 12:42:33

Table 5 Proportion mature at age

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0000,	.1500,	.1000,
3,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.3000,	.7900,	.7800,
4,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.7300,	1.0000,	.9500,
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,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
2,	.0000,	.0000,	.0900,	.0500,	.0000,	.0000,	.2500,	.2200,	.0800,	.1400,
3,	.7200,	.3500,	.2200,	.3800,	.1200,	.1600,	.8200,	.7500,	.3900,	.4400,
4,	1.0000,	.9200,	.9300,	.8900,	.8600,	.8700,	.9800,	.9300,	.8100,	.9600,
5,	1.0000,	1.0000,	.9600,	.9900,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	.9800,	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 2.4.7

Haddock in the Faroe Grounds (Fishing Area Vb) 09:18 Thursday, May 4, 1995

Longliners < 100GRT, revised in 1995 (code: LL95A) (Catch: Thousands) (Effort: Fishing days)

Year	Effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9
1985	7558	2542	787	306	65	23	30	120
1986	6692	1435	1747	530	256	12	51	15
1987	6728	1027	1819	1118	331	155	20	12
1988	8753	311	1557	1405	768	138	40	5
1989	12804	1042	433	1676	1361	1015	313	74
1990	14543	993	1141	428	955	1005	457	155
1991	14801	733	1165	615	281	560	385	170
1992	10599	103	419	480	282	65	154	181
1993	7497	92	80	152	112	64	22	46
1994	7625	47	50	25	55	57	51	18

Table 2.4.8

Haddock in the Faroe Grounds (Fishing Area Vb) 09:18 Thursday, May 4, 1995

Longliners > 100GRT, revised in 1995 (code: LL95B) (Catch: Thousands) (Effort: Fishing days)

Year	Effort	Catch, age 4	Catch, age 5	Catch, age 6
1985	2973	300	188	40
1986	2176	584	203	124
1987	2915	168	323	220
1988	3203	200	470	504
1989	3369	79	421	492
1990	3521	316	146	312
1991	3573	260	223	127
1992	2892	92	216	188
1993	2046	55	124	134
1994	2925	92	43	98

Table 2.4.9

Haddock in the Faroe Grounds (Fishing Area Vb) 09:18 Thursday, May 4, 1995

Magnus Heinason Groundfish Survey revised in 1995 (code: MH95A) (Catch: Number) (Effort: Trawlhour)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1986	100	87.1	46.5	21.7	4.2	0.8
1987	100	11.8	26.4	16.7	8.7	1.5
1988	100	88.1	11.8	21.2	10.7	3.8
1989	100	146.6	113.0	8.5	23.2	31.2
1990	100	43.1	64.0	23.9	2.5	7.7
1991	100	16.5	13.4	9.8	3.9	1.5
1992	100	26.9	8.5	15.5	6.8	5.1
1993	100	9.2	9.9	6.2	6.3	7.7
1994	100	19.2	2.6	3.5	1.8	3.3

Table 2.4.10

Haddock in the Faroe Grounds (Fishing Area Vb)

09:18 Thursday, May 4, 199

Otter board trawlers 400-999 HP, revised in 1995 (code: OB95A) (Catch: Thousands) (Effort: Fishing days)

Year	Effort	Catch, age 5	Catch, age 6	Catch, age 7
1988	2204	118	86	19
1989	1993	91	92	56
1990	1853	25	52	48
1991	1038	15	10	12
1992	495	8	4	2
1993	1008	24	14	12
1994	677	3	6	6

Table 2.4.11

Haddock in the Faroe Grounds (Fishing Area Vb)

09:18 Thursday, May 4, 19

Pair trawlers > 1000HP, revised in 1995 (code: PT95A) (Catch: Thousands) (Effort: Fishing days)

Year	Effort	Catch, age 5	Catch, age 6	Catch, age 7
1988	6034	251	194	55
1989	5127	162	156	39
1990	7491	57	156	184
1991	7875	181	104	131
1992	7243	107	150	52
1993	6335	82	111	122
1994	6227	32	133	128

Table 2.4.12 Final run

Lowestoft VPA Version 3.1

6-May-95 11:48:19

Extended Survivors Analysis

Haddock in the Faroe (run: JR5/TU5)

CPUE data from file /users/fish/ifad/ifapwork/wg_109/had_farp/FLEET.TU5

Catch data for 34 years. 1961 to 1994. Ages 2 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
LL95A: Longliners < ,	1985,	1994,	3,	9,	.000,	1.000
LL95B: Longliners > ,	1985,	1994,	4,	6,	.000,	1.000
MH95A: Magnus Heinas,	1986,	1994,	2,	6,	.200,	.300
OB95A: Otter board t,	1988,	1994,	5,	7,	.000,	1.000
PT95A: Pair trawlers,	1988,	1994,	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 had not converged after 50 iterations

Total absolute residual between iterations
49 and 50 = .00019

Final year F values

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 49,	.0391,	.2082,	.2880,	.1862,	.2257,	.2754,	.4463,	.5104
Iteration 50,	.0391,	.2082,	.2881,	.1863,	.2257,	.2754,	.4463,	.5104

Regression weights

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

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
2,	.029,	.010,	.040,	.046,	.005,	.013,	.034,	.018,	.087,	.039
3,	.170,	.098,	.099,	.081,	.143,	.136,	.171,	.088,	.181,	.208
4,	.243,	.251,	.193,	.201,	.165,	.270,	.284,	.186,	.222,	.288
5,	.336,	.265,	.264,	.250,	.368,	.296,	.283,	.292,	.196,	.186
6,	.435,	.342,	.316,	.310,	.345,	.413,	.441,	.367,	.222,	.226
7,	.193,	.167,	.442,	.215,	.526,	.472,	.504,	.428,	.311,	.275
8,	.181,	.466,	.638,	.215,	.407,	.476,	.314,	.316,	.295,	.446
9,	.322,	.332,	.311,	.270,	.299,	.365,	.311,	.299,	.281,	.510

Continued

Table 2.4.12 (Cont'd)

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7	8	9
1985	3.80E+04	3.21E+04	1.13E+04	4.81E+03	5.29E+02	5.72E+02	4.07E+02	2.02E+03
1986	2.49E+04	3.03E+04	2.22E+04	7.23E+03	2.81E+03	2.81E+02	3.86E+02	2.78E+02
1987	8.03E+03	2.02E+04	2.25E+04	1.41E+04	4.54E+03	1.64E+03	1.94E+02	1.98E+02
1988	1.61E+04	6.32E+03	1.49E+04	1.52E+04	8.88E+03	2.71E+03	8.61E+02	8.41E+01
1989	1.36E+04	1.26E+04	4.77E+03	1.00E+04	9.67E+03	5.34E+03	1.79E+03	5.68E+02
1990	9.07E+03	1.11E+04	8.96E+03	3.31E+03	5.67E+03	5.61E+03	2.58E+03	9.76E+02
1991	2.56E+03	7.33E+03	7.93E+03	5.60E+03	2.02E+03	3.07E+03	2.86E+03	1.31E+03
1992	2.47E+03	2.02E+03	5.06E+03	4.89E+03	3.45E+03	1.06E+03	1.52E+03	1.71E+03
1993	1.50E+03	1.98E+03	1.52E+03	3.44E+03	2.99E+03	1.96E+03	5.67E+02	9.07E+02
1994	7.98E+03	1.12E+03	1.36E+03	9.95E+02	2.31E+03	1.96E+03	1.18E+03	3.46E+02

Estimated population abundance at 1st Jan 1995

	.00E+00	6.29E+03	7.47E+02	8.32E+02	6.76E+02	1.51E+03	1.22E+03	6.16E+02

Taper weighted geometric mean of the VPA populations:

	8.66E+03	7.20E+03	6.21E+03	4.68E+03	3.38E+03	2.10E+03	1.28E+03	7.67E+02

Standard error of the weighted Log(VPA populations) :

	1.0600	1.1167	1.0284	.9854	.9239	.9938	.9972	1.1102

Continued

Table 2.4.12 (Cont'd)

Log catchability residuals.

Fleet : LL95A: Longliners <

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	No data for this fleet at this age									
3	.50	.08	.15	-.16	.01	-.04	.07	-.31	-.02	-.12
4	.08	.32	.32	.31	-.23	.04	.17	-.12	-.21	-.55
5	.04	.27	.34	.23	.50	.08	-.11	.12	-.38	-.96
6	.67	.45	.21	.11	.23	.32	.12	-.11	-.61	-1.08
7	-.56	-.39	.53	-.46	.62	.41	.42	-.37	-.71	-.86
8	.04	.87	.69	-.55	.48	.40	.03	.08	-.54	-.38
9	-.11	-.08	.02	-.28	.14	.24	-.01	.12	-.28	-.17

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	-11.7919	-11.4554	-11.4726	-11.3925	-11.3925	-11.3925	-11.3925
S.E(Log q)	.2082	.2911	.4334	.5225	.5884	.5092	.1840

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	.89	2.742	11.46	.99	10	.14	-11.79
4	.79	6.705	10.89	.99	10	.09	-11.46
5	.68	5.269	10.55	.97	10	.14	-11.47
6	1.00	-.020	11.41	.70	10	.56	-11.39
7	.75	1.656	10.54	.86	10	.39	-11.53
8	1.11	-.478	11.78	.73	10	.58	-11.30
9	.93	1.220	11.09	.98	10	.16	-11.43

Continued

Table 2.4.12 (Cont'd)

Fleet : LL95B: Longliners >

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	.08,	.39,	-1.19,	-.70,	-.55,	.21,	.13,	-.30,	.75,	1.06
5	.08,	.03,	-.47,	-.27,	.04,	.01,	-.11,	.21,	.31,	.13
6	.39,	.12,	-.09,	-.03,	-.17,	-.10,	.03,	.06,	.15,	-.27
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,	-11.4922,	-11.0614,	-10.6714,
S.E(Log q),	.6900,	.2287,	.1804,

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,	1.86,	-2.432,	13.79,	.53,	10,	1.01,	-11.49,
5,	1.22,	-2.319,	11.61,	.94,	10,	.23,	-11.06,
6,	1.17,	-2.240,	11.10,	.96,	10,	.17,	-10.67,

Continued

Table 2.4.12 (Cont'd)

Fleet : MH95A: Magnus Heinas

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	99.99	-.08	-1.49	.38	1.19	.04	.08	.74	-.11	-.86
3	99.99	-.69	-.85	-.50	1.09	.65	-.49	.32	.51	-.25
4	99.99	-.63	-.92	-.27	-.05	.38	-.39	.50	.79	.35
5	99.99	-.60	-.54	-.41	.81	-.33	-.42	.28	.53	.51
6	99.99	-1.26	-1.11	-.86	1.17	.32	-.27	.40	.92	.33
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	6
Mean Log q	-10.3232	-10.7925	-11.3374	-11.3772
S.E(Log q)	.6758	.5667	.5447	.8659

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	1.27	-.850	10.15	.59	9	.85	-9.86

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	1.15	-.577	10.57	.69	9	.82	-10.32
4	1.81	-3.606	12.43	.75	9	.64	-10.79
5	1.38	-1.217	12.37	.62	9	.73	-11.34
6	.86	.268	10.96	.37	9	.80	-11.38

Continued

Table 2.4.12 (Cont'd)

Fleet : OB95A: Otter board t

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
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	99.99	-.14	.17	.02	-.44	-.19	.51	.06
6	99.99	99.99	99.99	.05	.15	.22	.20	-.55	.07	-.12
7	99.99	99.99	99.99	-.31	.33	.18	-.01	-.04	.38	.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	-12.1963	-12.1449	-12.1449
S.E(Log q)	.3022	.2719	.2534

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	1.09	-.553	12.54	.88	7	.35	-12.20
6	.91	.537	11.79	.87	7	.26	-12.14
7	.90	.671	11.63	.90	7	.22	-12.06

Continued

Table 2.4.12 (Cont'd)

Fleet : PT95A: Pair trawlers

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
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	99.99	-.21	-.02	-.37	.21	-.10	.08	.39
6	99.99	99.99	99.99	-.36	-.48	-.30	.29	.17	.08	.54
7	99.99	99.99	99.99	-.48	-1.19	-.10	.13	.32	.64	.69
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	-12.3768	-11.9262	-11.9262
S.E(Log q)	.2568	.3791	.6647

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	1.19	-1.434	13.13	.92	7	.28	-12.38
6	2.32	-6.322	16.68	.83	7	.32	-11.93
7	4.08	-2.005	24.30	.08	7	2.20	-11.91

Continued

Table 2.4.12 (Cont'd)

Terminal year survivor and F summaries :

Age 2 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
LL95A: Longliners < ,	1.,	.000,	.000,	.00,	0,	.000,	.000
LL95B: Longliners > ,	1.,	.000,	.000,	.00,	0,	.000,	.000
MH95A: Magnus Heinas,	2661.,	.913,	.000,	.00,	1,	.194,	.090
OB95A: Otter board t,	1.,	.000,	.000,	.00,	0,	.000,	.000
PT95A: Pair trawlers,	1.,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean ,	7199.,	1.12,,,,				.135,	.034
F shrinkage mean ,	7839.,	.50,,,,				.672,	.031

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6286.,	.41,	.68,	3,	1.659,	.039

Age 3 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 < ,	660.,	.300,	.000,	.00,	1,	.586,	.233
LL95B: Longliners > ,	1.,	.000,	.000,	.00,	0,	.000,	.000
MH95A: Magnus Heinas,	610.,	.578,	.066,	.11,	2,	.154,	.250
OB95A: Otter board t,	1.,	.000,	.000,	.00,	0,	.000,	.000
PT95A: Pair trawlers,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	1113.,	.50,,,,				.260,	.144

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
747.,	.24,	.16,	4,	.679,	.208

Continued

Table 2.4.12 (Cont'd)

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

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
LL95A: Longliners < ,	615.,	.215,	.265,	1.23,	2,	.611,	.373
LL95B: Longliners > ,	2390.,	.726,	.000,	.00,	1,	.058,	.110
MH95A: Magnus Heinas,	1332.,	.411,	.103,	.25,	3,	.167,	.189
OB95A: Otter board t,	1.,	.000,	.000,	.00,	0,	.000,	.000
PT95A: Pair trawlers,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	1092.,	.50,,,,				.164,	.227

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
832.,	.17,	.19,	7,	1.094,	.288

Age 5 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
LL95A: Longliners < ,	446.,	.195,	.210,	1.08,	3,	.320,	.271
LL95B: Longliners > ,	827.,	.278,	.204,	.74,	2,	.188,	.155
MH95A: Magnus Heinas,	1128.,	.338,	.130,	.38,	4,	.112,	.116
OB95A: Otter board t,	719.,	.324,	.000,	.00,	1,	.142,	.176
PT95A: Pair trawlers,	999.,	.300,	.000,	.00,	1,	.166,	.130
F shrinkage mean ,	414.,	.50,,,,				.072,	.289

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
676.,	.12,	.13,	12,	1.079,	.186

Continued

Table 2.4.12 (Cont'd)

Age 6 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
LL95A: Longliners < ,	1162.,	.187,	.223,	1.19,	4,	.234,	.285
LL95B: Longliners > ,	1474.,	.205,	.201,	.98,	3,	.242,	.231
MH95A: Magnus Heinas,	2014.,	.320,	.180,	.56,	5,	.083,	.174
OB95A: Otter board t,	1736.,	.221,	.310,	1.40,	2,	.213,	.199
PT95A: Pair trawlers,	1965.,	.242,	.225,	.93,	2,	.171,	.178
F shrinkage mean ,	884.,	.50,,,,				.056,	.360

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1512.,	.10,	.10,	17,	.980,	.226

Age 7 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 < ,	1029.,	.187,	.194,	1.04,	5,	.206,	.319
LL95B: Longliners > ,	1445.,	.207,	.022,	.11,	3,	.197,	.237
MH95A: Magnus Heinas,	1735.,	.330,	.253,	.77,	5,	.062,	.201
OB95A: Otter board t,	1232.,	.181,	.075,	.41,	3,	.310,	.273
PT95A: Pair trawlers,	1324.,	.233,	.187,	.80,	3,	.162,	.256
F shrinkage mean ,	677.,	.50,,,,				.063,	.452

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1219.,	.10,	.07,	20,	.781,	.275

Continued

Table 2.4.12 (Cont'd)

Age 8 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 < ,	504.,	.194,	.112,	.58,	6,	.241,	.523
LL95B: Longliners > ,	615.,	.207,	.068,	.33,	3,	.171,	.447
MH95A: Magnus Heinas,	757.,	.330,	.257,	.78,	5,	.054,	.377
OB95A: Otter board t,	562.,	.184,	.314,	1.71,	3,	.287,	.481
PT95A: Pair trawlers,	803.,	.236,	.119,	.50,	3,	.144,	.359
F shrinkage mean ,	789.,	.50,,,,				.103,	.364

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
616.,	.10,	.08,	21,	.771,	.446

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
LL95A: Longliners < ,	139.,	.185,	.066,	.36,	7,	.400,	.597
LL95B: Longliners > ,	168.,	.208,	.094,	.45,	3,	.121,	.515
MH95A: Magnus Heinas,	117.,	.329,	.181,	.55,	5,	.040,	.675
OB95A: Otter board t,	178.,	.186,	.073,	.39,	3,	.210,	.492
PT95A: Pair trawlers,	167.,	.239,	.237,	.99,	3,	.102,	.516
F shrinkage mean ,	342.,	.50,,,,				.127,	.286

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
170.,	.11,	.08,	22,	.696,	.510

Table 2.4.13

Run title : Haddock in the Faroe (run: JR5/TU5)

At 6-May-95 11:49:44

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,	1964,
AGE				
2,	.1875,	.3232,	.3801,	.0876,
3,	.4162,	.5866,	.5640,	.3723,
4,	.4209,	.5980,	.7261,	.5193,
5,	.4387,	.3480,	.5591,	.5369,
6,	.5879,	.6706,	.4026,	.6107,
7,	.9483,	1.0499,	1.2493,	.3375,
8,	.8742,	.9736,	1.1139,	1.2027,
9,	.6600,	.7351,	.8185,	.6472,
+gp,	.6600,	.7351,	.8185,	.6472,
FBAR 3- 7,	.5624,	.6506,	.7002,	.4753,

Table 8 Fishing mortality (F) at age

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
2,	.0691,	.0610,	.0641,	.1262,	.0861,	.0552,	.0527,	.0253,	.1674,	.1269,
3,	.2354,	.2371,	.1873,	.2647,	.2365,	.2530,	.1939,	.4236,	.4314,	.2175,
4,	.4767,	.4515,	.2971,	.3483,	.5321,	.3348,	.4191,	.2859,	.2391,	.3737,
5,	.3678,	.5006,	.2997,	.2847,	.3330,	.3640,	.2759,	.4525,	.3140,	.1283,
6,	.5882,	.5421,	.5406,	.4540,	.4976,	.5561,	.5563,	.1498,	.2699,	.1718,
7,	.9618,	.9128,	.6907,	.8367,	.8278,	.8743,	.8384,	.6728,	.1949,	.2139,
8,	2.3618,	.7509,	.6635,	.5852,	1.0633,	.5432,	.4227,	.4065,	.2912,	.1436,
9,	.9619,	.6373,	.5022,	.5057,	.6567,	.5388,	.5064,	.3961,	.2632,	.2072,
+gp,	.9619,	.6373,	.5022,	.5057,	.6567,	.5388,	.5064,	.3961,	.2632,	.2072,
FBAR 3- 7,	.5260,	.5288,	.4031,	.4377,	.4854,	.4764,	.4567,	.3969,	.2899,	.2210,

Continued

Table 2.4.13 (Cont'd)

Run title : Haddock in the Faroe (run: JR5/TU5)

At 6-May-95 11:49:44

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	.1236,	.0913,	.0109,	.0010,	.0004,	.0318,	.0240,	.0378,	.0255,	.0331,
3,	.2656,	.1888,	.1134,	.0549,	.0472,	.0292,	.1343,	.4692,	.1884,	.1182,
4,	.2417,	.3823,	.1826,	.1676,	.1259,	.2102,	.1349,	.3603,	.3565,	.3806,
5,	.2121,	.2221,	.5301,	.2132,	.1927,	.2762,	.2211,	.3014,	.3357,	.2241,
6,	.0960,	.2880,	.7274,	.3851,	.1421,	.2156,	.2277,	.2944,	.1440,	.3149,
7,	.0862,	.1607,	.3920,	.5802,	.2752,	.1720,	.2028,	.2542,	.3239,	.0893,
8,	.1603,	.2547,	.3807,	.5001,	.3341,	.4017,	.0931,	.2299,	.3131,	.3265,
9,	.1599,	.2630,	.4458,	.3717,	.2150,	.2565,	.1767,	.2897,	.2963,	.2685,
+gp,	.1599,	.2630,	.4458,	.3717,	.2150,	.2565,	.1767,	.2897,	.2963,	.2685,
FBAR 3- 7,	.1803,	.2484,	.3891,	.2802,	.1566,	.1806,	.1842,	.3359,	.2697,	.2254,

Table 8 Fishing mortality (F) at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 61-94
AGE											
2,	.0290,	.0103,	.0397,	.0459,	.0051,	.0129,	.0338,	.0181,	.0871,	.0391,	.0739,
3,	.1703,	.0977,	.0989,	.0808,	.1426,	.1358,	.1712,	.0878,	.1814,	.2082,	.2236,
4,	.2428,	.2508,	.1928,	.2010,	.1653,	.2704,	.2839,	.1858,	.2225,	.2881,	.3197,
5,	.3360,	.2648,	.2645,	.2500,	.3677,	.2960,	.2829,	.2920,	.1961,	.1863,	.3138,
6,	.4350,	.3423,	.3162,	.3096,	.3451,	.4130,	.4410,	.3666,	.2218,	.2257,	.3779,
7,	.1934,	.1668,	.4421,	.2153,	.5264,	.4720,	.5039,	.4283,	.3110,	.2754,	.4906,
8,	.1811,	.4656,	.6382,	.2155,	.4066,	.4765,	.3138,	.3162,	.2949,	.4463,	.5337,
9,	.3223,	.3317,	.3111,	.2699,	.2993,	.3651,	.3106,	.2993,	.2808,	.5104,	.4141,
+gp,	.3223,	.3317,	.3111,	.2699,	.2993,	.3651,	.3106,	.2993,	.2808,	.5104,	
FBAR 3- 7,	.2755,	.2245,	.2629,	.2113,	.3094,	.3174,	.3366,	.2721,	.2266,	.2367,	

Table 2.4.14

Run title : Haddock in the Faroe (run: JR5/TU5)

At 6-May-95 11:49:44

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,
AGE				
2,	51278,	38537,	47362,	30109,
3,	23796,	34806,	22837,	26514,
4,	16517,	12850,	15850,	10638,
5,	6028,	8877,	5786,	6278,
6,	3245,	3182,	5132,	2708,
7,	1512,	1476,	1332,	2809,
8,	448,	480,	423,	313,
9,	135,	153,	148,	114,
+gp,	0,	0,	0,	0,
TOTAL,	102958,	100361,	98870,	79484,

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

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
2,	22643,	20203,	25353,	54814,	31954,	35548,	15429,	33145,	23664,	52239,
3,	22585,	17300,	15563,	19468,	39557,	24005,	27541,	11983,	26458,	16389,
4,	14961,	14613,	11175,	10566,	12232,	25565,	15260,	18574,	6423,	14072,
5,	5182,	7604,	7617,	6798,	6106,	5882,	14976,	8217,	11425,	4141,
6,	3005,	2937,	3774,	4621,	4186,	3583,	3346,	9305,	4279,	6833,
7,	1204,	1366,	1398,	1799,	2403,	2084,	1682,	1571,	6559,	2675,
8,	1641,	377,	449,	574,	638,	860,	712,	596,	656,	4419,
9,	77,	127,	146,	189,	262,	180,	409,	382,	325,	402,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	52,	864,
TOTAL,	71297,	64527,	65474,	98829,	97338,	97707,	79356,	83772,	79842,	102032,

Continued

Table 2.4.14 (Cont'd)

Run title : Haddock in the Faroe (run: JR5/TU5)

At 6-May-95 11:49:44

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
2,	69757,	55693,	26107,	33995,	2719,	5045,	3448,	16076,	19388,	40559,
3,	37672,	50473,	41620,	21144,	27804,	2225,	4001,	2756,	12675,	15475,
4,	10795,	23648,	34214,	30421,	16387,	21713,	1769,	2864,	1412,	8595,
5,	7929,	6940,	13210,	23336,	21063,	11829,	14408,	1266,	1636,	809,
6,	2982,	5251,	4550,	6366,	15437,	14222,	7348,	9456,	767,	957,
7,	4712,	2218,	3224,	1800,	3546,	10965,	9385,	4791,	5768,	543,
8,	1768,	3539,	1546,	1783,	825,	2205,	7559,	6273,	3042,	3416,
9,	3134,	1233,	2246,	865,	885,	484,	1208,	5638,	4081,	1821,
+gp,	1393,	1511,	2603,	1102,	421,	418,	245,	934,	3404,	4515,
TOTAL,	140141,	150508,	129321,	120813,	89087,	69106,	49371,	50056,	52171,	76691,

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE											
2,	38046,	24875,	8033,	16139,	13623,	9070,	2558,	2469,	1497,	7984,	0,
3,	32126,	30258,	20158,	6321,	12621,	11097,	7331,	2024,	1985,	1123,	6286,
4,	11257,	22183,	22467,	14949,	4773,	8960,	7932,	5058,	1518,	1355,	747,
5,	4810,	7230,	14133,	15169,	10011,	3313,	5597,	4889,	3439,	995,	832,
6,	529,	2814,	4542,	8882,	9672,	5674,	2017,	3454,	2989,	2314,	676,
7,	572,	281,	1636,	2711,	5336,	5608,	3074,	1063,	1960,	1960,	1512,
8,	407,	386,	194,	861,	1790,	2581,	2864,	1521,	567,	1176,	1219,
9,	2017,	278,	198,	84,	568,	976,	1312,	1713,	907,	346,	616,
+gp,	3875,	2768,	1371,	594,	344,	387,	132,	688,	830,	824,	575,
TOTAL,	93640,	91072,	72733,	65710,	58738,	47665,	32817,	22877,	15692,	18077,	12462,

Table 2.4.15

Run title : Haddock in the Faroe (run: JR5/TU5)

At 6-May-95 11:49:44

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,	51278,	81164,	47797,	20831,	.4358,	.5624,
1962,	38537,	83420,	51875,	27151,	.5234,	.6506,
1963,	47362,	80753,	49547,	27571,	.5565,	.7002,
1964,	30109,	68576,	44127,	19490,	.4417,	.4753,
1965,	22643,	65653,	45555,	18479,	.4056,	.5260,
1966,	20203,	60931,	43951,	18766,	.4270,	.5288,
1967,	25353,	60201,	41956,	13381,	.3189,	.4031,
1968,	54814,	78055,	45374,	17852,	.3934,	.4377,
1969,	31954,	83784,	53407,	23272,	.4358,	.4854,
1970,	35548,	87244,	59827,	21361,	.3570,	.4764,
1971,	15429,	81680,	62857,	19393,	.3085,	.4567,
1972,	33145,	82983,	61902,	16485,	.2663,	.3969,
1973,	23664,	82635,	61483,	17969,	.2923,	.2899,
1974,	52239,	95239,	64507,	14763,	.2289,	.2210,
1975,	69757,	121449,	75232,	20715,	.2753,	.1803,
1976,	55693,	135109,	88939,	26211,	.2947,	.2484,
1977,	26107,	120601,	96054,	25553,	.2660,	.3891,
1978,	33995,	119541,	96613,	19200,	.1987,	.2802,
1979,	2719,	96489,	84543,	12424,	.1470,	.1566,
1980,	5045,	86444,	80731,	15016,	.1860,	.1806,
1981,	3448,	77647,	74521,	12233,	.1642,	.1842,
1982,	16076,	67336,	53464,	11937,	.2233,	.3359,
1983,	19388,	62761,	53046,	12894,	.2431,	.2697,
1984,	40559,	82350,	53510,	12378,	.2313,	.2254,
1985,	38046,	91012,	63196,	15143,	.2396,	.2755,
1986,	24875,	95908,	61253,	14477,	.2363,	.2245,
1987,	8033,	85040,	64954,	14882,	.2291,	.2629,
1988,	16139,	72699,	59850,	12178,	.2035,	.2113,
1989,	13623,	64640,	47469,	14325,	.3018,	.3094,
1990,	9070,	48466,	36884,	11726,	.3179,	.3174,
1991,	2558,	34008,	31904,	8429,	.2642,	.3366,
1992,	2469,	24439,	22772,	5446,	.2392,	.2721,
1993,	1497,	20742,	18217,	4026,	.2210,	.2266,
1994,	7984,	22813,	16874,	4251,	.2519,	.2367,
Arith. Mean,	25864,	77112,	56300,	16183,	.2978,	.3451,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.4.16

Management option tables INPUT DATA FAROE HADDOCK

Stock size

The yearclasses up to 1991 included are derived from the final 1995 VPA

The yearclasses 1992-94 at age 2 are estimated with RCT3 and 4 indices from the grounfish survey
The yearclass 1992 at age 3 is estimated from the age 2 estimate (Rct3) and an average F for two years old 1991-93)
The yearclass 1995 in 1997 is estimated as average number of two years old 1986-94, i e 1986-91 from final VPA, 1992-94 from RCT3

Age	1995	1996	1997
2	29465	38703	12768
3	4781		
4	747		
5	832		
6	676		
7	1512		
8	1219		
9	616		
10+	575		

Proportion mature at age

Age	1995	1996	1997
2	0.14	0.12	0.12
3	0.67	0.5	0.5
4	1	0.92	0.92
5	1	1	1
6	1	1	1
7	1	1	1
8	1	1	1
9	1	1	1
10+	1	1	1

Catch/stock weights at age

Age	1995	1996	1997	1992	1993	1994
2	0.678	0.678	0.678	0.525	0.755	0.754
3	1.1565	1.0805	1.0805	0.724	0.982	1.103
4	1.3905	1.444	1.368	0.817	1.027	1.254
5	1.6605	1.797	1.8505	1.038	1.192	1.465
6	1.8355	2.031	2.1675	1.249	1.378	1.593
7	2.003	2.2455	2.441	1.43	1.643	1.804
8	2.19	2.389	2.6315	1.564	1.796	2.049
9	2.467	2.608	2.807	1.633	1.971	2.225
10+	2.7545	2.9965	3.1375	2.126	2.24	2.423

By comparing mean weights at age for the 1.quarter 1994 and 1995, respectively, it is seen, that the mean weights at age still are increasing. Assuming this tendency will continue the rest of 1995 and in 1996-97, the mean weights at age in 1995 are calculated by adding the annual growth by age group in 1992-94 to the observed mean weights at age in 1994. The mean weights at age in 1996 and 1997 are calculated in the same way except that the average annual growth is added to the mean weight at age in 1995 and 1996, respectively.
The average growth is calculated as AVERAGE[w(a+1,y+1)-w(a,y)]
Regarding weight for age 2 no good informations are available for a possible increase/decrease, but inspecting the weights for the latest years, it is not very wrong to use average values for weight at age 2 1992-94 for each of the years 1995-1997 age 2.

Exploitation pattern

Age	1995	1996	1997
2	0.0391	0.0391	0.0391
3	0.2082	0.2082	0.2082
4	0.288	0.288	0.288
5	0.1862	0.1862	0.1862
6	0.2256	0.2256	0.2256
7	0.2753	0.2753	0.2753
8	0.4462	0.4462	0.4462
9	0.5103	0.5103	0.5103
10+	0.5103	0.5103	0.5103

The exploitation pattern is taken directly from the 1994 fishing mortality matrix from the final VPA in 1995

Table 2.4.17

Faroe Haddock : VPA and groundfish survey data
4 10 2

'Yearclass'	'VPAage2'	'Surv1'	'Surv2'	'Surv3'	'Surv4'
1985	8033	23.6	11.8	11.8	8.5
1986	16144	40.6	88.1	113.0	23.9
1987	13595	40.5	146.6	64.0	9.8
1988	9077	43.8	43.1	13.4	15.5
1989	2557	6.1	16.5	8.5	6.2
1990	2466	4.0	26.9	9.9	3.5
1991	1496	6.2	9.2	2.6	2.3
1992	-11	28.1	19.2	9.7	-11
1993	-11	159.7	257.5	-11	-11
1994	-11	491.3	-11	-11	-11

Table 2.4.18

Analysis by RCT3 ver3.1 of data from file :

rct94b.dat

Faroe Haddock : VPA and groundfish survey data

Data for 4 surveys over 10 years : 1985 - 1994

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1988

	I-----------Regression-----------I					I-----------Prediction-------------I			
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	1.24	5.01	.12	.946	3	3.80	9.71	.276	.255
Surv2	.31	8.15	.24	.822	3	3.79	9.33	.483	.084
Surv3	.32	8.18	.01	1.000	3	2.67	9.03	.014	.487
Surv4	.90	7.05	.42	.599	3	2.80	9.57	.864	.026
						VPA Mean =	9.40	.364	.147

Yearclass = 1989

	I-----------Regression-----------I					I-----------Prediction-------------I			
Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	2.04	1.95	.56	.341	4	1.96	5.95	2.895	.003
Surv2	.36	7.89	.24	.736	4	2.86	8.93	.435	.131
Surv3	.30	8.26	.04	.988	4	2.25	8.94	.081	.619
Surv4	1.29	5.91	.56	.343	4	1.97	8.44	1.142	.019
						VPA Mean =	9.33	.329	.228

Continued

Table 2.4.18 (Cont'd)

Yearclass = 1990

Survey/ Series	Slope	Intercept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----Regression-----				I-----Prediction-----				
Surv1	.98	5.81	.29	.893	5	1.61	7.39	.575	.406
Surv2	.95	5.48	.78	.538	5	3.33	8.64	1.118	.107
Surv3	.80	6.39	.60	.660	5	2.39	8.32	.907	.163
Surv4	1.95	4.11	.72	.577	5	1.50	7.04	1.406	.068
						VPA Mean =	9.03	.724	.256

Yearclass = 1991

Survey/ Series	Slope	Intercept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----Regression-----				I-----Prediction-----				
Surv1	.87	6.22	.26	.926	6	1.97	7.93	.377	.642
Surv2	1.27	4.15	.98	.466	6	2.32	7.10	1.522	.039
Surv3	.95	5.84	.65	.664	6	1.28	7.06	1.074	.079
Surv4	1.58	5.11	.55	.735	6	1.19	7.00	.936	.104
						VPA Mean =	8.82	.819	.136

Yearclass = 1992

Survey/ Series	Slope	Intercept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----Regression-----				I-----Prediction-----				
Surv1	1.02	5.68	.37	.888	7	3.37	9.14	.479	.525
Surv2	1.21	4.39	.83	.608	7	3.01	8.03	1.077	.104
Surv3	.90	6.03	.55	.778	7	2.37	8.16	.714	.236
Surv4									
						VPA Mean =	8.60	.944	.135

Yearclass = 1993

Survey/ Series	Slope	Intercept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----Regression-----				I-----Prediction-----				
Surv1	1.02	5.69	.37	.887	7	5.08	10.88	.637	.599
Surv2	1.21	4.39	.83	.614	7	5.55	11.10	1.364	.131
Surv3									
Surv4									
						VPA Mean =	8.59	.947	.271

Continued

Table 2.4.18 (Cont'd)

Yearclass = 1994

	I-----------Regression-------------				I	-----------Prediction---------------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv1	1.02	5.69	.38	.887	7	6.20	12.03	.816	.577
Surv2									
Surv3									
Surv4									
						VPA Mean =	8.57	.952	.423

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	10906	9.30	.14	.14	1.04	9078	9.11
1989	8175	9.01	.16	.12	.61	2558	7.85
1990	3200	8.07	.37	.37	1.01	2466	7.81
1991	2579	7.86	.30	.26	.77	1496	7.31
1992	6116	8.72	.35	.27	.60		
1993	29465	10.29	.49	.74	2.23		
1994	38703	10.56	.62	1.71	7.60		

Table 2.4.19

Haddock in the Faroe Grounds (Fishing Area Vb) 11:39 Saturday, May

Prediction with management option table: Input data

Year: 1995								
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	29465.000	0.2000	0.1400	0.0000	0.0000	0.678	0.0391	0.678
3	4781.000	0.2000	0.6700	0.0000	0.0000	1.157	0.2082	1.157
4	747.000	0.2000	1.0000	0.0000	0.0000	1.391	0.2880	1.391
5	832.000	0.2000	1.0000	0.0000	0.0000	1.661	0.1862	1.661
6	676.000	0.2000	1.0000	0.0000	0.0000	1.836	0.2256	1.836
7	1512.000	0.2000	1.0000	0.0000	0.0000	2.003	0.2753	2.003
8	1219.000	0.2000	1.0000	0.0000	0.0000	2.190	0.4462	2.190
9	616.000	0.2000	1.0000	0.0000	0.0000	2.467	0.5103	2.467
10+	575.000	0.2000	1.0000	0.0000	0.0000	2.755	0.5103	2.755
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
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	38703.000	0.2000	0.1200	0.0000	0.0000	0.678	0.0391	0.678
3	.	0.2000	0.5000	0.0000	0.0000	1.081	0.2082	1.081
4	.	0.2000	0.9200	0.0000	0.0000	1.444	0.2880	1.444
5	.	0.2000	1.0000	0.0000	0.0000	1.797	0.1862	1.797
6	.	0.2000	1.0000	0.0000	0.0000	2.031	0.2256	2.031
7	.	0.2000	1.0000	0.0000	0.0000	2.246	0.2753	2.246
8	.	0.2000	1.0000	0.0000	0.0000	2.389	0.4462	2.389
9	.	0.2000	1.0000	0.0000	0.0000	2.608	0.5103	2.608
10+	.	0.2000	1.0000	0.0000	0.0000	2.997	0.5103	2.997
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	12768.000	0.2000	0.1200	0.0000	0.0000	0.678	0.0391	0.678
3	.	0.2000	0.5000	0.0000	0.0000	1.081	0.2082	1.081
4	.	0.2000	0.9200	0.0000	0.0000	1.368	0.2880	1.368
5	.	0.2000	1.0000	0.0000	0.0000	1.851	0.1862	1.851
6	.	0.2000	1.0000	0.0000	0.0000	2.168	0.2256	2.168
7	.	0.2000	1.0000	0.0000	0.0000	2.441	0.2753	2.441
8	.	0.2000	1.0000	0.0000	0.0000	2.632	0.4462	2.632
9	.	0.2000	1.0000	0.0000	0.0000	2.807	0.5103	2.807
10+	.	0.2000	1.0000	0.0000	0.0000	3.138	0.5103	3.138
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : JAK1
Date and time: 06MAY95:12:14

Table 2.4.20

11:39 Saturday, May 6, 1995

Haddock in the Faroe Grounds (Fishing Area Vb)

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
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
1.2922	0.3058	37973	18967	6200	0.0000	0.0000	63172	27339	0	80571	53771
.	.	.	.	.	0.0500	0.0118	.	27339	473	80029	53284
.	.	.	.	.	0.1000	0.0237	.	27339	941	79494	52803
.	.	.	.	.	0.1500	0.0355	.	27339	1402	78966	52329
.	.	.	.	.	0.2000	0.0473	.	27339	1858	78445	51862
.	.	.	.	.	0.2500	0.0592	.	27339	2308	77930	51401
.	.	.	.	.	0.3000	0.0710	.	27339	2752	77421	50945
.	.	.	.	.	0.3500	0.0828	.	27339	3191	76919	50496
.	.	.	.	.	0.4000	0.0947	.	27339	3624	76423	50053
.	.	.	.	.	0.4500	0.1065	.	27339	4051	75934	49616
.	.	.	.	.	0.5000	0.1183	.	27339	4474	75450	49185
.	.	.	.	.	0.5500	0.1302	.	27339	4891	74972	48759
.	.	.	.	.	0.6000	0.1420	.	27339	5303	74500	48339
.	.	.	.	.	0.6500	0.1538	.	27339	5710	74034	47924
.	.	.	.	.	0.7000	0.1657	.	27339	6112	73574	47515
.	.	.	.	.	0.7500	0.1775	.	27339	6509	73119	47111
.	.	.	.	.	0.8000	0.1893	.	27339	6901	72670	46713
.	.	.	.	.	0.8500	0.2012	.	27339	7288	72226	46319
.	.	.	.	.	0.9000	0.2130	.	27339	7671	71787	45931
.	.	.	.	.	0.9500	0.2248	.	27339	8049	71354	45547
.	.	.	.	.	1.0000	0.2367	.	27339	8423	70926	45169
.	.	.	.	.	1.0500	0.2485	.	27339	8792	70503	44795
.	.	.	.	.	1.1000	0.2603	.	27339	9157	70085	44426
.	.	.	.	.	1.1500	0.2722	.	27339	9517	69672	44062
.	.	.	.	.	1.2000	0.2840	.	27339	9873	69263	43703
.	.	.	.	.	1.2500	0.2958	.	27339	10225	68860	43348
.	.	.	.	.	1.3000	0.3077	.	27339	10573	68461	42997
.	.	.	.	.	1.3500	0.3195	.	27339	10917	68067	42651
.	.	.	.	.	1.4000	0.3313	.	27339	11256	67677	42309
.	.	.	.	.	1.4500	0.3432	.	27339	11592	67292	41972
.	.	.	.	.	1.5000	0.3550	.	27339	11924	66912	41639
.	.	.	.	.	1.5500	0.3668	.	27339	12252	66535	41309
.	.	.	.	.	1.6000	0.3787	.	27339	12576	66163	40984
.	.	.	.	.	1.6500	0.3905	.	27339	12897	65796	40663
.	.	.	.	.	1.7000	0.4023	.	27339	13214	65432	40346
.	.	.	.	.	1.7500	0.4142	.	27339	13527	65073	40033
.	.	.	.	.	1.8000	0.4260	.	27339	13837	64717	39724
.	.	.	.	.	1.8500	0.4378	.	27339	14143	64366	39418
.	.	.	.	.	1.9000	0.4497	.	27339	14446	64018	39116
.	.	.	.	.	1.9500	0.4615	.	27339	14745	63675	38818
.	.	.	.	.	2.0000	0.4733	.	27339	15041	63335	38523
.	.	.	.	.	2.0500	0.4852	.	27339	15334	62999	38232
.	.	.	.	.	2.1000	0.4970	.	27339	15623	62667	37945
.	.	.	.	.	2.1500	0.5088	.	27339	15909	62338	37661
.	.	.	.	.	2.2000	0.5207	.	27339	16192	62013	37380
.	.	.	.	.	2.2500	0.5325	.	27339	16472	61691	37102
.	.	.	.	.	2.3000	0.5443	.	27339	16749	61373	36828
.	.	.	.	.	2.3500	0.5562	.	27339	17023	61059	36558
.	.	.	.	.	2.4000	0.5680	.	27339	17294	60748	36290
.	.	.	.	.	2.4500	0.5798	.	27339	17562	60440	36026
.	.	.	.	.	2.5000	0.5916	.	27339	17827	60135	35764
.	.	.	.	.	2.5500	0.6035	.	27339	18089	59834	35506
.	.	.	.	.	2.6000	0.6153	.	27339	18349	59536	35251
.	.	.	.	.	2.6500	0.6271	.	27339	18605	59241	34998
.	.	.	.	.	2.7000	0.6390	.	27339	18859	58949	34749
.	.	.	.	.	2.7500	0.6508	.	27339	19111	58661	34503
.	.	.	.	.	2.8000	0.6626	.	27339	19359	58375	34259
.	.	.	.	.	2.8500	0.6745	.	27339	19605	58092	34018
.	.	.	.	.	2.9000	0.6863	.	27339	19848	57813	33780
.	.	.	.	.	2.9500	0.6981	.	27339	20089	57536	33545
.	.	.	.	.	3.0000	0.7100	.	27339	20327	57262	33312
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : JAK1
Date and time : 06MAY95:12:14
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1995 : TAC constraints

Table 2.4.21

Haddock in the Faroe Grounds (Fishing Areà Vb)

18:43 Saturday, May 6

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	0.545	0.0702	0.545
3	.	0.2000	0.4900	0.0000	0.0000	0.807	0.2225	0.807
4	.	0.2000	0.9200	0.0000	0.0000	1.044	0.3306	1.044
5	.	0.2000	1.0000	0.0000	0.0000	1.354	0.3320	1.354
6	.	0.2000	1.0000	0.0000	0.0000	1.669	0.3838	1.669
7	.	0.2000	1.0000	0.0000	0.0000	1.953	0.4667	1.953
8	.	0.2000	1.0000	0.0000	0.0000	2.149	0.5086	2.149
9	.	0.2000	1.0000	0.0000	0.0000	2.398	0.4128	2.398
10+	.	0.2000	1.0000	0.0000	0.0000	2.767	0.4128	2.767
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : JR5
Date and time: 06MAY95:18:44

Table 2.4.22

Haddock in the Faroe Grounds (Fishing Area Vb)

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	8437.194	4.135	7548.366	4.135	7548.366
0.0500	0.0174	0.071	124.521	5.165	7579.984	3.786	6693.150	3.786	6693.150
0.1000	0.0347	0.129	220.802	4.874	6882.161	3.497	5997.304	3.497	5997.304
0.1500	0.0521	0.179	296.285	4.628	6304.755	3.253	5421.861	3.253	5421.861
0.2000	0.0694	0.221	356.148	4.417	5820.317	3.045	4939.369	3.045	4939.369
0.2500	0.0868	0.258	404.084	4.235	5408.979	2.864	4529.962	2.864	4529.962
0.3000	0.1041	0.290	442.786	4.075	5056.032	2.707	4178.930	2.707	4178.930
0.3500	0.1215	0.318	474.252	3.934	4750.367	2.568	3875.165	2.568	3875.165
0.4000	0.1388	0.344	499.986	3.808	4483.450	2.444	3610.135	2.444	3610.135
0.4500	0.1562	0.367	521.140	3.695	4248.631	2.333	3377.186	2.333	3377.186
0.5000	0.1736	0.387	538.604	3.593	4040.652	2.233	3171.064	2.233	3171.064
0.5500	0.1909	0.406	553.073	3.500	3855.313	2.143	2987.567	2.143	2987.567
0.6000	0.2083	0.423	565.094	3.415	3689.219	2.060	2823.301	2.060	2823.301
0.6500	0.2256	0.439	575.105	3.338	3539.603	1.984	2675.499	1.984	2675.499
0.7000	0.2430	0.453	583.454	3.266	3404.188	1.915	2541.884	1.915	2541.884
0.7500	0.2603	0.467	590.424	3.200	3281.085	1.850	2420.567	1.850	2420.567
0.8000	0.2777	0.479	596.243	3.138	3168.719	1.791	2309.974	1.791	2309.974
0.8500	0.2951	0.491	601.098	3.081	3065.762	1.736	2208.776	1.736	2208.776
0.9000	0.3124	0.502	605.144	3.027	2971.094	1.684	2115.855	1.684	2115.855
0.9500	0.3298	0.512	608.506	2.977	2883.760	1.636	2030.254	1.636	2030.254
1.0000	0.3471	0.522	611.290	2.930	2802.944	1.590	1951.157	1.590	1951.157
1.0500	0.3645	0.531	613.583	2.885	2727.942	1.548	1877.863	1.548	1877.863
1.1000	0.3818	0.539	615.458	2.843	2658.149	1.508	1809.764	1.508	1809.764
1.1500	0.3992	0.547	616.977	2.803	2593.038	1.470	1746.335	1.470	1746.335
1.2000	0.4165	0.555	618.191	2.766	2532.150	1.434	1687.116	1.434	1687.116
1.2500	0.4339	0.562	619.144	2.730	2475.083	1.400	1631.706	1.400	1631.706
1.3000	0.4513	0.569	619.873	2.696	2421.484	1.368	1579.753	1.368	1579.753
1.3500	0.4686	0.576	620.409	2.664	2371.043	1.338	1530.945	1.338	1530.945
1.4000	0.4860	0.582	620.780	2.633	2323.484	1.309	1485.007	1.309	1485.007
1.4500	0.5033	0.588	621.008	2.603	2278.564	1.281	1441.696	1.281	1441.696
1.5000	0.5207	0.594	621.113	2.575	2236.063	1.254	1400.794	1.254	1400.794
1.5500	0.5380	0.600	621.112	2.548	2195.790	1.229	1362.107	1.229	1362.107
1.6000	0.5554	0.605	621.019	2.522	2157.568	1.205	1325.460	1.205	1325.460
1.6500	0.5727	0.610	620.847	2.497	2121.243	1.182	1290.699	1.182	1290.699
1.7000	0.5901	0.615	620.607	2.473	2086.672	1.160	1257.682	1.160	1257.682
1.7500	0.6075	0.620	620.309	2.450	2053.730	1.138	1226.281	1.138	1226.281
1.8000	0.6248	0.625	619.960	2.428	2022.301	1.118	1196.383	1.118	1196.383
1.8500	0.6422	0.629	619.567	2.406	1992.281	1.098	1167.883	1.098	1167.883
1.9000	0.6595	0.633	619.138	2.385	1963.574	1.079	1140.686	1.079	1140.686
1.9500	0.6769	0.637	618.676	2.365	1936.094	1.061	1114.706	1.061	1114.706
2.0000	0.6942	0.641	618.188	2.346	1909.763	1.043	1089.863	1.043	1089.863
2.0500	0.7116	0.645	617.677	2.328	1884.507	1.027	1066.086	1.027	1066.086
2.1000	0.7290	0.649	617.146	2.310	1860.261	1.010	1043.308	1.010	1043.308
2.1500	0.7463	0.653	616.600	2.292	1836.963	0.994	1021.469	0.994	1021.469
2.2000	0.7637	0.656	616.040	2.275	1814.558	0.979	1000.512	0.979	1000.512
2.2500	0.7810	0.660	615.469	2.259	1792.994	0.964	980.386	0.964	980.386
2.3000	0.7984	0.663	614.889	2.243	1772.222	0.950	961.043	0.950	961.043
2.3500	0.8157	0.666	614.303	2.227	1752.200	0.936	942.439	0.936	942.439
2.4000	0.8331	0.669	613.712	2.212	1732.885	0.923	924.534	0.923	924.534
2.4500	0.8504	0.672	613.117	2.198	1714.240	0.910	907.290	0.910	907.290
2.5000	0.8678	0.675	612.519	2.183	1696.230	0.897	890.670	0.897	890.670
2.5500	0.8852	0.678	611.920	2.170	1678.822	0.885	874.644	0.885	874.644
2.6000	0.9025	0.681	611.321	2.156	1661.985	0.873	859.179	0.873	859.179
2.6500	0.9199	0.684	610.722	2.143	1645.691	0.862	844.248	0.862	844.248
2.7000	0.9372	0.686	610.124	2.130	1629.913	0.851	829.824	0.851	829.824
2.7500	0.9546	0.689	609.529	2.118	1614.626	0.840	815.882	0.840	815.882
2.8000	0.9719	0.692	608.936	2.106	1599.806	0.829	802.400	0.829	802.400
2.8500	0.9893	0.694	608.345	2.094	1585.433	0.819	789.354	0.819	789.354
2.9000	1.0066	0.697	607.759	2.083	1571.485	0.809	776.726	0.809	776.726
2.9500	1.0240	0.699	607.176	2.071	1557.944	0.799	764.495	0.799	764.495
3.0000	1.0414	0.701	606.597	2.060	1544.790	0.790	752.644	0.790	752.644
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : JR5
Date and time : 06MAY95:18:44
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.5297
F-max factor : 1.5241
F-0.1 reference F : 0.1839
F-max reference F : 0.5290
Recruitment : Single recruit

Table 2.5.1 Nominal catch (tonnes) of Saithe in the Faroes (Division Vb), by countries, 1981-1994 as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987
Denmark	-	-	-	-	-	21	255
Faroe Islands	29,682	30,808	38,963	54,344	42,874	40,139	39,301
France	258	130	180	243	839	87	153
German Dem.Rep.	-	-	-	-	31	-	-
Germany Fed.Rep.	20	19	28	73	227	105	49
Netherlands	-	-	-	-	-	-	-
Norway	134	15	5	5	-	24	14
UK (Eng. & W.)	-	-	-	-	4	-	108
UK (Scotland)	9	1	-	-	630	1,340	140
United Kingdom	-	-	-	-	-	-	-
USSR	-	-	-	-	-	-	-
Total	30,103	30,973	39,176	54,665	44,605	41,716	40,020

Country	1988	1989	1990	1991	1992	1993	1994 [1]
Denmark	94	-	2	-	-	-	-
Faroe Islands	44,402	43,624	59,821	53,321	35,979	32,719	32,406
France [3]	313	-	-	-	1,999	-	-
German Dem.Rep.	-	9	-	-	-	-	-
Germany Fed.Rep.	74	20	15	32	5	2	-
Netherlands	-	22	67	65	-	-	-
Norway	52	51	46	103	34 [1]	34 [1]	156
UK (Eng. & W.)	-	-	-	5	74	280	-
UK (Scotland)	92	9	33	79	98	425	-
United Kingdom	-	-	-	-	-	-	538
USSR/Russia [2]	-	-	30	-	12	-	-
Total	45,027	43,735	60,014	53,605	38,201	33,460	33,100

[1] Provisional data
[2] As of 1991.
[3] Quantity unknown 1989-1991 and 1993

Table 2.5.2 Nominal catch (tonnes) of Saithe in the Faroes (Division Vb), by countries, 1981-1994 as used in assessment.

Country	1981	1982	1983	1984	1985	1986	1987
Denmark	-	-	-	-	-	21	255
Faroe Islands							
Vb	29,682	30,808	38,963	54,344	42,874	40,139	39,301
IIa_4	-	-	-	-	-	-	-
France	258	130	180	243	839	87	153
German Dem.Rep.	-	-	-	-	31	-	-
Germany Fed.Rep.	20	19	28	73	227	105	49
Netherlands	-	-	-	-	-	-	-
Norway	134	15	5	5	-	24	14
UK (Eng. & W.)	-	-	-	-	4	-	108
UK (Scotland)	9	1	-	-	630	1,340	140
United Kingdom	-	-	-	-	-	-	-
USSR	-	-	-	-	-	-	-
Total	30,103	30,973	39,176	54,665	44,605	41,716	40,020

Country	1988	1989	1990	1991	1992	1993	1994 [1]
Denmark	94	-	2	-	-	-	-
Faroe Islands							
Vb	44,402	43,624	59,821	53,321	35,979	32,719	32,406
IIa_4	258	269	988	963	165	-	-
France	313	473	626	283	1,999	9	10
German Dem.Rep.	-	9	-	-	-	-	-
Germany Fed.Rep.	74	20	15	32	5	3	-
Netherlands	-	22	67	65	-	-	-
Norway	52	51	46	103	34 [1]	34 [1]	156
UK (Eng. & W.)	-	-	-	5	74	280	-
UK (Scotland)	92	9	33	79	98	425	-
United Kingdom	-	-	-	-	-	-	604
USSR/Russia [2]	-	-	30	7	12	11	11
Total	45,285	44,477	61,628	54,863	38,366	33,481	33,187

[1] Provisional data
[2] As of 1991.

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

Table 2.5.4 Saithe in the Faroes. Catch numbers at age Numbers*10**-3.

Run title : Saithe in the Faroes (run: SAIFAS06/S06)

At 5-May-95 14:49:32

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

YEAR,	1960,	1961,	1962,	1963,	1964,
AGE					
3,	1647,	183,	562,	614,	684,
4,	383,	379,	542,	340,	1908,
5,	458,	483,	617,	340,	1506,
6,	443,	403,	495,	415,	617,
7,	243,	216,	286,	406,	572,
8,	210,	129,	131,	202,	424,
9,	158,	116,	129,	174,	179,
10,	80,	82,	113,	158,	150,
11,	29,	45,	71,	94,	100,
12,	28,	27,	29,	169,	83,
+gp,	76,	55,	76,	105,	91,
TOTALNUM,	3755,	2118,	3051,	3017,	6314,
TONSLAND,	11845,	9592,	10454,	12693,	21893,
SOPCOF %,	100,	108,	93,	96,	99,

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
3,	996,	488,	595,	614,	1191,	1445,	2857,	2714,	2515,	3504,
4,	850,	1540,	796,	1689,	2086,	6277,	3316,	1774,	6253,	4126,
5,	1708,	1201,	1364,	1116,	2294,	1558,	5585,	2588,	7075,	4011,
6,	965,	1686,	792,	1095,	1414,	1478,	1005,	2742,	3478,	2784,
7,	510,	806,	1192,	548,	1118,	899,	828,	1529,	1634,	1401,
8,	407,	377,	473,	655,	589,	730,	469,	1305,	693,	640,
9,	306,	294,	217,	254,	580,	316,	326,	1017,	550,	368,
10,	201,	205,	190,	128,	239,	241,	164,	743,	403,	340,
11,	156,	156,	97,	89,	115,	86,	100,	330,	215,	197,
12,	120,	94,	75,	59,	100,	48,	54,	133,	103,	124,
+gp,	165,	131,	65,	128,	90,	84,	46,	77,	83,	141,
TOTALNUM,	6384,	6978,	5856,	6375,	9816,	13162,	14750,	14952,	23002,	17636,
TONSLAND,	22181,	25563,	21319,	20387,	27437,	29110,	32706,	42186,	57574,	47188,
SOPCOF %,	92,	98,	104,	102,	97,	98,	109,	99,	120,	113,

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	2062,	3178,	1609,	611,	287,	996,	411,	387,	2483,	368,
4,	3361,	3217,	2937,	1743,	933,	877,	1804,	4076,	1103,	11067,
5,	3801,	1720,	2034,	1736,	1341,	720,	769,	994,	5052,	2359,
6,	1939,	1250,	1288,	548,	1033,	673,	932,	1114,	1343,	4093,
7,	1045,	877,	767,	373,	584,	726,	908,	380,	575,	875,
8,	714,	641,	708,	479,	414,	284,	734,	417,	339,	273,
9,	302,	468,	498,	466,	247,	212,	343,	296,	273,	161,
10,	192,	223,	338,	473,	473,	171,	192,	105,	98,	52,
11,	193,	141,	272,	407,	368,	196,	92,	88,	98,	65,
12,	126,	96,	129,	211,	206,	156,	128,	56,	99,	59,
+gp,	172,	191,	201,	324,	485,	630,	893,	846,	441,	194,
TOTALNUM,	13907,	12002,	10781,	7371,	6371,	5641,	7206,	8759,	11904,	19566,
TONSLAND,	41578,	33067,	34835,	28135,	27246,	25230,	30103,	30973,	39176,	54665,
SOPCOF %,	116,	107,	104,	100,	102,	99,	96,	96,	100,	100,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	1224,	1167,	1581,	866,	451,	294,	1030,	548,	1314,	690,
4,	3990,	1997,	5793,	2950,	5981,	3833,	5125,	4281,	2606,	3962,
5,	5583,	4473,	3827,	9555,	5300,	10120,	7452,	3860,	4680,	2663,
6,	1182,	3730,	2785,	2784,	7136,	9219,	5544,	2820,	1662,	2368,
7,	1898,	953,	990,	1300,	793,	5070,	3487,	1445,	856,	746,
8,	273,	1077,	532,	621,	546,	477,	1630,	941,	491,	500,
9,	103,	245,	333,	363,	185,	123,	405,	645,	447,	307,
10,	38,	104,	81,	159,	83,	61,	238,	129,	245,	303,
11,	26,	67,	43,	27,	55,	60,	128,	66,	54,	150,
12,	72,	33,	5,	43,	10,	18,	77,	39,	34,	28,
+gp,	203,	125,	92,	17,	29,	61,	41,	75,	18,	21,
TOTALNUM,	14592,	13971,	16062,	18685,	20569,	29336,	25157,	14849,	12407,	11738,
TONSLAND,	44605,	41716,	40020,	45285,	44477,	61561,	54863,	38366,	32639,	33187,
SOPCOF %,	94,	95,	96,	99,	97,	98,	99,	105,	99,	102,

Table 2.5.5 Saithe in the Faroes. Catch weights at age (kg).

Run title : Saithe in the Faroes (run: SAIFAS06/S06)

At 5-May-95 14:49:32

Table 2 Catch weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,
AGE					
3,	1.1480,	1.4300,	1.2730,	1.2800,	1.1750,
4,	2.5340,	2.3020,	2.0450,	2.1970,	2.0550,
5,	3.4030,	3.3480,	3.2930,	3.2120,	3.2660,
6,	4.2870,	4.2870,	4.1910,	4.5680,	4.2550,
7,	5.2200,	5.1280,	5.1460,	5.0560,	5.0380,
8,	6.1350,	6.1550,	5.6550,	5.9320,	5.6940,
9,	6.5330,	7.0600,	6.4690,	6.2590,	6.6620,
10,	8.0250,	7.2650,	6.7060,	8.0000,	6.8370,
11,	9.1540,	7.4970,	7.1500,	7.2650,	7.6860,
12,	8.8360,	8.1980,	7.9030,	8.5510,	8.3480,
+gp,	10.2190,	9.9000,	9.4510,	9.3540,	8.7520,
SOPCOFAC,	1.0005,	1.0779,	.9342,	.9591,	.9933,

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
3,	1.1810,	1.3610,	1.2730,	1.3020,	1.1880,	1.2440,	1.1010,	1.0430,	1.0880,	1.4300,
4,	2.1250,	2.0260,	1.7800,	1.7370,	1.6670,	1.4450,	1.3160,	1.4850,	1.4610,	1.5250,
5,	2.9410,	3.0550,	2.5340,	2.0360,	2.3020,	2.2490,	1.8180,	2.0550,	1.5820,	2.2070,
6,	4.0960,	3.6580,	3.5720,	3.1200,	2.8530,	2.8530,	2.9780,	2.8290,	2.2490,	2.5000,
7,	4.8780,	4.5850,	4.3680,	4.0490,	3.6730,	3.5150,	3.7020,	3.7910,	3.6870,	3.1200,
8,	5.9320,	5.5200,	5.3130,	5.1830,	5.0020,	4.4180,	4.2710,	4.1750,	4.3850,	4.6010,
9,	6.3210,	6.8370,	5.8120,	6.2380,	5.7140,	5.4440,	5.3880,	4.8080,	5.1280,	5.5590,
10,	7.2880,	7.2650,	6.5540,	7.5200,	6.4050,	5.7330,	5.9720,	5.2940,	5.2760,	5.7140,
11,	8.0740,	7.6620,	7.8060,	8.0490,	6.5540,	6.6620,	6.4900,	6.9480,	6.7270,	6.2590,
12,	7.8780,	8.1230,	7.5910,	8.6540,	7.5910,	7.3100,	7.1730,	6.7270,	7.3110,	6.8810,
+gp,	9.6490,	10.0130,	8.7940,	9.2950,	8.6380,	9.3130,	8.9810,	8.8750,	8.9240,	9.0040,
SOPCOFAC,	.9220,	.9769,	1.0357,	1.0194,	.9663,	.9774,	1.0935,	.9931,	1.2036,	1.1296,

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	1.1140,	1.0880,	1.2230,	1.4930,	1.2200,	1.2300,	1.3100,	1.3370,	1.2080,	1.4310,
4,	1.6580,	1.6760,	1.6410,	2.3240,	1.8800,	2.2100,	2.1300,	1.8510,	2.0290,	1.9530,
5,	2.2600,	2.8780,	2.6600,	3.0680,	2.6200,	3.3200,	3.0000,	2.9510,	2.9650,	2.4700,
6,	3.1200,	3.0810,	3.7900,	3.7460,	3.4000,	4.2800,	3.8100,	3.5770,	4.1430,	3.8500,
7,	3.5570,	4.2870,	4.2390,	4.9130,	4.1800,	5.1600,	4.7500,	4.9270,	4.7240,	5.1770,
8,	4.0960,	4.3520,	5.5970,	4.3680,	4.9500,	6.4200,	5.2500,	6.2430,	5.9010,	6.3470,
9,	5.1280,	4.7900,	5.3500,	5.2760,	5.6900,	6.8700,	5.9500,	7.2320,	6.8110,	7.8250,
10,	6.0940,	5.9120,	5.9120,	5.8320,	6.3800,	7.0900,	6.4300,	7.2390,	7.0510,	6.7460,
11,	7.1960,	6.6190,	6.8370,	6.0530,	7.0200,	7.9300,	7.0000,	8.3460,	7.2480,	8.6360,
12,	7.7820,	6.6190,	6.7270,	6.7060,	7.6200,	8.0700,	7.4700,	8.3450,	8.2920,	8.4670,
+gp,	9.1960,	8.5350,	8.3380,	8.1420,	9.2060,	9.4990,	9.1760,	10.1530,	10.4500,	10.5930,
SOPCOFAC,	1.1607,	1.0681,	1.0442,	1.0048,	1.0219,	.9906,	.9564,	.9635,	.9997,	.9991,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	1.4010,	1.7180,	1.6090,	1.5000,	1.3090,	1.2230,	1.2400,	1.2640,	1.4080,	1.5030,
4,	2.0320,	1.9860,	1.8350,	1.9750,	1.7350,	1.6330,	1.5860,	1.6020,	1.8600,	1.9510,
5,	2.9650,	2.6180,	2.3950,	1.9780,	1.9070,	1.8300,	1.8640,	2.0690,	2.3230,	2.2670,
6,	3.5960,	3.2770,	3.1820,	2.9370,	2.3730,	2.0520,	2.2110,	2.5540,	3.1310,	2.9360,
7,	5.3360,	4.1860,	4.0670,	3.7980,	3.8100,	2.8660,	2.6480,	3.0570,	3.7300,	4.2140,
8,	7.2020,	5.2890,	5.1490,	4.4190,	4.5670,	4.4740,	3.3800,	4.0780,	4.3940,	4.9710,
9,	6.9660,	6.0500,	5.5010,	5.1150,	5.5090,	5.4240,	4.8160,	5.0120,	5.2090,	5.6570,
10,	9.8620,	6.1500,	6.6260,	6.7120,	5.9720,	6.4690,	5.5160,	6.7680,	6.5400,	5.9500,
11,	10.6700,	9.5360,	6.3430,	8.0400,	6.9390,	6.3430,	6.4070,	7.7540,	8.4030,	6.8910,
12,	10.4610,	9.8230,	10.2450,	9.3640,	8.5430,	8.4180,	7.3950,	8.3030,	7.2750,	8.7520,
+gp,	12.4790,	10.3220,	10.2440,	8.0660,	10.4170,	8.2480,	8.3550,	8.2110,	9.5140,	9.5840,
SOPCOFAC,	.9415,	.9488,	.9620,	.9939,	.9710,	.9800,	.9922,	1.0496,	.9913,	1.0241,

Table 2.5.6 Saithe in the Faroes. Proportion mature at age.

Run title : Saithe in the Faroes (run: SAIFAS06/S06)

At 5-May-95 14:49:32

Table 5 Proportion mature at age

YEAR,	1960,	1961,	1962,	1963,	1964,
AGE					
3,	.0400,	.0400,	.0400,	.0400,	.0400,
4,	.2400,	.2400,	.2400,	.2400,	.2400,
5,	.5500,	.5500,	.5500,	.5500,	.5500,
6,	.8100,	.8100,	.8100,	.8100,	.8100,
7,	.9200,	.9200,	.9200,	.9200,	.9200,
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,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
3,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,
4,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,
5,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,
6,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,
7,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,
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,
12,	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,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0000,	.0000,
4,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.1300,	.4300,
5,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.4200,	.8400,
6,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	1.0000,	.9700,
7,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	1.0000,	1.0000,
8,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	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,
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,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	.0900,	.0400,	.2000,	.1000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.1900,	.5000,	.2500,	.2200,	.1800,	.2000,	.2100,	.0600,	.2300,	.2300,
5,	.4100,	.8800,	.3600,	.5200,	.6700,	.5300,	.4600,	.3300,	.6200,	.6200,
6,	.8500,	.9400,	.7900,	.7500,	.7100,	.5600,	.7700,	.7700,	.8100,	.8100,
7,	.9300,	1.0000,	1.0000,	.9100,	.8200,	.7500,	.8200,	.9200,	.9200,	.9200,
8,	1.0000,	1.0000,	1.0000,	.9200,	.8300,	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,
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,
+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 (Division Vb). Effort (fishing days) and catch at age in numbers (thousands) for eight Faroese pair trawlers ('Cuba' trawlers) in the 'Greater than 1000 HP' category, 1982-1994.

Year	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	Catch age 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

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output.

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Lowestoft VPA Version 3.1

   6-May-95  12:50:47

Extended Survivors Analysis

Saithe in the Faroes (run: SAIFAX12/X12)

CPUE data from file /users/fish/ifad/ifapwork/wg_109/sai_faro/FLEET.X12

Catch data for  35 years. 1960 to 1994. Ages  3 to  13.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,    year, year,  age ,  age
FLT02: CUBATRAWLERS ,   1982, 1994,    3,    12,   .000,  1.000


Time series weights :

     Tapered time weighting applied
     Power =    3 over  12 years


Catchability analysis :

     Catchability independent of stock size for all ages

     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   25 iterations



Regression weights
       , .193,  .348,  .515,  .670,  .798,  .893,  .954,  .986,  .998, 1.000



Fishing mortalities
   Age,  1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994

     3,  .063,  .021,  .036,  .021,  .017,  .015,  .044,  .037,  .041,  .024
     4,  .234,  .138,  .137,  .087,  .201,  .193,  .390,  .261,  .248,  .167
     5,  .504,  .449,  .426,  .350,  .221,  .618,  .704,  .579,  .509,  .434
     6,  .295,  .765,  .564,  .640,  .481,  .748,  .850,  .640,  .531,  .528
     7,  .577,  .411,  .466,  .565,  .373,  .769,  .721,  .556,  .404,  .485
     8,  .406,  .780,  .426,  .606,  .494,  .404,  .606,  .428,  .369,  .438
     9,  .260,  .797,  .591,  .585,  .361,  .193,  .728,  .516,  .371,  .417
    10,  .319,  .456,  .677,  .635,  .251,  .193,  .701,  .538,  .375,  .465
    11,  .319, 1.653,  .345,  .501,  .469,  .290,  .785,  .421,  .454,  .417
    12,  .311,  .874,  .486,  .700,  .348,  .274,  .750,  .587,  .400,  .452
```

(Continued)

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

XSA population numbers (Thousands)

YEAR	AGE 3	4	5	6	7	8	9	10	11	12
1985	2.22E+04	2.11E+04	1.56E+04	5.12E+03	4.78E+03	9.04E+02	4.97E+02	1.54E+02	1.05E+02	2.98E+02
1986	6.25E+04	1.71E+04	1.37E+04	7.71E+03	3.12E+03	2.20E+03	4.93E+02	3.14E+02	9.16E+01	6.26E+01
1987	4.97E+04	5.01E+04	1.22E+04	7.14E+03	2.94E+03	1.69E+03	8.25E+02	1.82E+02	1.63E+02	1.44E+01
1988	4.52E+04	3.93E+04	3.58E+04	6.51E+03	3.33E+03	1.51E+03	9.06E+02	3.74E+02	7.57E+01	9.44E+01
1989	3.00E+04	3.62E+04	2.95E+04	2.06E+04	2.81E+03	1.55E+03	6.75E+02	4.13E+02	1.62E+02	3.76E+01
1990	2.17E+04	2.41E+04	2.43E+04	1.94E+04	1.04E+04	1.58E+03	7.74E+02	3.85E+02	2.63E+02	8.31E+01
1991	2.63E+04	1.75E+04	1.63E+04	1.07E+04	7.50E+03	3.96E+03	8.66E+02	5.22E+02	2.60E+02	1.61E+02
1992	1.66E+04	2.06E+04	9.71E+03	6.60E+03	3.74E+03	2.99E+03	1.77E+03	3.42E+02	2.12E+02	9.71E+01
1993	3.63E+04	1.31E+04	1.30E+04	4.46E+03	2.85E+03	1.76E+03	1.59E+03	8.65E+02	1.64E+02	1.14E+02
1994	3.25E+04	2.85E+04	8.37E+03	6.38E+03	2.15E+03	1.56E+03	9.95E+02	9.01E+02	4.86E+02	8.51E+01

Estimated population abundance at 1st Jan 1995

, .00E+00, 2.60E+04, 1.97E+04, 4.44E+03, 3.08E+03, 1.08E+03, 8.23E+02, 5.36E+02, 4.63E+02, 2.63E+02,

Taper weighted geometric mean of the VPA populations:

, 3.00E+04, 2.41E+04, 1.56E+04, 8.60E+03, 3.87E+03, 1.95E+03, 9.62E+02, 4.52E+02, 2.00E+02, 8.20E+01,

Standard error of the weighted Log(VPA populations) :

, .3837, .4215, .5086, .5529, .5484, .3992, .4140, .5289, .5567, .6895,

Log catchability residuals.

Fleet : FLT02: CUBATRAWLERS

Age	1982	1983	1984
3	99.99	.65	.05
4	99.99	-.41	.90
5	99.99	-.08	-.49
6	99.99	-.06	-.02
7	99.99	-.07	.33
8	99.99	.59	-.11
9	99.99	1.12	.12
10	99.99	-.94	-1.18
11	99.99	.47	-1.14
12	99.99	.73	.50

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	.76	.22	.52	.03	.28	-.39	-.16	-1.01	.40	.34
4	.28	-.12	-.40	-.70	.29	-.35	.19	-.25	.54	.21
5	.65	.37	.09	-.23	-.56	.04	.06	-.20	.26	.18
6	-.23	.42	.13	.23	-.17	-.03	.01	-.28	-.01	.11
7	.35	.04	.14	.12	-.25	.15	.00	-.29	-.10	.19
8	.05	.76	.18	.21	.03	-.36	.02	-.51	.00	.28
9	-.21	.98	.47	.44	-.17	-.91	-.38	.05	-.05	.44
10	-.68	.31	.55	-.09	-.28	-1.07	.05	.06	.05	.48
11	.39	1.38	.11	-.63	.35	-.65	.46	-.21	.22	.35
12	.04	1.06	.30	-.76	.15	-.48	.28	-.27	.20	-.03

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	10	11	12
Mean Log q	-13.2172	-10.8862	-9.9917	-9.6701	-9.8202	-9.9691	-10.1174	-10.1174	-10.1174	-10.1174
S.E(Log q)	.5236	.4144	.2989	.1880	.1969	.3313	.5121	.5176	.5512	.4437

(Continued)

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(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
3,	.49,	2.679,	11.74,	.84,	12,	.18,	-13.22,
4,	1.99,	-1.373,	11.68,	.26,	12,	.77,	-10.89,
5,	1.39,	-1.261,	10.12,	.66,	12,	.40,	-9.99,
6,	1.08,	-.498,	9.72,	.89,	12,	.22,	-9.67,
7,	.96,	.297,	9.75,	.90,	12,	.20,	-9.82,
8,	1.29,	-.651,	10.66,	.49,	12,	.45,	-9.97,
9,	.99,	.018,	10.09,	.40,	12,	.55,	-10.12,
10,	.80,	.625,	9.36,	.64,	12,	.43,	-10.18,
11,	.97,	.070,	9.90,	.53,	12,	.57,	-10.03,
12,	1.10,	-.347,	10.73,	.67,	12,	.53,	-10.13,

Fleet disaggregated estimates of survivors :

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

Year class = 1991

FLT02: CUBATRAWLERS

Age,	3,
Survivors,	36535.,
Raw Weights,	3.140,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: CUBATRAWLERS ,	36535.,	.558,	.000,	.00,	1,	.440,	.017
F shrinkage mean ,	19893.,	.50,,,,				.560,	.031

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
25989.,	.37,	.46,	2,	1.222,	.024

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

Year class = 1990

FLT02: CUBATRAWLERS

Age,	4,	3,
Survivors,	24465.,	29419.,
Raw Weights,	4.345,	2.607,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: CUBATRAWLERS ,	26217.,	.346,	.089,	.26,	2,	.635,	.128
F shrinkage mean ,	12060.,	.50,,,,				.365,	.260

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
19743.,	.29,	.34,	3,	1.174,	.167

(Continued)

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

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

Year class = 1989

FLT02: CUBATRAWLERS
        Age,          5,           4,            3,
  Survivors,      5331.,       7619.,        1624.,
Raw Weights,      6.394,       2.592,        1.545,

Fleet,                     Estimated,    Int,        Ext,     Var,     N, Scaled,  Estimated
     ,                     Survivors,    s.e,        s.e,     Ratio,    , Weights,     F
FLT02: CUBATRAWLERS ,         4889.,     .237,       .340,     1.44,   3,  .725,      .401

  F shrinkage mean  ,         3443.,     .50,,,,                           .275,      .531

Weighted prediction :

Survivors,         Int,      Ext,     N,    Var,      F
at end of year,    s.e,      s.e,      ,    Ratio,
    4439.,         .22,      .26,     4,    1.178,   .434


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

Year class = 1988

FLT02: CUBATRAWLERS
        Age,          6,           5,            4,            3,
  Survivors,      3445.,       3983.,        2401.,        2638.,
Raw Weights,      6.555,       3.492,        1.383,         .801,

Fleet,                     Estimated,    Int,        Ext,     Var,     N, Scaled,  Estimated
     ,                     Survivors,    s.e,        s.e,     Ratio,    , Weights,     F
FLT02: CUBATRAWLERS ,         3387.,     .195,       .092,      .47,   4,  .754,      .490

  F shrinkage mean  ,         2312.,     .50,,,,                           .246,      .656

Weighted prediction :

Survivors,         Int,      Ext,     N,    Var,      F
at end of year,    s.e,      s.e,      ,    Ratio,
    3083.,         .19,      .12,     5,     .611,   .528


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

Year class = 1987

FLT02: CUBATRAWLERS
        Age,          7,           6,            5,            4,            3,
  Survivors,      1307.,       1071.,         885.,        1307.,         736.,
Raw Weights,      6.843,       4.017,        1.975,         .673,         .389,

Fleet,                     Estimated,    Int,        Ext,     Var,     N, Scaled,  Estimated
     ,                     Survivors,    s.e,        s.e,     Ratio,    , Weights,     F
FLT02: CUBATRAWLERS ,         1149.,     .179,       .080,      .45,   5,  .776,      .462

  F shrinkage mean  ,          880.,     .50,,,,                           .224,      .569

Weighted prediction :

Survivors,         Int,      Ext,     N,    Var,      F
at end of year,    s.e,      s.e,      ,    Ratio,
    1082.,         .18,      .08,     6,     .474,   .485
```

(Continued)

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

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

Year class = 1986

FLT02: CUBATRAWLERS

Age,	8,	7,	6,	5,	4,	3,
Survivors,	1090.,	747.,	624.,	874.,	578.,	1094.,
Raw Weights,	5.183,	4.781,	2.492,	1.058,	.425,	.234,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: CUBATRAWLERS ,	840.,	.175,	.100,	.57,	6,	.780,	.431
F shrinkage mean ,	767.,	.50,,,,				.220,	.464

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
823.,	.18,	.08,	7,	.472,	.438

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

Year class = 1985

FLT02: CUBATRAWLERS

Age,	9,	8,	7,	6,	5,	4,	3,
Survivors,	831.,	534.,	403.,	541.,	561.,	715.,	550.,
Raw Weights,	2.215,	3.651,	2.861,	1.183,	.530,	.201,	.104,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: CUBATRAWLERS ,	548.,	.187,	.102,	.55,	7,	.729,	.410
F shrinkage mean ,	507.,	.50,,,,				.271,	.437

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
536.,	.19,	.08,	8,	.427,	.417

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

Year class = 1984

FLT02: CUBATRAWLERS

Age,	10,	9,	8,	7,	6,	5,	4,	3,
Survivors,	745.,	441.,	277.,	463.,	450.,	266.,	229.,	780.,
Raw Weights,	2.068,	1.455,	2.239,	1.457,	.646,	.411,	.165,	.076,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: CUBATRAWLERS ,	434.,	.198,	.145,	.73,	8,	.680,	.490
F shrinkage mean ,	534.,	.50,,,,				.320,	.415

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
463.,	.21,	.12,	9,	.572,	.465

(Continued)

Table 2.5.8 Saithe in the Faroes (Division Vb). XSA diagnostic output. *(Continued).*

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1983

FLT02: CUBATRAWLERS

Age,	11,
Survivors,	372.,
Raw Weights,	1.913,

Age,	10,	9,	8,	7,	6,	5,	4,	3,
Survivors,	276.,	277.,	268.,	305.,	222.,	209.,	177.,	326.,
Raw Weights,	1.488,	.896,	1.130,	.678,	.375,	.197,	.069,	.028,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: CUBATRAWLERS ,	295.,	.229,	.060,	.26,	9,	.629,	.379
F shrinkage mean ,	216.,	.50,,,,				.371,	.488

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
263.,	.24,	.08,	10,	.330,	.417

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1982

FLT02: CUBATRAWLERS

Age,	12,	11,
Survivors,	43.,	55.,
Raw Weights,	2.850,	1.171,

Age,	10,	9,	8,	7,	6,	5,	4,	3,
Survivors,	47.,	30.,	31.,	34.,	56.,	48.,	39.,	95.,
Raw Weights,	.766,	.365,	.545,	.464,	.206,	.092,	.028,	.009,

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: CUBATRAWLERS ,	43.,	.247,	.062,	.25,	10,	.619,	.462
F shrinkage mean ,	46.,	.50,,,,				.381,	.436

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
44.,	.24,	.05,	11,	.199,	.452

FLT02: CUBATRAWLERS

CPUE adjusted to start of year

	AGE									
YEAR ,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12,
1982 ,	.0000E+00,	.0000E+00,	.0000E+00,	.0000E+00,	.0000E+00,	.0000E+00,	.0000E+00,	.0000E+00,	.0000E+00,	.0000E+00,
1983 ,	.1432E+00,	.1497E+00,	.7686E+00,	.2380E+00,	.8814E-01,	.6918E-01,	.6567E-01,	.1009E-01,	.2269E-01,	.2448E-01,
1984 ,	.4994E-01,	.1442E+01,	.2486E+00,	.6385E+00,	.1562E+00,	.3807E-01,	.1657E-01,	.2296E-02,	.5611E-02,	.1318E-01,
1985 ,	.8640E-01,	.5218E+00,	.1361E+01,	.2579E+00,	.3679E+00,	.4467E-01,	.1631E-01,	.3141E-02,	.6284E-02,	.1252E-01,
1986 ,	.1413E+00,	.2848E+00,	.9032E+00,	.7416E+00,	.1764E+00,	.2199E+00,	.5301E-01,	.1729E-01,	.1475E-01,	.7298E-02,
1987 ,	.1523E+00,	.6303E+00,	.6095E+00,	.5137E+00,	.1842E+00,	.9545E-01,	.5338E-01,	.1278E-01,	.7362E-02,	.7843E-03,
1988 ,	.8434E-01,	.3636E+00,	.1301E+01,	.5192E+00,	.2048E+00,	.8713E-01,	.5671E-01,	.1384E-01,	.1632E-02,	.1779E-02,
1989 ,	.7249E-01,	.9034E+00,	.7745E+00,	.1103E+01,	.1186E+00,	.7437E-01,	.2306E-01,	.1265E-01,	.9312E-02,	.1764E-02,
1990 ,	.2687E-01,	.3170E+00,	.1160E+01,	.1186E+01,	.6590E+00,	.5198E-01,	.1263E-01,	.5315E-02,	.5560E-02,	.2069E-02,
1991 ,	.4088E-01,	.3962E+00,	.7922E+00,	.6811E+00,	.4070E+00,	.1893E+00,	.2397E-01,	.2216E-01,	.1663E-01,	.8584E-02,
1992 ,	.1105E-01,	.2998E+00,	.3635E+00,	.3159E+00,	.1527E+00,	.8364E-01,	.7537E-01,	.1464E-01,	.6950E-02,	.2991E-02,
1993 ,	.9827E-01,	.4206E+00,	.7670E+00,	.2787E+00,	.1405E+00,	.8192E-01,	.6128E-01,	.3669E-01,	.8261E-02,	.5645E-02,
1994 ,	.8312E-01,	.6608E+00,	.4599E+00,	.4503E+00,	.1408E+00,	.9662E-01,	.6218E-01,	.5850E-01,	.2781E-01,	.3324E-02,

Table 2.5.9 Saithe in the Faroes (Division Vb). Fishing mortality at age 1960-1994.

Run title : Saithe in the Faroes (run: SAIFAX12/X12)

At 6-May-95 12:52:45

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,
AGE					
3,	.1726,	.0234,	.0458,	.0335,	.0503,
4,	.0577,	.0544,	.0896,	.0352,	.1383,
5,	.1054,	.0959,	.1179,	.0746,	.2155,
6,	.1494,	.1272,	.1347,	.1085,	.1882,
7,	.1046,	.1009,	.1251,	.1560,	.2143,
8,	.1163,	.0742,	.0819,	.1221,	.2424,
9,	.0634,	.0869,	.0988,	.1491,	.1515,
10,	.1304,	.0424,	.1143,	.1688,	.1854,
11,	.0630,	.1005,	.0469,	.1313,	.1534,
12,	.0859,	.0768,	.0869,	.1503,	.1641,
+gp,	.0859,	.0768,	.0869,	.1503,	.1641,
FBAR 4- 8,	.1067,	.0905,	.1098,	.0993,	.1997,

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
3,	.0500,	.0250,	.0272,	.0324,	.0341,	.0498,	.0881,	.0923,	.1221,	.2165,
4,	.0816,	.1018,	.0517,	.1006,	.1469,	.2529,	.1546,	.0724,	.3177,	.3015,
5,	.1769,	.1587,	.1232,	.0952,	.1931,	.1560,	.3751,	.1736,	.4552,	.3467,
6,	.2085,	.2657,	.1491,	.1377,	.1679,	.1835,	.1427,	.3187,	.3728,	.3245,
7,	.2346,	.2698,	.3049,	.1461,	.2034,	.1531,	.1483,	.3355,	.3191,	.2514,
8,	.2328,	.2727,	.2511,	.2735,	.2313,	.1983,	.1114,	.3677,	.2493,	.1982,
9,	.2769,	.2630,	.2490,	.2072,	.4158,	.1869,	.1274,	.3742,	.2598,	.2029,
10,	.2540,	.3025,	.2711,	.2278,	.3074,	.3033,	.1396,	.4754,	.2480,	.2536,
11,	.2995,	.3204,	.2283,	.1962,	.3295,	.1722,	.1979,	.4592,	.2422,	.1840,
12,	.2783,	.2970,	.2508,	.2114,	.3531,	.2219,	.1556,	.4394,	.2513,	.2145,
+gp,	.2783,	.2970,	.2508,	.2114,	.3531,	.2219,	.1556,	.4394,	.2513,	.2145,
FBAR 4- 8,	.1869,	.2138,	.1760,	.1506,	.1885,	.1888,	.1864,	.2536,	.3428,	.2845,

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.1455,	.1921,	.1478,	.0863,	.0363,	.0923,	.0138,	.0287,	.0694,	.0157,
4,	.3330,	.3543,	.2732,	.2367,	.1841,	.1485,	.2406,	.1841,	.1067,	.4961,
5,	.5041,	.2836,	.3980,	.2573,	.2890,	.2113,	.1880,	.2022,	.3654,	.3484,
6,	.2806,	.3055,	.3566,	.1754,	.2398,	.2300,	.4653,	.4558,	.4617,	.5735,
7,	.1933,	.1972,	.3117,	.1644,	.2871,	.2648,	.5552,	.3496,	.4526,	.6291,
8,	.1959,	.1740,	.2420,	.3271,	.2773,	.2200,	.4691,	.5385,	.6089,	.4034,
9,	.1351,	.1903,	.1989,	.2486,	.2793,	.2230,	.4511,	.3493,	.8452,	.6662,
10,	.1547,	.1397,	.2045,	.2948,	.4305,	.3181,	.3234,	.2397,	.1852,	.3697,
11,	.2233,	.1626,	.2529,	.4060,	.3942,	.3179,	.2825,	.2405,	.3693,	.1801,
12,	.1717,	.1649,	.2198,	.3183,	.3704,	.2879,	.3546,	.2780,	.4678,	.3982,
+gp,	.1717,	.1649,	.2198,	.3183,	.3704,	.2879,	.3546,	.2780,	.4678,	.3982,
FBAR 4- 8,	.3014,	.2629,	.3163,	.2322,	.2555,	.2149,	.3836,	.3461,	.3991,	.4901,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
3,	.0628,	.0209,	.0358,	.0214,	.0168,	.0151,	.0443,	.0372,	.0409,	.0237,	.0339,
4,	.2344,	.1383,	.1367,	.0866,	.2014,	.1930,	.3904,	.2614,	.2483,	.1669,	.2255,
5,	.5038,	.4489,	.4265,	.3498,	.2214,	.6183,	.7042,	.5785,	.5089,	.4336,	.5070,
6,	.2945,	.7647,	.5637,	.6397,	.4814,	.7476,	.8502,	.6395,	.5310,	.5277,	.5661,
7,	.5774,	.4114,	.4657,	.5651,	.3735,	.7691,	.7209,	.5562,	.4035,	.4847,	.4815,
8,	.4061,	.7800,	.4261,	.6059,	.4938,	.4045,	.6063,	.4279,	.3693,	.4380,	.4117,
9,	.2600,	.7966,	.5910,	.5848,	.3610,	.1932,	.7277,	.5157,	.3709,	.4173,	.4346,
10,	.3188,	.4560,	.6770,	.6347,	.2509,	.1925,	.7008,	.5385,	.3755,	.4648,	.4596,
11,	.3190,	1.6530,	.3450,	.5010,	.4692,	.2901,	.7854,	.4214,	.4537,	.4167,	.4306,
12,	.3106,	.8737,	.4859,	.6996,	.3485,	.2736,	.7499,	.5871,	.4002,	.4520,	.4798,
+gp,	.3106,	.8737,	.4859,	.6996,	.3485,	.2736,	.7499,	.5871,	.4002,	.4520,	
0 FBAR 4- 8,	.4033,	.5087,	.4037,	.4494,	.3543,	.5465,	.6544,	.4927,	.4122,	.4102,	

Table 2.5.10 Saithe in the Faroes (Division Vb). Stock in numbers at age, 1960-1994.

Run title : Saithe in the Faroes (run: SAIFAX12/X12)

At 6-May-95 12:52:45

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1960,	1961,	1962,	1963,	1964,
AGE					
3,	11479,	8736,	13889,	20621,	15396,
4,	7553,	7908,	6987,	10863,	16328,
5,	5060,	5837,	6132,	5230,	8586,
6,	3527,	3729,	4342,	4462,	3974,
7,	2703,	2487,	2688,	3107,	3278,
8,	2113,	1994,	1841,	1942,	2177,
9,	2841,	1540,	1515,	1389,	1407,
10,	723,	2183,	1156,	1124,	980,
11,	525,	520,	1713,	844,	777,
12,	376,	403,	385,	1338,	606,
+gp,	1018,	819,	1006,	828,	662,
TOTAL,	37920,	36157,	41654,	51748,	54170,

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
3,	22574,	21876,	24474,	21283,	39232,	32844,	37449,	34011,	24177,	19892,
4,	11986,	17581,	17469,	19499,	16870,	31043,	25583,	28076,	25390,	17519,
5,	11642,	9044,	13000,	13582,	14436,	11924,	19736,	17945,	21381,	15130,
6,	5667,	7986,	6318,	9410,	10110,	9744,	8353,	11105,	12350,	11104,
7,	2696,	3767,	5013,	4456,	6713,	6998,	6640,	5929,	6611,	6965,
8,	2166,	1745,	2355,	3025,	3153,	4485,	4916,	4687,	3471,	3934,
9,	1398,	1405,	1088,	1500,	1884,	2048,	3011,	3601,	2657,	2215,
10,	990,	868,	884,	694,	998,	1018,	1391,	2170,	2028,	1677,
11,	666,	629,	525,	552,	453,	601,	615,	990,	1105,	1296,
12,	546,	404,	374,	342,	371,	267,	414,	413,	512,	710,
+gp,	746,	560,	322,	739,	332,	464,	351,	237,	410,	803,
TOTAL,	61076,	65865,	71821,	75082,	94552,	101435,	108460,	109165,	100093,	81244,

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	16834,	20094,	12939,	8166,	8897,	12489,	33170,	15137,	40940,	26182,
4,	13116,	11917,	13576,	9138,	6133,	7025,	9324,	26785,	12043,	31272,
5,	10610,	7697,	6846,	8458,	5904,	4177,	4958,	6001,	18242,	8862,
6,	8758,	5248,	4745,	3765,	5354,	3621,	2769,	3363,	4014,	10364,
7,	6572,	5416,	3165,	2720,	2586,	3449,	2355,	1423,	1746,	2071,
8,	4434,	4435,	3641,	1897,	1889,	1589,	2167,	1107,	822,	909,
9,	2642,	2985,	3051,	2340,	1120,	1172,	1044,	1110,	529,	366,
10,	1480,	1890,	2020,	2047,	1494,	694,	768,	544,	641,	186,
11,	1066,	1038,	1345,	1348,	1248,	795,	413,	455,	351,	436,
12,	882,	698,	723,	855,	735,	689,	474,	255,	293,	199,
+gp,	1199,	1382,	1120,	1304,	1718,	2765,	3281,	3828,	1292,	647,
TOTAL,	67594,	62800,	53171,	42039,	37080,	38464,	60722,	60009,	80911,	81493,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 60-92	AMST 60-92
AGE													
3,	22222,	62474,	49729,	45211,	29978,	21731,	26263,	16603,	36253,	32506,	0,	21894,	24757,
4,	21103,	17087,	50094,	39284,	36232,	24136,	17525,	20570,	13098,	28493,	25989,	16519,	19000,
5,	15589,	13667,	12182,	35772,	29494,	24252,	16293,	9711,	12968,	8365,	19743,	10908,	12648,
6,	5121,	7712,	7143,	6511,	20642,	19352,	10699,	6596,	4458,	6383,	4439,	6597,	7514,
7,	4782,	3123,	2939,	3328,	2812,	10443,	7502,	3743,	2849,	2146,	3083,	3805,	4249,
8,	904,	2198,	1695,	1510,	1548,	1585,	3962,	2987,	1757,	1558,	1082,	2251,	2524,
9,	497,	493,	825,	906,	675,	774,	866,	1769,	1594,	995,	823,	1359,	1596,
10,	154,	314,	182,	374,	413,	385,	522,	342,	865,	901,	536,	799,	1010,
11,	105,	92,	163,	76,	162,	263,	260,	212,	164,	486,	463,	503,	656,
12,	298,	63,	14,	94,	38,	83,	161,	97,	114,	85,	263,	308,	428,
+gp,	835,	233,	262,	37,	108,	280,	85,	185,	60,	63,	77,		
TOTAL,	71610,	107455,	125227,	133103,	122102,	103283,	84139,	62817,	74180,	81981,	56500,		

Table 2.5.11 Saithe in the Faroes (Division Vb). Spawning stock biomass at age (spawning time) Tonnes

Run title : Saithe in the Faroes (run: SAIFAX12/X12)

At 6-May-95 12:52:45

Terminal Fs derived using XSA (With F shrinkage)

Table 13 Spawning stock biomass at age (spawning time) Tonnes

YEAR,	1960,	1961,	1962,	1963,	1964,
AGE					
3,	527,	500,	707,	1056,	724,
4,	4593,	4369,	3429,	5728,	8053,
5,	9471,	10749,	11105,	9239,	15423,
6,	12249,	12948,	14740,	16509,	13698,
7,	12983,	11734,	12727,	14453,	15191,
8,	12706,	12025,	10202,	11290,	12145,
9,	18560,	10874,	9803,	8692,	9375,
10,	5806,	15859,	7752,	8992,	6697,
11,	4805,	3898,	12249,	6133,	5974,
12,	3324,	3308,	3042,	11444,	5060,
+gp,	10401,	8113,	9505,	7745,	5791,
TOTSPBIO,	95424,	94376,	95263,	101282,	98132,

YEAR,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,
AGE										
3,	1066,	1191,	1246,	1108,	1864,	1634,	1649,	1419,	1052,	1138,
4,	6113,	8548,	7463,	8129,	6749,	10766,	8080,	10006,	8903,	6412,
5,	18831,	15197,	18119,	15209,	18278,	14750,	19734,	20282,	18604,	18365,
6,	18802,	23662,	18280,	23780,	23364,	22517,	20149,	25447,	22499,	22485,
7,	12097,	15888,	20144,	16600,	22685,	22631,	22615,	20680,	22424,	19991,
8,	12591,	9442,	12259,	15367,	15454,	19417,	20577,	19178,	14916,	17738,
9,	8839,	9606,	6323,	9355,	10767,	11150,	16224,	17312,	13624,	12312,
10,	7217,	6306,	5796,	5222,	6392,	5836,	8307,	11490,	10698,	9585,
11,	5379,	4818,	4099,	4444,	2967,	4003,	3994,	6881,	7431,	8109,
12,	4301,	3284,	2837,	2961,	2820,	1949,	2971,	2781,	3745,	4885,
+gp,	7197,	5605,	2832,	6865,	2866,	4322,	3155,	2105,	3662,	7230,
TOTSPBIO,	102433,	103547,	99398,	109040,	114206,	118973,	127454,	137581,	127559,	128250,

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	750,	874,	633,	488,	434,	614,	1738,	810,	0,	0,
4,	5219,	4794,	5347,	5097,	2767,	3726,	4766,	11899,	3176,	26262,
5,	13188,	12183,	10016,	14271,	8508,	7628,	8181,	9740,	22717,	18386,
6,	22133,	13096,	14568,	11423,	14744,	12552,	8544,	9745,	16630,	38704,
7,	21506,	21361,	12344,	12293,	9946,	16371,	10293,	6452,	8247,	10722,
8,	17800,	18916,	19969,	8122,	9165,	9998,	11147,	6771,	4848,	5769,
9,	13547,	14296,	16324,	12346,	6373,	8053,	6212,	8025,	3602,	2863,
10,	9021,	11171,	11943,	11941,	9533,	4917,	4937,	3941,	4517,	1254,
11,	7669,	6873,	9198,	8160,	8763,	6307,	2892,	3797,	2542,	3764,
12,	6867,	4620,	4860,	5736,	5604,	5561,	3540,	2128,	2428,	1681,
+gp,	11028,	11800,	9337,	10620,	15816,	26264,	30107,	38866,	13505,	6857,
TOTSPBIO,	128729,	119983,	114538,	100497,	91655,	101992,	92356,	102174,	82212,	116263,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	2802,	4293,	16003,	6782,	0,	0,	0,	0,	0,	0,
4,	8147,	16967,	22980,	17069,	11315,	7883,	5837,	1977,	5603,	12786,
5,	18951,	31487,	10504,	36793,	37684,	23522,	13970,	6631,	18677,	11758,
6,	15652,	23755,	17955,	14343,	34777,	22238,	18215,	12972,	11307,	15179,
7,	23730,	13073,	11952,	11502,	8785,	22447,	16290,	10528,	9777,	8321,
8,	6510,	11623,	8725,	6140,	5869,	7090,	13393,	12182,	7722,	7745,
9,	3463,	2983,	4537,	4634,	3717,	4196,	4170,	8868,	8305,	5626,
10,	1517,	1930,	1206,	2510,	2469,	2491,	2880,	2317,	5657,	5360,
11,	1122,	873,	1033,	609,	1126,	1670,	1666,	1645,	1375,	3352,
12,	3118,	615,	147,	884,	321,	700,	1193,	806,	829,	745,
+gp,	10415,	2409,	2680,	297,	1126,	2309,	708,	1515,	569,	606,
TOTSPBIO,	95428,	110010,	97723,	101563,	107190,	94545,	78321,	59441,	69820,	71477,

Table 2.5.12 Saithe in the Faroes (Division Vb). Summary of population statistics, 1960-1994.

Run title : Saithe in the Faroes (run: SAIFAX12/X12)

At 6-May-95 12:52:45

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 8,
1960,	11479,	134632,	95424,	11845,	.1241,	.1067,
1961,	8736,	133301,	94376,	9592,	.1016,	.0905,
1962,	13889,	136954,	95262,	10454,	.1097,	.1098,
1963,	20621,	157678,	101282,	12693,	.1253,	.0993,
1964,	15396,	158399,	98132,	21893,	.2231,	.1997,
1965,	22574,	168510,	102433,	22181,	.2165,	.1869,
1966,	21876,	178758,	103547,	25563,	.2469,	.2138,
1967,	24474,	174052,	99398,	21319,	.2145,	.1760,
1968,	21283,	181162,	109040,	20387,	.1870,	.1506,
1969,	39232,	203045,	114206,	27437,	.2402,	.1885,
1970,	32844,	212001,	118973,	29110,	.2447,	.1888,
1971,	37449,	215882,	127454,	32706,	.2566,	.1864,
1972,	34011,	228075,	137581,	42186,	.3066,	.2536,
1973,	24177,	203757,	127559,	57574,	.4514,	.3428,
1974,	19892,	198264,	128250,	47188,	.3679,	.2845,
1975,	16834,	181475,	128729,	41578,	.3230,	.3014,
1976,	20094,	171434,	119983,	33067,	.2756,	.2629,
1977,	12939,	159754,	114538,	34835,	.3041,	.3163,
1978,	8166,	143932,	100497,	28135,	.2800,	.2322,
1979,	8897,	122310,	91655,	27246,	.2973,	.2555,
1980,	12489,	139349,	101992,	25230,	.2474,	.2149,
1981,	33170,	158983,	92356,	30103,	.3259,	.3836,
1982,	15137,	170238,	102175,	30973,	.3031,	.3461,
1983,	40940,	184296,	82212,	39176,	.4765,	.3991,
1984,	26182,	193241,	116263,	54665,	.4702,	.4901,
1985,	22222,	190313,	95428,	44605,	.4674,	.4033,
1986,	62474,	235825,	110010,	41716,	.3792,	.5087,
1987,	49729,	254122,	97723,	40020,	.4095,	.4037,
1988,	45211,	263531,	101563,	45285,	.4459,	.4494,
1989,	29978,	233875,	107190,	44477,	.4149,	.3543,
1990,	21731,	198467,	94545,	61561,	.6511,	.5465,
1991,	26263,	158262,	78321,	54863,	.7005,	.6544,
1992,	16603,	129656,	59441,	38366,	.6454,	.4927,
1993,	36253,	154572,	69820,	32639,	.4675,	.4122,
1994,	32506,	174627,	71477,	33187,	.4643,	.4102,
Arith. Mean ,	25307,	180078,	102538,	33539,	.3361,	.3033,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.5.13 Saithe in the Faroes (Division Vb). Prediction with management option tables: input data.

10:03 Tuesday, May 9, 1995

Saithe in the Faroes Grounds (Fishing Area Vb)

Prediction with management option table: Input data

Year: 1995								
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	28000.000	0.2000	0.0700	0.0000	0.0000	1.392	0.0237	1.392
4	22388.000	0.2000	0.2700	0.0000	0.0000	2.003	0.1669	2.003
5	15247.000	0.2000	0.8100	0.0000	0.0000	2.488	0.4336	2.488
6	4439.000	0.2000	0.8900	0.0000	0.0000	3.055	0.5277	3.055
7	3083.000	0.2000	0.9800	0.0000	0.0000	3.971	0.4847	3.971
8	1082.000	0.2000	1.0000	0.0000	0.0000	5.550	0.4380	5.550
9	823.000	0.2000	1.0000	0.0000	0.0000	5.293	0.4173	5.293
10	536.000	0.2000	1.0000	0.0000	0.0000	6.419	0.4648	6.419
11	463.000	0.2000	1.0000	0.0000	0.0000	7.683	0.4167	7.683
12	263.000	0.2000	1.0000	0.0000	0.0000	8.110	0.4520	8.110
13+	77.000	0.2000	1.0000	0.0000	0.0000	9.103	0.4520	9.103
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
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	28000.000	0.2000	0.0400	0.0000	0.0000	1.392	0.0237	1.392
4	.	0.2000	0.2400	0.0000	0.0000	1.892	0.1669	1.892
5	.	0.2000	0.5700	0.0000	0.0000	2.540	0.4336	2.540
6	.	0.2000	0.8200	0.0000	0.0000	3.276	0.5277	3.276
7	.	0.2000	0.9200	0.0000	0.0000	4.090	0.4847	4.090
8	.	0.2000	0.9800	0.0000	0.0000	5.307	0.4380	5.307
9	.	0.2000	1.0000	0.0000	0.0000	6.892	0.4173	6.892
10	.	0.2000	1.0000	0.0000	0.0000	6.700	0.4648	6.700
11	.	0.2000	1.0000	0.0000	0.0000	7.827	0.4167	7.827
12	.	0.2000	1.0000	0.0000	0.0000	8.271	0.4520	8.271
13+	.	0.2000	1.0000	0.0000	0.0000	9.555	0.4520	9.555
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	28000.000	0.2000	0.0400	0.0000	0.0000	1.392	0.0237	1.392
4	.	0.2000	0.2400	0.0000	0.0000	1.892	0.1669	1.892
5	.	0.2000	0.5700	0.0000	0.0000	2.429	0.4336	2.429
6	.	0.2000	0.8200	0.0000	0.0000	3.329	0.5277	3.329
7	.	0.2000	0.9200	0.0000	0.0000	4.311	0.4847	4.311
8	.	0.2000	0.9800	0.0000	0.0000	5.426	0.4380	5.426
9	.	0.2000	1.0000	0.0000	0.0000	6.649	0.4173	6.649
10	.	0.2000	1.0000	0.0000	0.0000	8.299	0.4648	8.299
11	.	0.2000	1.0000	0.0000	0.0000	8.108	0.4167	8.108
12	.	0.2000	1.0000	0.0000	0.0000	8.416	0.4520	8.416
13+	.	0.2000	1.0000	0.0000	0.0000	9.717	0.4520	9.717
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SAIFR023
Date and time: 09MAY95:10:05

Table 2.5.14 Saithe in the Faroes (Division Vb). Prediction with management option tables.

Saithe in the Faroes Grounds (Fishing Area Vb) 10:03 Tuesday, May 9, 1995

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
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
1.2469	0.5115	167750	89823	42000	0.0000	0.0000	169251	78523	0	219605	120668
.	.	.	.	.	0.1000	0.0410	.	78523	4344	214544	116424
.	.	.	.	.	0.2000	0.0820	.	78523	8518	209689	112362
.	.	.	.	.	0.3000	0.1231	.	78523	12528	205031	108472
.	.	.	.	.	0.4000	0.1641	.	78523	16383	200561	104748
.	.	.	.	.	0.5000	0.2051	.	78523	20087	196271	101182
.	.	.	.	.	0.6000	0.2461	.	78523	23649	192152	97767
.	.	.	.	.	0.7000	0.2871	.	78523	27074	188198	94497
.	.	.	.	.	0.8000	0.3281	.	78523	30369	184400	91363
.	.	.	.	.	0.9000	0.3692	.	78523	33538	180753	88362
.	.	.	.	.	1.0000	0.4102	.	78523	36587	177249	85486
.	.	.	.	.	1.1000	0.4512	.	78523	39521	173882	82730
.	.	.	.	.	1.2000	0.4922	.	78523	42346	170647	80089
.	.	.	.	.	1.3000	0.5332	.	78523	45066	167537	77557
.	.	.	.	.	1.4000	0.5743	.	78523	47684	164547	75130
.	.	.	.	.	1.5000	0.6153	.	78523	50207	161672	72803
.	.	.	.	.	1.6000	0.6563	.	78523	52637	158906	70571
.	.	.	.	.	1.7000	0.6973	.	78523	54979	156246	68431
.	.	.	.	.	1.8000	0.7383	.	78523	57236	153686	66378
.	.	.	.	.	1.9000	0.7793	.	78523	59412	151223	64409
.	.	.	.	.	2.0000	0.8204	.	78523	61510	148851	62520
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : SAIFR023
Date and time : 09MAY95:10:05
Computation of ref. F: Simple mean, age 4 - 8
Basis for 1995 : TAC constraints

Table 2.5.15 Saithe in the Faroes (Division Vb). Yield per recruit: input data.

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	0.0400	0.0000	0.0000	1.296	0.1136	1.296
4	.	0.2000	0.2400	0.0000	0.0000	1.864	0.2664	1.864
5	.	0.2000	0.5700	0.0000	0.0000	2.563	0.4133	2.563
6	.	0.2000	0.8200	0.0000	0.0000	3.353	0.4699	3.353
7	.	0.2000	0.9200	0.0000	0.0000	4.245	0.4540	4.245
8	.	0.2000	0.9797	0.0000	0.0000	5.138	0.4474	5.138
9	.	0.2000	1.0000	0.0000	0.0000	5.898	0.4469	5.898
10	.	0.2000	1.0000	0.0000	0.0000	6.603	0.4405	6.603
11	.	0.2000	1.0000	0.0000	0.0000	7.434	0.4512	7.434
12	.	0.2000	1.0000	0.0000	0.0000	8.050	0.4512	8.050
13+	.	0.2000	1.0000	0.0000	0.0000	9.368	0.4512	9.368
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SAIFR024
Date and time: 07MAY95:20:43

Table 2.5.16 Saithe in the Faroes (Division Vb). Yield per recruit: Summary table.

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	23408.285	3.504	19743.360	3.504	19743.360
0.1000	0.0410	0.147	656.255	4.785	18087.097	2.803	14512.238	2.803	14512.238
0.2000	0.0820	0.249	1017.685	4.277	14648.287	2.324	11157.289	2.324	11157.289
0.3000	0.1231	0.324	1225.917	3.903	12285.771	1.977	8873.022	1.977	8873.022
0.4000	0.1641	0.382	1349.209	3.616	10586.158	1.716	7246.571	1.716	7246.571
0.5000	0.2051	0.429	1423.132	3.387	9318.124	1.512	6047.079	1.512	6047.079
0.6000	0.2461	0.466	1467.315	3.201	8343.539	1.349	5136.834	1.349	5136.834
0.7000	0.2871	0.498	1493.081	3.046	7575.644	1.217	4429.447	1.217	4429.447
0.8000	0.3282	0.525	1507.197	2.915	6957.676	1.106	3868.485	1.106	3868.485
0.9000	0.3692	0.548	1513.827	2.802	6451.217	1.014	3415.829	1.014	3415.829
1.0000	0.4102	0.568	1515.599	2.703	6029.513	0.934	3044.990	0.934	3044.990
1.1000	0.4512	0.585	1514.203	2.617	5673.460	0.866	2737.102	0.866	2737.102
1.2000	0.4922	0.601	1510.749	2.540	5369.123	0.807	2478.445	0.807	2478.445
1.3000	0.5333	0.615	1505.972	2.471	5106.138	0.755	2258.849	0.755	2258.849
1.4000	0.5743	0.628	1500.368	2.409	4876.663	0.709	2070.646	0.709	2070.646
1.5000	0.6153	0.640	1494.274	2.352	4674.677	0.668	1907.971	0.668	1907.971
1.6000	0.6563	0.651	1487.919	2.301	4495.485	0.632	1766.274	0.632	1766.274
1.7000	0.6973	0.660	1481.461	2.253	4335.387	0.599	1641.983	0.599	1641.983
1.8000	0.7384	0.669	1475.005	2.210	4191.427	0.569	1532.260	0.569	1532.260
1.9000	0.7794	0.678	1468.625	2.169	4061.222	0.543	1434.830	0.543	1434.830
2.0000	0.8204	0.686	1462.369	2.132	3942.831	0.518	1347.848	0.518	1347.848
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : SAIFRO24
Date and time : 07MAY95:20:43
Computation of ref. F: Simple mean, age 4 - 8
F-0.1 factor : 0.4122
F-max factor : 0.9988
F-0.1 reference F : 0.1691
F-max reference F : 0.4097
Recruitment : Single recruit

Table 3.2.1 Nominal catch (tonnes) of SAITHE in Division Va, by countries, 1981-1994, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987
Belgium	532	201	224	269	158	218	217
Faroe Islands	3,545	3,582	2,138	2,044	1,778	783	2,139
France	-	23	-	-	-	-	-
Iceland	54,921	65,124	55,904	60,406	55,135	63,867	78,175
Norway	3	1	+	-	1	-	-
UK (Engl. and Wales)	-	-	-	-	29	-	-
Total	59,001	68,931	58,266	62,719	57,101	64,868	80,531
Working Group estimate	-	-	-	-	-	66,376 [2]	-

Country	1988	1989	1990	1991	1992	1993	1994 [1]
Belgium	268	369	190	236	195	104	30
Faroe Islands	2,596	2,246	2,905	2,690	1,570	1,562	975
France	-	-	-	-	-	-	-
Iceland	74,383	79,796	95,032	99,390	77,832	69,982	62,722
Norway	-	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-
Total	77,247	82,411	98,127	102,316	79,597	71,648	63,727
Working Group estimate	-	-	-	102,737 [3]	-		64,549 [4]

1) Provisional.

2) Additional catch by Faroe Islands of 1,508 t included.

3) Additional catch by Iceland of 451 t included.

4) Additional catch by Iceland of 822 t included.

Table 3.2.2: Icelandic saithe, catch in numbers.

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Run title : Saithe in the Icelan (run: GG5/E3)
At  7-May-95  19:55:00
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YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	526,	329,	59,	548,	480,	275,	203,	508,	107,	53,
4,	2997,	3234,	2099,	1145,	3764,	2540,	1325,	1092,	1750,	657,
5,	2479,	3045,	2858,	2435,	1991,	5214,	3503,	2804,	1065,	800,
6,	1829,	2530,	1801,	1556,	3616,	2596,	5404,	4845,	2455,	1825,
7,	3496,	2154,	1036,	1275,	1566,	2169,	1457,	4293,	4454,	2184,
8,	2994,	2367,	1068,	961,	718,	1341,	1415,	1215,	2311,	3610,
9,	1434,	1530,	1528,	537,	292,	387,	578,	975,	501,	844,
10,	710,	1064,	958,	575,	669,	262,	242,	306,	251,	376,
11,	325,	295,	538,	476,	589,	155,	61,	59,	38,	291,
12,	176,	191,	166,	279,	489,	112,	154,	35,	12,	135,
13,	100,	94,	71,	139,	150,	64,	135,	48,	2,	185,
14,	36,	68,	12,	91,	72,	33,	128,	46,	4,	226,
+gp,	61,	18,	49,	55,	0,	58,	141,	99,	174,	190,
0 TOTALNUM,	17163,	16919,	12243,	10072,	14396,	15206,	14746,	16325,	13124,	11376,
TONSLAND,	87954,	82003,	62026,	49672,	63504,	58347,	58986,	68615,	58266,	62719,
SOPCOF %,	100,	97,	98,	97,	98,	100,	99,	99,	99,	100,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	376,	3108,	956,	1318,	315,	143,	198,	242,	657,	701,
4,	4014,	1400,	5135,	5067,	4313,	1692,	874,	2928,	1083,	2955,
5,	3366,	4170,	4428,	6619,	8471,	5471,	3613,	3844,	2841,	1771,
6,	1958,	2665,	5409,	3678,	7309,	10112,	6844,	4355,	2252,	2610,
7,	1536,	1550,	2915,	2859,	1794,	6174,	10772,	3884,	2247,	1384,
8,	1172,	1116,	1348,	1775,	1928,	1816,	3223,	4046,	2314,	1249,
9,	747,	628,	661,	845,	848,	1087,	858,	1290,	3671,	1270,
10,	479,	1549,	496,	226,	270,	380,	838,	350,	830,	2011,
11,	74,	216,	498,	270,	191,	151,	228,	196,	223,	455,
12,	23,	51,	58,	107,	135,	55,	40,	56,	188,	159,
13,	72,	30,	27,	24,	76,	76,	6,	54,	81,	189,
14,	71,	14,	48,	1,	10,	37,	5,	15,	12,	82,
+gp,	291,	95,	22,	1,	8,	42,	42,	1,	1,	52,
0 TOTALNUM,	14179,	16592,	22001,	22790,	25668,	27236,	27541,	21261,	16400,	14888,
TONSLAND,	57101,	66376,	80559,	77247,	82425,	98130,	102737,	79597,	71648,	64549,
SOPCOF %,	99,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 3.2.3: Icelandic saithe, catch weights at age.

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Run title : Saithe in the Icelan (run: GG5/E3)
At  7-May-95  19:55:00
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YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	1.1200,	1.1200,	1.1200,	1.1200,	1.1200,	1.4280,	1.5850,	1.5470,	1.5300,	1.6530,
4,	1.7600,	1.7600,	1.7600,	1.7600,	1.7600,	1.9830,	2.0370,	2.1940,	2.2210,	2.4320,
5,	2.7300,	2.7300,	2.7300,	2.7300,	2.7300,	2.6670,	2.6960,	3.0150,	3.1710,	3.3300,
6,	4.2900,	4.2900,	4.2900,	4.2900,	4.2900,	3.6890,	3.5250,	3.1830,	4.2700,	4.6810,
7,	5.5400,	5.5400,	5.5400,	5.5400,	5.5400,	5.4090,	4.5410,	5.1140,	4.1070,	5.4660,
8,	7.2700,	7.2700,	7.2700,	7.2700,	7.2700,	6.3210,	6.2470,	6.2020,	5.9840,	4.9730,
9,	8.4200,	8.4200,	8.4200,	8.4200,	8.4200,	7.2130,	6.9910,	7.2560,	7.5650,	7.4070,
10,	9.4100,	9.4100,	9.4100,	9.4100,	9.4100,	8.5650,	8.2020,	7.9220,	8.6730,	8.1790,
11,	10.0000,	10.0000,	10.0000,	10.0000,	10.0000,	9.1470,	9.5370,	8.9240,	8.8010,	8.7700,
12,	10.5600,	10.5600,	10.5600,	10.5600,	10.5600,	9.6170,	9.0890,	10.1340,	9.0390,	8.8310,
13,	11.8700,	11.8700,	11.8700,	11.8700,	11.8700,	10.0660,	9.3510,	9.4470,	11.1380,	11.0100,
14,	13.1200,	13.1200,	13.1200,	13.1200,	13.1200,	11.0410,	10.2250,	10.5350,	9.8180,	11.1270,
+gp,	14.0000,	14.0000,	14.0000,	14.0000,	13.1200,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,
0 SOPCOFAC,	.9996,	.9706,	.9769,	.9691,	.9840,	.9989,	.9933,	.9922,	.9915,	.9975,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	1.6090,	1.4500,	1.5160,	1.2610,	1.4030,	1.6470,	1.2240,	1.2690,	1.3810,	1.4450,
4,	2.1720,	2.1900,	1.7150,	2.0170,	2.0210,	1.9830,	1.9390,	1.9090,	2.1430,	1.8370,
5,	3.1690,	2.9590,	2.6700,	2.5130,	2.1940,	2.5660,	2.4320,	2.5780,	2.7420,	2.6500,
6,	3.9220,	4.4020,	3.8390,	3.4760,	3.0470,	3.0210,	3.1600,	3.2880,	3.6360,	3.5140,
7,	4.6970,	5.4880,	5.0810,	4.7190,	4.5050,	4.0770,	3.6340,	4.1500,	4.3980,	4.9090,
8,	6.4110,	6.4060,	6.1850,	5.9320,	5.8890,	5.7440,	4.9670,	4.8650,	5.4210,	5.5420,
9,	6.4920,	7.5700,	7.3300,	7.5230,	7.1720,	7.0380,	6.6290,	6.1680,	5.3190,	6.8200,
10,	8.3460,	6.4870,	8.0250,	8.4390,	8.8520,	7.5640,	7.7040,	7.9260,	7.0060,	6.3790,
11,	9.4010,	9.6160,	7.9740,	8.7480,	10.1700,	8.8540,	9.0610,	8.3490,	8.0700,	8.3440,
12,	10.3350,	10.4620,	9.6150,	9.5590,	10.3920,	10.6450,	9.1170,	9.0290,	10.0480,	9.7690,
13,	11.0270,	11.7470,	12.2460,	10.8240,	12.5220,	11.6740,	10.9220,	11.5740,	9.1060,	10.5260,
14,	10.6440,	11.9020,	11.6560,	14.0990,	11.9230,	11.4310,	11.3420,	9.4660,	11.5910,	11.2550,
+gp,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,	13.0000,
0 SOPCOFAC,	.9929,	.9987,	1.0005,	.9999,	.9998,	1.0005,	.9999,	1.0002,	1.0013,	1.0015,

Table 3.2.4. Icelandic Saithe. Maturity at age, data and fitted values.

Fitted:

Year	a3	a4	a5	a6	a7	a8	a9
1980	0.1034	0.153	0.3381	0.6777	0.8197	0.9266	0.9703
1981	0.1174	0.2265	0.3145	0.5647	0.8423	0.9203	0.9698
1982	0.1137	0.2525	0.4265	0.5381	0.7671	0.9313	0.967
1983	0.0938	0.2458	0.4618	0.6538	0.7474	0.8932	0.9718
1984	0.0722	0.2082	0.4529	0.6854	0.8275	0.8826	0.9551
1985	0.0908	0.165	0.4005	0.6777	0.847	0.9241	0.9502
1986	0.0466	0.2024	0.3341	0.6291	0.8423	0.9336	0.9687
1987	0.0214	0.1104	0.3919	0.5603	0.8116	0.9313	0.9727
1988	0.0611	0.0526	0.2396	0.6207	0.7639	0.9163	0.9718
1989	0.0938	0.1418	0.1235	0.4445	0.8061	0.8915	0.9653
1990	0.1067	0.2082	0.2955	0.2635	0.6702	0.9135	0.9543
1991	0.0954	0.2328	0.4005	0.5159	0.4761	0.8377	0.964
1992	0.1156	0.2112	0.4352	0.6291	0.7302	0.6977	0.9291
1993	0.0851	0.2492	0.4048	0.6619	0.8116	0.873	0.8543
1994	0.0851	0.1911	0.4573	0.6333	0.8325	0.9163	0.9458

Data:

Year	a3	a4	a5	a6	a7	a8	a9
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

Table 3.2.5: Icelandic saithe, proportions mature at age.

Run title : Saithe in the Icelan (run: GG5/E3)
At 7-May-95 19:55:00

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.1030,	.1170,	.1140,	.0940,	.0720,
4,	.0600,	.0600,	.0600,	.0600,	.0600,	.1530,	.2270,	.2520,	.2460,	.2080,
5,	.2700,	.2700,	.2700,	.2700,	.2700,	.3380,	.3150,	.4260,	.4620,	.4530,
6,	.6300,	.6300,	.6300,	.6300,	.6300,	.6780,	.5650,	.5380,	.6540,	.6850,
7,	.8100,	.8100,	.8100,	.8100,	.8100,	.8200,	.8420,	.7670,	.7470,	.8270,
8,	.9700,	.9700,	.9700,	.9700,	.9700,	.9720,	.9200,	.9310,	.8930,	.8830,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9700,	.9700,	.9670,	.9720,	.9550,
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,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	.0910,	.0470,	.0210,	.0610,	.0940,	.1070,	.0950,	.1160,	.0850,	.0850,
4,	.1650,	.2020,	.1100,	.0530,	.1420,	.2080,	.2330,	.2110,	.2490,	.1910,
5,	.4000,	.3340,	.3920,	.2400,	.1230,	.2960,	.4000,	.4350,	.4050,	.4570,
6,	.6700,	.6290,	.5600,	.6210,	.4440,	.2640,	.5160,	.6290,	.6620,	.6330,
7,	.8470,	.8420,	.8120,	.7640,	.8060,	.6701,	.4760,	.7300,	.8120,	.8320,
8,	.9240,	.9340,	.9310,	.9160,	.8910,	.9140,	.8380,	.6980,	.8730,	.9160,
9,	.9500,	.9690,	.9730,	.9720,	.9650,	.9540,	.9640,	.9290,	.8540,	.9460,
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: Icelandic saithe, tuning data.

12:48 Monday, May 8, 1995

Saithe in the Iceland Grounds (Fishing Area Va)

TRW EFFORT (code: FLT04)

Year	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	37	631	963	2509	1911	1649	1251	2206	458	105	132	67
1994	35	677	2828	1622	1943	715	601	616	1216	273	91	199

12:48 Monday, May 8, 1995

Saithe in the Iceland Grounds (Fishing Area Va)

TRW CPU JAN.- MAY (code: FLT06)

Year	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	.0052
1981	100	0.0279	0.1012	0.2176	0.0473	0.0140	0.0035	0.0013	.0003
1982	100	0.0213	0.1374	0.0556	0.0638	0.0262	0.0164	0.0033	.0016
1983	100	0.0095	0.0278	0.0723	0.1359	0.0380	0.0037	0.0007	.0000
1984	100	0.0394	0.0516	0.0446	0.0298	0.0840	0.0053	0.0026	.0000
1985	100	0.0095	0.0589	0.0364	0.0524	0.0349	0.0182	0.0044	.0007
1986	100	0.0277	0.2478	0.0703	0.0203	0.0018	0.0000	0.0018	.0000
1987	100	0.1257	0.0864	0.1132	0.0440	0.0149	0.0039	0.0031	.0016
1988	100	0.0189	0.1013	0.0774	0.0700	0.0280	0.0206	0.0049	.0074
1989	100	0.0097	0.0434	0.1263	0.0531	0.0381	0.0179	0.0060	.0022
1990	100	0.0211	0.0484	0.1039	0.0899	0.0192	0.0123	0.0062	.0052
1991	100	0.0059	0.0387	0.0783	0.1292	0.0412	0.0135	0.0126	.0042
1992	100	0.0235	0.0483	0.0713	0.0736	0.0734	0.0185	0.0037	.0016
1993	100	0.0048	0.0242	0.0546	0.0710	0.0520	0.0480	0.0112	.0026
1994	100	0.0373	0.0319	0.0637	0.0301	0.0267	0.0224	0.0396	.0057

12:48 Monday, May 8, 1995

Saithe in the Iceland Grounds (Fishing Area Va)

TRW CPU JUNE - DES. (code: FLT08)

Year	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	.0058	.0040
1981	100	0.0114	0.0517	0.1159	0.1249	0.0270	0.0098	0.0031	0.0023	.0000	.0008
1982	100	0.0098	0.0242	0.0600	0.1590	0.0585	0.0103	0.0025	0.0015	.0003	.0008
1983	100	0.0045	0.1260	0.0386	0.0379	0.0932	0.0186	0.0013	0.0006	.0000	.0000
1984	100	0.0019	0.0139	0.0057	0.0368	0.0152	0.0780	0.0063	0.0082	.0076	.0038
1985	100	0.0105	0.1504	0.0900	0.0561	0.0197	0.0055	0.0105	0.0055	.0000	.0000
1986	100	0.0716	0.0284	0.0734	0.0400	0.0248	0.0144	0.0122	0.0160	.0077	.0025
1987	100	0.0236	0.0721	0.0676	0.0575	0.0409	0.0216	0.0112	0.0070	.0039	.0008
1988	100	0.0173	0.1087	0.1042	0.0592	0.0343	0.0159	0.0048	0.0007	.0007	.0003
1989	100	0.0022	0.0557	0.1058	0.0947	0.0156	0.0118	0.0088	0.0037	.0033	.0028
1990	100	0.0047	0.0305	0.0928	0.1423	0.0435	0.0064	0.0022	0.0006	.0006	.0000
1991	100	0.0026	0.0118	0.0440	0.0875	0.1380	0.0353	0.0041	0.0041	.0002	.0000
1992	100	0.0027	0.0505	0.0703	0.0687	0.0550	0.0530	0.0142	0.0023	.0011	.0002
1993	100	0.0142	0.0232	0.0628	0.0383	0.0261	0.0211	0.0540	0.0105	.0023	.0008
1994	100	0.0198	0.0428	0.0321	0.0377	0.0160	0.0139	0.0126	0.0382	.0056	.0013

Table 3.2.7: Icelandic saithe, XSA tuning results.

Lowestoft VPA Version 3.1

7-May-95 19:36:00

Extended Survivors Analysis

Saithe in the Icelan (run: TUNE4/E1)

CPUE data from file /users/fish/ifad/ifapwork/wg_109/sai_icel/FLEET.E1

Catch data for 25 years. 1970 to 1994. Ages 3 to 13.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT04: TRW EFFORT ,	1980,	1994,	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 23 iterations

1

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

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
3,	.012,	.047,	.009,	.025,	.010,	.007,	.008,	.014,	.014,	.014
4,	.121,	.056,	.102,	.062,	.106,	.071,	.055,	.149,	.080,	.079
5,	.200,	.177,	.251,	.185,	.139,	.190,	.213,	.361,	.211,	.183
6,	.254,	.241,	.368,	.342,	.321,	.246,	.386,	.429,	.373,	.306
7,	.361,	.328,	.453,	.338,	.279,	.496,	.450,	.396,	.412,	.415
8,	.361,	.488,	.532,	.556,	.402,	.507,	.527,	.302,	.435,	.425
9,	.216,	.334,	.607,	.773,	.570,	.417,	.479,	.414,	.496,	.455
10,	.709,	.944,	.483,	.428,	.607,	.545,	.669,	.366,	.515,	.561
11,	.382,	.840,	.960,	.532,	.802,	.845,	.757,	.317,	.421,	.600
12,	.510,	.496,	.565,	.549,	.560,	.567,	.561,	.415,	.575,	.609

1

XSA population numbers (Thousands)

	AGE									
YEAR ,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12,
1985 ,	3.51E+04,	3.91E+04,	2.05E+04,	9.64E+03,	5.60E+03,	4.28E+03,	4.25E+03,	1.04E+03,	2.58E+02,	6.36E+01,
1986 ,	7.48E+04,	2.84E+04,	2.83E+04,	1.37E+04,	6.12E+03,	3.20E+03,	2.44E+03,	2.80E+03,	4.20E+02,	1.44E+02,
1987 ,	1.15E+05,	5.85E+04,	2.20E+04,	1.94E+04,	8.84E+03,	3.61E+03,	1.61E+03,	1.43E+03,	8.92E+02,	1.48E+02,
1988 ,	5.93E+04,	9.36E+04,	4.32E+04,	1.40E+04,	1.10E+04,	4.60E+03,	1.73E+03,	7.17E+02,	7.23E+02,	2.80E+02,

Continued

Table 3.2.7 Continued

1989 ,	3.37E+04,	4.74E+04,	7.20E+04,	2.94E+04,	8.15E+03,	6.43E+03,	2.16E+03,	6.56E+02,	3.83E+02,	3.48E+02,
1990 ,	2.22E+04,	2.73E+04,	3.49E+04,	5.13E+04,	1.75E+04,	5.05E+03,	3.52E+03,	9.99E+02,	2.93E+02,	1.40E+02,
1991 ,	2.88E+04,	1.81E+04,	2.08E+04,	2.36E+04,	3.29E+04,	8.70E+03,	2.49E+03,	1.90E+03,	4.74E+02,	1.03E+02,
1992 ,	1.92E+04,	2.34E+04,	1.40E+04,	1.38E+04,	1.31E+04,	1.71E+04,	4.21E+03,	1.26E+03,	7.97E+02,	1.82E+02,
1993 ,	5.34E+04,	1.55E+04,	1.65E+04,	7.99E+03,	7.35E+03,	7.24E+03,	1.04E+04,	2.28E+03,	7.17E+02,	4.75E+02,
1994 ,	5.67E+04,	4.31E+04,	1.17E+04,	1.09E+04,	4.50E+03,	3.99E+03,	3.84E+03,	5.18E+03,	1.11E+03,	3.85E+02,

Estimated population abundance at 1st Jan 1995

, .00E+00, 4.58E+04, 3.26E+04, 7.99E+03, 6.59E+03, 2.43E+03, 2.13E+03, 1.99E+03, 2.42E+03, 5.00E+02,

Taper weighted geometric mean of the VPA populations:

, 3.97E+04, 3.09E+04, 2.24E+04, 1.58E+04, 9.50E+03, 5.46E+03, 2.74E+03, 1.29E+03, 4.98E+02, 1.93E+02,

Standard error of the weighted Log(VPA populations) :

, .5358, .5397, .5473, .5470, .5677, .5150, .5865, .6805, .6153, .7675,

1

Log catchability residuals.

Fleet : FLT04: TRW EFFORT

Age ,	1980,	1981,	1982,	1983,	1984
3 ,	.39,	.64,	1.13,	-.52,	-1.58
4 ,	.26,	.40,	.47,	.66,	-.85
5 ,	.64,	.18,	.41,	-.26,	-.90
6 ,	.58,	.79,	.20,	.03,	-.15
7 ,	.42,	.51,	.27,	.35,	-.37
8 ,	.57,	-.10,	.11,	.53,	.64
9 ,	.61,	-.20,	-.09,	.09,	.03
10 ,	.96,	.93,	-.15,	-.70,	1.11
11 ,	.22,	-1.09,	.85,	-4.06,	1.91
12 ,	.67,	-1.05,	1.13,	-1.61,	1.30

Age ,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
3 ,	.22,	1.10,	-.45,	.41,	-.16,	-.49,	-.50,	.25,	.13,	.16
4 ,	.60,	-.11,	.22,	-.35,	.10,	-.52,	-.75,	.51,	.01,	.12
5 ,	.24,	.21,	.27,	-.08,	-.46,	-.36,	-.20,	.54,	.15,	.10
6 ,	-.02,	-.22,	.09,	.03,	-.12,	-.60,	-.08,	.23,	.21,	-.06
7 ,	.17,	.05,	.03,	-.15,	-.57,	-.01,	.02,	.07,	.15,	-.14
8 ,	-.05,	.16,	.18,	.02,	-.69,	-.26,	.07,	-.24,	-.01,	-.09
9 ,	-.35,	-.04,	.19,	.40,	-.02,	-.52,	-.24,	.03,	.30,	.06
10 ,	.42,	.29,	-.34,	-.71,	.01,	-.41,	.02,	-.39,	.01,	.24
11 ,	-.71,	.99,	-.04,	-.18,	.56,	.56,	.27,	-.68,	-.19,	.46
12 ,	-2.30,	.67,	-.06,	-.51,	.35,	.05,	-.32,	-.54,	.51,	.42

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,	-6.2666,	-5.4465,	-4.9820,	-4.9635,	-5.0572,	-5.1351,	-4.8924,	-5.0439,	-5.0439,
S.E(Log q),	.4786,	.3900,	.2898,	.2650,	.3327,	.2764,	.5165,	1.2012,	.9351,

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,	.75,	.650,	8.81,	.40,	15,	.69,	-8.21,

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,	1.00,	-.018,	6.25,	.56,	15,	.51,	-6.27,
5,	1.21,	-.790,	4.48,	.59,	15,	.48,	-5.45,
6,	1.35,	-1.736,	3.35,	.72,	15,	.36,	-4.98,

Continued

Table 3.2.7 Continued

7,	.97,	.233,	5.11,	.83,	15,	.27,	-4.96,
8,	1.14,	-.560,	4.57,	.64,	15,	.39,	-5.06,
9,	1.06,	-.382,	4.96,	.80,	15,	.31,	-5.14,
10,	.98,	.068,	4.93,	.65,	15,	.53,	-4.89,
11,	1.01,	-.010,	5.04,	.19,	15,	1.27,	-5.04,
12,	.59,	2.027,	5.16,	.71,	15,	.48,	-5.13,

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Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT ,	53723.,	.730,	.000,	.00,	1,	.199,	.012
P shrinkage mean ,	30898.,	.54,,,,				.370,	.020
F shrinkage mean ,	59580.,	.50,,,,				.431,	.011

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
45780.,	.33,	.24,	3,	.740,	.014

1

Age 4 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 ,	36934.,	.411,	.001,	.00,	2,	.577,	.070
F shrinkage mean ,	27587.,	.50,,,,				.423,	.093

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
32641.,	.32,	.13,	3,	.422,	.079

Age 5 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 ,	8783.,	.289,	.054,	.19,	3,	.705,	.168
F shrinkage mean ,	6380.,	.50,,,,				.295,	.224

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7993.,	.25,	.11,	4,	.425,	.183

1

Age 6 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 ,	6897.,	.212,	.138,	.65,	4,	.785,	.294
F shrinkage mean ,	5572.,	.50,,,,				.215,	.353

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6588.,	.20,	.12,	5,	.591,	.306

Continued

Table 3.2.7 Continued

Age 7 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 ,	2423.,	.180,	.164,	.91,	5,	.799,	.417
F shrinkage mean ,	2476.,	.50,,,,				.201,	.409

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2434.,	.18,	.13,	6,	.746,	.415

1

Age 8 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 ,	2154.,	.167,	.087,	.52,	6,	.799,	.422
F shrinkage mean ,	2058.,	.50,,,,				.201,	.438

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2134.,	.17,	.07,	7,	.430,	.425

Age 9 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 ,	2022.,	.157,	.045,	.29,	7,	.812,	.450
F shrinkage mean ,	1871.,	.50,,,,				.188,	.479

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1993.,	.16,	.04,	8,	.252,	.455

1

Age 10 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 ,	2389.,	.154,	.123,	.80,	8,	.755,	.566
F shrinkage mean ,	2512.,	.50,,,,				.245,	.545

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2419.,	.17,	.10,	9,	.593,	.561

Age 11 Catchability constant w.r.t. time and dependent on age

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT ,	523.,	.169,	.051,	.30,	9,	.631,	.581
F shrinkage mean ,	465.,	.50,,,,				.369,	.634

Continued

Table 3.2.7

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
500.,	.21,	.04,	10,	.210,	.600

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Age 12 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
FLT04: TRW EFFORT ,	142.,	.177,	.093,	.52,	10,	.588,	.700
F shrinkage mean ,	225.,	.50,,,,				.412,	.495

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
172.,	.23,	.11,	11,	.497,	.609

Table 3.2.8: Icelandic saithe, XSA tuning results.

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Lowestoft VPA Version 3.1

   7-May-95  19:45:12

 Extended Survivors Analysis

 Saithe in the Icelan (run: TUNE5/E2)

 CPUE data from file /users/fish/ifad/ifapwork/wg_109/sai_icel/FLEET.E2

 Catch data for  25 years. 1970 to 1994. Ages  3 to  13.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                  ,     year, year,  age ,  age
 FLT06: TRW CPU JAN.-,   1980, 1994,   4,    11,   .000,   .420
 FLT08: TRW CPU JUNE ,   1980, 1994,   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   25 iterations

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



 Fishing mortalities
   Age, 1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994

     3,  .012,  .047,  .009,  .025,  .010,  .007,  .008,  .015,  .014,  .013
     4,  .121,  .056,  .102,  .062,  .106,  .066,  .051,  .147,  .086,  .083
     5,  .199,  .178,  .252,  .185,  .141,  .189,  .197,  .328,  .208,  .198
     6,  .253,  .239,  .370,  .343,  .321,  .249,  .383,  .385,  .326,  .300
     7,  .360,  .325,  .448,  .342,  .279,  .496,  .458,  .391,  .352,  .341
     8,  .359,  .486,  .525,  .545,  .408,  .508,  .526,  .310,  .429,  .337
     9,  .216,  .332,  .603,  .753,  .549,  .427,  .481,  .413,  .514,  .445
    10,  .707,  .944,  .478,  .424,  .576,  .512,  .696,  .368,  .514,  .597
    11,  .397,  .834,  .960,  .524,  .786,  .760,  .672,  .338,  .425,  .597
    12,  .412,  .528,  .558,  .550,  .546,  .545,  .460,  .339,  .638,  .619


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Continued

Table 3.2.8 Continued

XSA population numbers (Thousands)

YEAR	3	4	5	6	7	8	9	10	11	12
1985	3.51E+04	3.89E+04	2.06E+04	9.70E+03	5.61E+03	4.29E+03	4.25E+03	1.04E+03	2.50E+02	7.53E+01
1986	7.49E+04	2.84E+04	2.82E+04	1.38E+04	6.17E+03	3.20E+03	2.46E+03	2.80E+03	4.22E+02	1.37E+02
1987	1.14E+05	5.85E+04	2.20E+04	1.93E+04	8.93E+03	3.65E+03	1.61E+03	1.44E+03	8.92E+02	1.50E+02
1988	5.96E+04	9.28E+04	4.32E+04	1.40E+04	1.09E+04	4.67E+03	1.77E+03	7.23E+02	7.32E+02	2.80E+02
1989	3.60E+04	4.76E+04	7.14E+04	2.94E+04	8.14E+03	6.35E+03	2.22E+03	6.81E+02	3.88E+02	3.55E+02
1990	2.40E+04	2.92E+04	3.51E+04	5.08E+04	1.75E+04	5.04E+03	3.46E+03	1.05E+03	3.13E+02	1.45E+02
1991	2.92E+04	1.95E+04	2.24E+04	2.37E+04	3.24E+04	8.71E+03	2.48E+03	1.85E+03	5.15E+02	1.20E+02
1992	1.80E+04	2.37E+04	1.52E+04	1.50E+04	1.33E+04	1.68E+04	4.22E+03	1.26E+03	7.54E+02	2.15E+02
1993	5.08E+04	1.45E+04	1.67E+04	8.95E+03	8.38E+03	7.33E+03	1.01E+04	2.28E+03	7.12E+02	4.40E+02
1994	5.86E+04	4.10E+04	1.09E+04	1.11E+04	5.29E+03	4.83E+03	3.91E+03	4.94E+03	1.12E+03	3.81E+02

Estimated population abundance at 1st Jan 1995

.00E+00	4.74E+04	3.09E+04	7.33E+03	6.76E+03	3.08E+03	2.82E+03	2.05E+03	2.23E+03	5.04E+02

Taper weighted geometric mean of the VPA populations:

4.00E+04	3.10E+04	2.26E+04	1.61E+04	9.74E+03	5.55E+03	2.75E+03	1.29E+03	5.07E+02	2.02E+02

Standard error of the weighted Log(VPA populations) :

.5336	.5355	.5465	.5299	.5425	.5017	.5777	.6630	.6005	.7215

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Log catchability residuals.

Fleet : FLT06: TRW CPU JAN.-

Age	1980	1981	1982	1983	1984
3	No data for this fleet at this age				
4	.65	.67	.77	-.06	.89
5	.42	.14	1.12	-.09	.47
6	.18	.90	-.73	.26	.10
7	-.40	.42	.04	.39	-.37
8	.14	-.33	.58	.45	.66
9	-.06	-.65	.57	-.52	-.72
10	1.28	-.43	-.12	-1.20	.06
11	.25	99.99	1.14	99.99	99.99
12	No data for this fleet at this age				

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	No data for this fleet at this age									
4	-.86	.47	1.26	-1.10	-1.06	.16	-.69	.52	-.57	.39
5	.14	1.25	.46	-.07	-1.43	-.60	-.36	.26	-.55	.16
6	-.22	.09	.26	.19	-.06	-.81	-.31	.05	.30	.23
7	.48	-.57	-.13	.11	.12	-.07	-.34	-.02	.39	-.01
8	.50	-2.04	-.15	.23	.20	-.24	-.01	-.14	.38	.12
9	-.16	99.99	-.62	.98	.56	-.32	.18	-.06	.02	.17
10	-.05	-1.68	-.70	.48	.76	.31	.56	-.30	.14	.68
11	-.41	99.99	-.88	.49	-.08	1.05	.31	-.83	-.35	-.08
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	-18.8538	-17.4229	-16.7987	-16.5637	-16.7108	-16.7317	-16.8440	-16.5035
S.E(Log q)	.7911	.6945	.3927	.3142	.6534	.5053	.7417	.6661

Regression statistics :

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

Continued

Table 3.2.8 Continued

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4,	1.26,	-.445,	21.08,	.23,	15,	1.04,	-18.85,
5,	2.50,	-1.678,	28.48,	.11,	15,	1.60,	-17.42,
6,	1.92,	-2.639,	23.33,	.46,	15,	.60,	-16.80,
7,	1.14,	-.670,	17.60,	.70,	15,	.37,	-16.56,
8,	.73,	.856,	14.57,	.52,	15,	.49,	-16.71,
9,	.98,	.059,	16.58,	.58,	14,	.52,	-16.73,
10,	1.12,	-.311,	18.05,	.39,	15,	.87,	-16.84,
11,	2.53,	-1.768,	32.12,	.16,	11,	1.50,	-16.50,

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Fleet : FLT08: TRW CPU JUNE

Age	1980	1981	1982	1983	1984
3	-1.17,	.94,	.77,	-.11,	-1.18
4	-1.11,	.51,	.12,	1.71,	-.94
5	-.05,	.21,	.26,	.17,	-1.78
6	.16,	.54,	.45,	-.24,	.04
7	.72,	.34,	.53,	.49,	-.58
8	.86,	-.21,	.11,	.29,	1.08
9	1.56,	-.38,	-.43,	-1.36,	.04
10	1.93,	.65,	-.39,	-1.12,	1.34
11	.48,	99.99,	99.99,	99.99,	2.01
12	.99,	-.61,	.91,	99.99,	1.19

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	.36,	.98,	-.26,	.15,	-.90,	.17,	-.39,	.09,	.17,	.28
4	1.09,	-.32,	-.07,	-.14,	-.11,	-.24,	-.80,	.52,	.18,	-.24
5	.53,	-.01,	.22,	-.08,	-.59,	.03,	-.27,	.67,	.39,	.13
6	.37,	-.34,	-.21,	.11,	-.17,	-.36,	.01,	.23,	.11,	-.13
7	.01,	.11,	.32,	-.14,	-.64,	-.25,	.25,	.18,	-.14,	-.17
8	-.87,	.35,	.70,	.15,	-.54,	-.93,	.30,	-.09,	-.11,	-.16
9	-.24,	.48,	1.00,	.22,	.44,	-1.59,	-.53,	.15,	.70,	.17
10	.57,	.73,	.25,	-1.05,	.50,	-1.36,	-.41,	-.94,	.26,	.79
11	99.99,	1.54,	.18,	-1.30,	.61,	-.29,	99.99,	-1.46,	-.65,	.11
12	99.99,	1.47,	.30,	99.99,	.53,	99.99,	99.99,	99.99,	-.72,	-.59

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,	-17.9338,	-17.1958,	-16.7153,	-16.7630,	-16.8190,	-16.9398,	-16.6126,	-16.2977,	-16.2977,
S.E(Log q),	.6704,	.5712,	.2612,	.3634,	.5681,	.7815,	.9050,	1.1146,	.9325,

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,	.72,	.761,	17.31,	.44,	15,	.64,	-19.88,

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,	1.26,	-.525,	19.91,	.30,	15,	.87,	-17.93,
5,	1.22,	-.541,	18.74,	.39,	15,	.72,	-17.20,
6,	1.22,	-1.217,	18.25,	.76,	15,	.31,	-16.72,
7,	.86,	.777,	15.69,	.76,	15,	.32,	-16.76,
8,	1.00,	-.001,	16.82,	.42,	15,	.60,	-16.82,
9,	.97,	.078,	16.64,	.36,	15,	.79,	-16.94,
10,	.81,	.533,	14.85,	.46,	15,	.76,	-16.61,
11,	-11.82,	-1.198,	******,	.00,	10,	12.81,	-16.30,
12,	-80.15,	-1.872,	******,	.00,	9,	57.88,	-15.99,

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Terminal year survivor and F summaries :

Continued

Table 3.2.8 Continued

Age 3 Catchability dependent on age and year class strength

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT08: TRW CPU JUNE ,	62802.,	.688,	.000,	.00,	1,	.218,	.010
P shrinkage mean ,	30996.,	.54,,,,				.364,	.020
F shrinkage mean ,	59169.,	.50,,,,				.418,	.011

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
47364.,	.32,	.30,	3,	.938,	.013

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Age 4 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.-,	45600.,	.824,	.000,	.00,	1,	.147,	.057
FLT08: TRW CPU JUNE ,	29966.,	.486,	.204,	.42,	2,	.420,	.085
F shrinkage mean ,	27947.,	.50,,,,				.434,	.091

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
30922.,	.32,	.13,	4,	.404,	.083

Age 5 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.-,	6349.,	.544,	.362,	.66,	2,	.221,	.225
FLT08: TRW CPU JUNE ,	8367.,	.379,	.022,	.06,	3,	.448,	.175
F shrinkage mean ,	6733.,	.50,,,,				.331,	.213

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7325.,	.27,	.10,	6,	.360,	.198

1

Age 6 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.-,	7638.,	.330,	.234,	.71,	3,	.283,	.269
FLT08: TRW CPU JUNE ,	6619.,	.238,	.152,	.64,	4,	.539,	.305
F shrinkage mean ,	5936.,	.50,,,,				.178,	.335

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6760.,	.18,	.10,	8,	.576,	.300

Continued

Table 3.2.8 Continued

Age 7 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.-,	3279.,	.238,	.127,	.54,	4,	.389,	.323
FLT08: TRW CPU JUNE ,	3089.,	.206,	.148,	.72,	5,	.469,	.340
F shrinkage mean ,	2564.,	.50,,,,				.142,	.398

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3079.,	.15,	.09,	10,	.572,	.341

1

Age 8 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.-,	3511.,	.229,	.104,	.45,	5,	.377,	.279
FLT08: TRW CPU JUNE ,	2645.,	.201,	.116,	.58,	6,	.458,	.356
F shrinkage mean ,	2049.,	.50,,,,				.165,	.439

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2822.,	.15,	.09,	12,	.594,	.337

Age 9 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.-,	2037.,	.228,	.131,	.58,	6,	.399,	.447
FLT08: TRW CPU JUNE ,	2183.,	.206,	.046,	.22,	7,	.387,	.423
F shrinkage mean ,	1863.,	.50,,,,				.214,	.480

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2053.,	.16,	.06,	14,	.358,	.445

1

Age 10 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.-,	1867.,	.230,	.219,	.95,	7,	.365,	.680
FLT08: TRW CPU JUNE ,	2386.,	.214,	.169,	.79,	8,	.346,	.567
F shrinkage mean ,	2557.,	.50,,,,				.289,	.537

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2226.,	.18,	.11,	16,	.624,	.597

Continued

Table 3.2.8 Continued

Age 11 Catchability constant w.r.t. time and dependent on age

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	496.,	.267,	.064,	.24,	8,	.363,	.604
FLT08: TRW CPU JUNE ,	524.,	.259,	.086,	.33,	9,	.265,	.580
F shrinkage mean ,	499.,	.50,,,,				.372,	.602

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
504.,	.22,	.04,	18,	.180,	.597

1

Age 12 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
FLT06: TRW CPU JAN.-,	159.,	.252,	.097,	.39,	8,	.297,	.643
FLT08: TRW CPU JUNE ,	104.,	.278,	.128,	.46,	10,	.284,	.870
F shrinkage mean ,	242.,	.50,,,,				.419,	.467

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
168.,	.24,	.12,	19,	.502,	.619

Table 3.2.9 The results from the TSA

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4	45002.	23270.	16624.	18982.	27432.	39167.	28957.	59287.	90253.	49152.	29384.	24417.	28204.	17973.	43475.
5	29965.	34403.	17857.	12609.	14164.	21392.	28499.	22272.	43674.	68542.	36716.	22430.	18848.	20382.	13666.
6	9532.	20007.	24278.	12161.	8919.	10175.	14543.	19638.	14229.	29789.	47337.	25176.	15135.	11851.	14039.
7	8312.	5563.	12037.	15040.	7661.	5670.	6407.	9266.	11155.	8423.	18299.	29367.	14511.	8634.	7393.
8	2766.	4692.	3240.	6242.	8595.	4335.	3338.	3831.	4990.	6292.	4986.	9870.	15835.	8244.	4976.
9	796.	1113.	2572.	1595.	3178.	4280.	2445.	1824.	1954.	2497.	3380.	2507.	4967.	8948.	4426.
10	325.	303.	489.	1271.	848.	1645.	2513.	1354.	904.	920.	1296.	1769.	1248.	2755.	4567.
11	277.	55.	111.	223.	690.	416.	918.	1327.	678.	474.	481.	688.	840.	677.	1449.

STANDARD DEVIATION OF STOCK ESTIMATES

4	3089.	1514.	1096.	1192.	1556.	2474.	1713.	3943.	6299.	3632.	2529.	2487.	4556.	4393.	12208.
5	1894.	2469.	1195.	869.	937.	1230.	1877.	1351.	2960.	4789.	2794.	2003.	1971.	3681.	3517.
6	794.	1417.	1829.	885.	631.	700.	890.	1410.	979.	2168.	3410.	2090.	1521.	1584.	2829.
7	685.	481.	950.	1218.	587.	419.	456.	623.	947.	672.	1449.	2252.	1454.	1104.	1209.
8	330.	453.	324.	611.	749.	388.	263.	296.	409.	637.	454.	930.	1444.	1009.	806.
9	211.	220.	289.	203.	376.	494.	245.	167.	187.	270.	411.	289.	601.	946.	704.
10	182.	151.	158.	187.	125.	279.	338.	171.	120.	135.	194.	283.	205.	416.	694.
11	144.	134.	103.	99.	106.	88.	184.	215.	115.	82.	93.	131.	189.	136.	278.

FISHING MORTALITY RATES

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4	0.069	0.063	0.070	0.083	0.047	0.112	0.063	0.106	0.069	0.092	0.070	0.058	0.114	0.070	0.075
5	0.198	0.148	0.181	0.140	0.129	0.185	0.169	0.238	0.182	0.164	0.177	0.192	0.250	0.169	0.163
6	0.313	0.300	0.278	0.261	0.250	0.256	0.251	0.353	0.313	0.287	0.270	0.346	0.355	0.265	0.253
7	0.365	0.332	0.433	0.353	0.369	0.322	0.308	0.418	0.366	0.324	0.415	0.416	0.364	0.348	0.291
8	0.504	0.397	0.494	0.471	0.496	0.368	0.400	0.471	0.489	0.420	0.486	0.483	0.363	0.421	0.375
9	0.494	0.443	0.502	0.421	0.451	0.324	0.387	0.502	0.551	0.454	0.447	0.493	0.389	0.471	0.417
10	0.528	0.473	0.518	0.367	0.504	0.383	0.437	0.492	0.444	0.447	0.434	0.537	0.413	0.442	0.469
11	0.501	0.401	0.457	0.378	0.476	0.365	0.405	0.504	0.485	0.477	0.438	0.484	0.412	0.443	0.443

STANDARD DEVIATIONS OF LOG(F)

4	0.16	0.16	0.12	0.13	0.15	0.20	0.16	0.24	0.28	0.22	0.16	0.13	0.19	0.15	0.29
5	0.09	0.11	0.10	0.09	0.08	0.12	0.09	0.10	0.12	0.14	0.11	0.12	0.13	0.12	0.17
6	0.13	0.10	0.12	0.11	0.13	0.12	0.10	0.10	0.09	0.11	0.13	0.11	0.12	0.11	0.16
7	0.12	0.10	0.10	0.12	0.11	0.12	0.12	0.10	0.10	0.10	0.11	0.13	0.12	0.13	0.15
8	0.10	0.12	0.11	0.10	0.13	0.12	0.12	0.12	0.11	0.12	0.11	0.12	0.14	0.14	0.16
9	0.14	0.10	0.12	0.13	0.14	0.14	0.15	0.14	0.13	0.13	0.14	0.13	0.14	0.16	0.17
10	0.16	0.15	0.13	0.16	0.17	0.16	0.18	0.16	0.16	0.16	0.16	0.17	0.16	0.17	0.19
11	0.18	0.17	0.18	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.19	0.19

Table 3.2.10: Icelandic saithe, fishing mortality.

Run title : Saithe in the Icelan (run: GG5/E3)
At 7-May-95 19:55:00

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.0226,	.0117,	.0030,	.0123,	.0096,	.0109,	.0115,	.0256,	.0035,	.0012,
4,	.1859,	.1880,	.0959,	.0740,	.1094,	.0644,	.0664,	.0790,	.1153,	.0268,
5,	.2119,	.2919,	.2524,	.1537,	.1777,	.2173,	.1188,	.1948,	.1031,	.0707,
6,	.2070,	.3475,	.2809,	.2120,	.3572,	.3693,	.3661,	.2392,	.2611,	.2570,
7,	.3319,	.4000,	.2334,	.3288,	.3419,	.3776,	.3656,	.5578,	.3606,	.3908,
8,	.3735,	.3934,	.3540,	.3528,	.3118,	.5533,	.4542,	.5940,	.6737,	.5595,
9,	.3573,	.3324,	.4772,	.3025,	.1714,	.2758,	.4933,	.6584,	.5260,	.5615,
10,	.4665,	.4916,	.3587,	.3310,	.7625,	.2290,	.2778,	.5312,	.3487,	.9936,
11,	.3366,	.3598,	.4977,	.3039,	.6698,	.3939,	.0762,	.1005,	.1132,	.8813,
12,	.6969,	.3386,	.3534,	.5249,	.5861,	.2524,	.8706,	.0571,	.0267,	.7237,
13,	.4184,	1.0598,	.2025,	.5657,	.6027,	.1374,	.5457,	.7539,	.0041,	.6991,
14,	.4800,	.5630,	.3530,	.4310,	.6550,	.2530,	.4430,	.3610,	.1230,	.8240,
+gp,	.4800,	.5630,	.3530,	.4310,	.6550,	.2530,	.4430,	.3610,	.1230,	.8240,
0 FBAR 4- 9,	.2779,	.3255,	.2823,	.2373,	.2449,	.3096,	.3107,	.3872,	.3400,	.3110,
FBARC,	.2523,	.3022,	.2658,	.2373,	.2962,	.3060,	.3144,	.3445,	.3153,	.3914,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
3,	.0117,	.0462,	.0089,	.0247,	.0104,	.0062,	.0068,	.0128,	.0131,	.0100,	.0119,
4,	.1138,	.0550,	.1001,	.0593,	.1051,	.0713,	.0475,	.1314,	.0727,	.0750,	.0930,
5,	.1854,	.1658,	.2456,	.1810,	.1331,	.1882,	.2135,	.3014,	.1819,	.1630,	.2154,
6,	.2465,	.2192,	.3353,	.3314,	.3106,	.2322,	.3788,	.4295,	.2900,	.2530,	.3242,
7,	.3578,	.3146,	.3953,	.2975,	.2670,	.4697,	.4142,	.3845,	.4128,	.2910,	.3628,
8,	.3761,	.4796,	.4969,	.4466,	.3358,	.4733,	.4815,	.2692,	.4171,	.4260,	.3708,
9,	.2114,	.3551,	.5878,	.6760,	.3987,	.3214,	.4301,	.3610,	.4177,	.4260,	.4016,
10,	.7355,	.8910,	.5278,	.4081,	.4752,	.3127,	.4403,	.3123,	.4175,	.4260,	.3853,
11,	.5309,	.9082,	.8325,	.6191,	.7288,	.5364,	.3134,	.1728,	.3357,	.4260,	.3115,
12,	.1487,	.8827,	.6680,	.4204,	.7391,	.4761,	.2623,	.1174,	.2495,	.4260,	.2643,
13,	1.1616,	.2941,	2.2834,	.6546,	.6014,	1.3666,	.0853,	.6757,	.2479,	.4260,	.4499,
14,	.6440,	.7440,	1.0780,	.5260,	.6360,	.6730,	.2730,	.3160,	.3060,	.4260,	.3493,
+gp,	.6440,	.7440,	1.0780,	.5260,	.6360,	.6730,	.2730,	.3160,	.3060,	.4260,	
0 FBAR 4- 9,	.2485,	.2649,	.3602,	.3320,	.2584,	.2927,	.3276,	.3128,	.2987,	.2723,	
FBARC,	.2793,	.2962,	.3298,	.3033,	.2687,	.3076,	.3229,	.3054,	.2794,	.2598,	

Table 3.2.11: Icelandic saithe, stock in numbers (in the beginning of the year).

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Run title : Saithe in the Icelan (run: GG5/E3)
At  7-May-95  19:55:00
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YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	25929,	31242,	21673,	49446,	55312,	28074,	19562,	22175,	33645,	50264,
4,	19428,	20754,	25281,	17691,	39988,	44852,	22737,	15833,	17697,	27449,
5,	14274,	13207,	14079,	18806,	13451,	29346,	34430,	17420,	11978,	12911,
6,	10757,	9455,	8076,	8956,	13203,	9220,	19333,	25031,	11737,	8846,
7,	13580,	7161,	5469,	4993,	5932,	7562,	5218,	10977,	16134,	7402,
8,	10534,	7978,	3930,	3546,	2942,	3450,	4244,	2964,	5144,	9210,
9,	5235,	5937,	4407,	2258,	2040,	1764,	1624,	2206,	1340,	2147,
10,	2085,	2998,	3486,	2239,	1366,	1407,	1096,	812,	935,	648,
11,	1248,	1071,	1501,	1994,	1317,	522,	916,	680,	391,	540,
12,	383,	730,	612,	747,	1205,	552,	288,	695,	503,	286,
13,	320,	156,	426,	352,	362,	549,	351,	99,	537,	401,
14,	103,	173,	44,	285,	164,	162,	392,	166,	38,	438,
+gp,	175,	46,	181,	172,	0,	285,	432,	358,	1655,	368,
0 TOTAL,	104052,	100906,	89166,	111484,	137282,	127745,	110623,	99416,	101735,	120911,

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 75-92	AMST 75-92
AGE													
3,	35630,	75951,	119501,	59592,	33447,	25531,	32193,	21053,	55768,	77718,	0,	36134,	41123,
4,	41104,	28832,	59378,	96975,	47600,	27099,	20774,	26179,	17018,	45065,	62997,	29409,	33314,
5,	21880,	30034,	22342,	43984,	74824,	35082,	20661,	16219,	18794,	12956,	34230,	21589,	24718,
6,	9849,	14883,	20834,	14309,	30050,	53626,	23796,	13663,	9824,	12829,	9012,	14702,	16979,
7,	5601,	6302,	9786,	12198,	8411,	18034,	34806,	13339,	7280,	6019,	8155,	9241,	10717,
8,	4100,	3206,	3767,	5396,	7417,	5273,	9231,	18832,	7435,	3945,	3684,	5349,	6176,
9,	4310,	2305,	1625,	1876,	2827,	4341,	2689,	4669,	11780,	4011,	2109,	2688,	2978,
10,	1003,	2856,	1323,	739,	781,	1553,	2577,	1432,	2665,	6351,	2145,	1431,	1630,
11,	196,	393,	959,	639,	402,	398,	930,	1358,	858,	1437,	3396,	730,	859,
12,	183,	95,	130,	342,	282,	159,	190,	557,	936,	502,	768,	357,	441,
13,	113,	129,	32,	55,	184,	110,	81,	120,	405,	597,	269,	184,	243,
14,	163,	29,	79,	3,	23,	82,	23,	61,	50,	259,	319,	80,	135,
+gp,	669,	197,	36,	3,	19,	94,	193,	4,	4,	164,	226,		
0 TOTAL,	124802,	165213,	239792,	236110,	206265,	171381,	148144,	117487,	132817,	171853,	127311,		

Table 3.2.12: Icelandic saithe, summary.

Run title : Saithe in the Icelan (run: GG6/E4)
At 7-May-95 22:45:34

	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,	167482,	58347,	.3484,	.3096,
1981,	19562,	333100,	170486,	58986,	.3460,	.3107,
1982,	22175,	318648,	180439,	68615,	.3803,	.3872,
1983,	33645,	330042,	195652,	58266,	.2978,	.3400,
1984,	50264,	363055,	183445,	62719,	.3419,	.3110,
1985,	35630,	358939,	170508,	57101,	.3349,	.2485,
1986,	75951,	427958,	181762,	66376,	.3652,	.2649,
1987,	119501,	528859,	178132,	80559,	.4522,	.3602,
1988,	59592,	550456,	175140,	77247,	.4411,	.3320,
1989,	33447,	517444,	184690,	82425,	.4463,	.2584,
1990,	25531,	502577,	211592,	98130,	.4638,	.2927,
1991,	32193,	428960,	221515,	102737,	.4638,	.3276,
1992,	21053,	368941,	220942,	79597,	.3603,	.3128,
1993,	55768,	375038,	214158,	71648,	.3346,	.2987,
1994,	77718,	422010,	208815,	64549,	.3091,	.2723,
Arith. Mean ,	48601,	449265,	221909,	76367,	.3524,	.2931,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 3.2.13

Saithe in the Iceland Grounds (Fishing Area Va) 17:48 Tuesday, May 9, 19

Prediction with management option table: Input data

Year: 1995								
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	0.0900	0.0000	0.0000	1.365	0.0112	1.365
4	32.423	0.2000	0.1900	0.0000	0.0000	2.064	0.0859	2.064
5	34.231	0.2000	0.3700	0.0000	0.0000	2.635	0.1990	2.635
6	9.012	0.2000	0.6800	0.0000	0.0000	3.719	0.2999	3.719
7	8.155	0.2000	0.8100	0.0000	0.0000	4.616	0.3354	4.616
8	3.684	0.2000	0.9300	0.0000	0.0000	6.042	0.3428	6.042
9	2.109	0.2000	0.9700	0.0000	0.0000	6.822	0.3690	6.822
10	2.145	0.2000	1.0000	0.0000	0.0000	7.832	0.3550	7.832
11	3.396	0.2000	1.0000	0.0000	0.0000	7.149	0.2868	7.149
12	0.768	0.2000	1.0000	0.0000	0.0000	9.614	0.2448	9.614
13	0.269	0.2000	1.0000	0.0000	0.0000	10.401	0.4194	10.401
14	0.319	0.2000	1.0000	0.0000	0.0000	10.771	0.3260	10.771
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
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	0.0900	0.0000	0.0000	1.365	0.0112	1.365
4	.	0.2000	0.1900	0.0000	0.0000	2.011	0.0859	2.011
5	.	0.2000	0.3700	0.0000	0.0000	2.785	0.1990	2.785
6	.	0.2000	0.6000	0.0000	0.0000	3.591	0.2999	3.591
7	.	0.2000	0.8400	0.0000	0.0000	4.828	0.3354	4.828
8	.	0.2000	0.9200	0.0000	0.0000	5.810	0.3428	5.810
9	.	0.2000	0.9700	0.0000	0.0000	7.209	0.3690	7.209
10	.	0.2000	1.0000	0.0000	0.0000	7.832	0.3550	7.832
11	.	0.2000	1.0000	0.0000	0.0000	8.250	0.2868	8.250
12	.	0.2000	1.0000	0.0000	0.0000	8.000	0.2448	8.000
13	.	0.2000	1.0000	0.0000	0.0000	10.401	0.4194	10.401
14	.	0.2000	1.0000	0.0000	0.0000	10.771	0.3260	10.771
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	0.0900	0.0000	0.0000	1.365	0.0112	1.365
4	.	0.2000	0.1900	0.0000	0.0000	2.011	0.0859	2.011
5	.	0.2000	0.3700	0.0000	0.0000	2.750	0.1990	2.750
6	.	0.2000	0.6000	0.0000	0.0000	3.690	0.2999	3.690
7	.	0.2000	0.7900	0.0000	0.0000	4.625	0.3354	4.625
8	.	0.2000	0.9300	0.0000	0.0000	6.025	0.3428	6.025
9	.	0.2000	0.9700	0.0000	0.0000	7.013	0.3690	7.013
10	.	0.2000	1.0000	0.0000	0.0000	7.832	0.3550	7.832
11	.	0.2000	1.0000	0.0000	0.0000	8.250	0.2868	8.250
12	.	0.2000	1.0000	0.0000	0.0000	9.614	0.2448	9.614
13	.	0.2000	1.0000	0.0000	0.0000	9.000	0.4194	9.000
14	.	0.2000	1.0000	0.0000	0.0000	10.771	0.3260	10.771
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PRED94
Date and time: 09MAY95:18:06

Table 3.2.14

17:48 Tuesday, May 9, 1995

Saithe in the Iceland Grounds (Fishing Area Va)

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
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	0.2720	374220	193636	61270	0.6000	0.1632	382500	197425	40886	413932	224036
.	.	.	.	.	0.7000	0.1904	.	197425	47081	407037	218613
.	.	.	.	.	0.8000	0.2176	.	197425	53111	400328	213347
.	.	.	.	.	0.9000	0.2448	.	197425	58983	393799	208232
.	.	.	.	.	1.0000	0.2720	.	197425	64701	387445	203264
.	.	.	.	.	1.1000	0.2992	.	197425	70269	381261	198439
.	.	.	.	.	1.2000	0.3264	.	197425	75692	375241	193752
.	.	.	.	.	1.3000	0.3536	.	197425	80974	369382	189199
.	.	.	.	.	1.4000	0.3808	.	197425	86119	363677	184776
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED94
Date and time : 09MAY95:18:06
Computation of ref. F: Simple mean, age 4 - 9
Basis for 1995 : F factors

Table 3.2.15

15:45 Sunday, April 30, 1995

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	0.0870	0.0000	0.0000	1.464	0.0430	1.464
4	.	0.2000	0.1900	0.0000	0.0000	2.055	0.2500	2.055
5	.	0.2000	0.3700	0.0000	0.0000	2.763	0.5500	2.763
6	.	0.2000	0.5300	0.0000	0.0000	3.650	0.9400	3.650
7	.	0.2000	0.7700	0.0000	0.0000	4.690	1.1800	4.690
8	.	0.2000	0.8900	0.0000	0.0000	5.811	1.5400	5.811
9	.	0.2000	0.9500	0.0000	0.0000	6.969	1.5400	6.969
10	.	0.2000	1.0000	0.0000	0.0000	7.886	1.5400	7.886
11	.	0.2000	1.0000	0.0000	0.0000	8.921	1.5400	8.921
12	.	0.2000	1.0000	0.0000	0.0000	9.717	1.5400	9.717
13	.	0.2000	1.0000	0.0000	0.0000	10.880	1.5400	10.880
14	.	0.2000	1.0000	0.0000	0.0000	11.204	1.5400	11.204
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YIELD3
Date and time: 30APR95:19:54

Table 3.2.16

Saithe in the Iceland Grounds (Fishing Area Va) 15:45 Sunday, April 30, 1995

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.016	21411.749	2.628	15879.357	2.628	15879.357
0.0200	0.0200	0.066	397.681	4.806	19694.031	2.432	14223.242	2.432	14223.242
0.0400	0.0400	0.122	707.050	4.621	18220.248	2.261	12808.635	2.261	12808.635
0.0600	0.0600	0.168	948.007	4.459	16950.175	2.112	11595.447	2.112	11595.447
0.0800	0.0800	0.208	1135.893	4.315	15850.735	1.981	10550.729	1.981	10550.729
0.1000	0.1000	0.242	1282.547	4.187	14894.675	1.866	9647.345	1.866	9647.345
0.1200	0.1200	0.271	1397.113	4.073	14059.482	1.764	8862.898	1.764	8862.898
0.1400	0.1400	0.296	1486.664	3.971	13326.523	1.673	8178.854	1.673	8178.854
0.1600	0.1600	0.319	1556.681	3.879	12680.329	1.592	7579.846	1.592	7579.846
0.1800	0.1800	0.338	1611.412	3.794	12108.035	1.519	7053.096	1.519	7053.096
0.2000	0.2000	0.356	1654.158	3.718	11598.903	1.454	6587.954	1.454	6587.954
0.2200	0.2200	0.371	1687.488	3.649	11143.955	1.395	6175.521	1.395	6175.521
0.2400	0.2400	0.386	1713.403	3.585	10735.658	1.341	5808.338	1.341	5808.338
0.2600	0.2600	0.398	1733.467	3.526	10367.677	1.292	5480.140	1.292	5480.140
0.2800	0.2800	0.410	1748.903	3.471	10034.664	1.247	5185.647	1.247	5185.647
0.3000	0.3000	0.421	1760.670	3.421	9732.097	1.206	4920.397	1.206	4920.397
0.3200	0.3200	0.431	1769.523	3.374	9456.137	1.169	4680.609	1.169	4680.609
0.3400	0.3400	0.440	1776.056	3.330	9203.513	1.134	4463.067	1.134	4463.067
0.3600	0.3600	0.449	1780.737	3.289	8971.434	1.101	4265.031	1.101	4265.031
0.3800	0.3800	0.457	1783.939	3.250	8757.508	1.071	4084.158	1.071	4084.158
0.4000	0.4000	0.464	1785.957	3.214	8559.680	1.043	3918.436	1.043	3918.436
0.4200	0.4200	0.471	1787.024	3.179	8376.175	1.017	3766.136	1.017	3766.136
0.4400	0.4400	0.478	1787.330	3.147	8205.461	0.993	3625.763	0.993	3625.763
0.4600	0.4600	0.485	1787.024	3.116	8046.206	0.970	3496.027	0.970	3496.027
0.4800	0.4800	0.491	1786.228	3.087	7897.252	0.948	3375.802	0.948	3375.802
0.5000	0.5000	0.496	1785.037	3.059	7757.587	0.928	3264.112	0.928	3264.112
0.5200	0.5200	0.502	1783.532	3.033	7626.325	0.909	3160.102	0.909	3160.102
0.5400	0.5400	0.507	1781.776	3.007	7502.686	0.891	3063.023	0.891	3063.023
0.5600	0.5600	0.512	1779.820	2.983	7385.984	0.873	2972.216	0.873	2972.216
0.5800	0.5800	0.517	1777.708	2.960	7275.611	0.857	2887.102	0.857	2887.102
0.6000	0.6000	0.521	1775.472	2.937	7171.028	0.842	2807.167	0.842	2807.167
0.6200	0.6200	0.526	1773.143	2.916	7071.757	0.827	2731.956	0.827	2731.956
0.6400	0.6400	0.530	1770.742	2.895	6977.370	0.813	2661.066	0.813	2661.066
0.6600	0.6600	0.534	1768.289	2.875	6887.484	0.799	2594.135	0.799	2594.135
0.6800	0.6800	0.538	1765.799	2.856	6801.758	0.786	2530.841	0.786	2530.841
0.7000	0.7000	0.542	1763.287	2.838	6719.883	0.774	2470.897	0.774	2470.897
0.7200	0.7200	0.546	1760.761	2.820	6641.581	0.762	2414.042	0.762	2414.042
0.7400	0.7400	0.549	1758.231	2.803	6566.600	0.751	2360.043	0.751	2360.043
0.7600	0.7600	0.553	1755.705	2.786	6494.714	0.740	2308.689	0.740	2308.689
0.7800	0.7800	0.556	1753.188	2.770	6425.714	0.730	2259.790	0.730	2259.790
0.8000	0.8000	0.559	1750.685	2.754	6359.414	0.720	2213.173	0.720	2213.173
0.8200	0.8200	0.562	1748.201	2.739	6295.642	0.710	2168.680	0.710	2168.680
0.8400	0.8400	0.565	1745.738	2.724	6234.240	0.701	2126.169	0.701	2126.169
0.8600	0.8600	0.568	1743.299	2.710	6175.066	0.692	2085.509	0.692	2085.509
0.8800	0.8800	0.571	1740.886	2.696	6117.986	0.683	2046.581	0.683	2046.581
0.9000	0.9000	0.574	1738.501	2.682	6062.881	0.675	2009.275	0.675	2009.275
0.9200	0.9200	0.577	1736.146	2.669	6009.638	0.667	1973.492	0.667	1973.492
0.9400	0.9400	0.580	1733.820	2.656	5958.153	0.659	1939.139	0.659	1939.139
0.9600	0.9600	0.582	1731.526	2.643	5908.332	0.651	1906.131	0.651	1906.131
0.9800	0.9800	0.585	1729.263	2.631	5860.087	0.644	1874.391	0.644	1874.391
1.0000	1.0000	0.587	1727.032	2.619	5813.335	0.637	1843.845	0.637	1843.845
1.0200	1.0200	0.590	1724.834	2.608	5768.001	0.630	1814.427	0.630	1814.427
1.0400	1.0400	0.592	1722.667	2.596	5724.013	0.623	1786.075	0.623	1786.075
1.0600	1.0600	0.594	1720.532	2.585	5681.306	0.617	1758.731	0.617	1758.731
1.0800	1.0800	0.597	1718.430	2.574	5639.818	0.611	1732.342	0.611	1732.342
1.1000	1.1000	0.599	1716.359	2.564	5599.492	0.605	1706.859	0.605	1706.859
1.1200	1.1200	0.601	1714.319	2.553	5560.275	0.599	1682.235	0.599	1682.235
1.1400	1.1400	0.603	1712.311	2.543	5522.115	0.593	1658.427	0.593	1658.427
1.1600	1.1600	0.605	1710.333	2.533	5484.966	0.587	1635.394	0.587	1635.394
1.1800	1.1800	0.607	1708.385	2.523	5448.783	0.582	1613.099	0.582	1613.099
1.2000	1.2000	0.609	1706.468	2.514	5413.524	0.577	1591.507	0.577	1591.507
1.2200	1.2200	0.611	1704.579	2.504	5379.152	0.571	1570.584	0.571	1570.584
1.2400	1.2400	0.613	1702.720	2.495	5345.628	0.566	1550.299	0.566	1550.299
1.2600	1.2600	0.615	1700.889	2.486	5312.918	0.561	1530.624	0.561	1530.624
1.2800	1.2800	0.617	1699.085	2.477	5280.989	0.557	1511.531	0.557	1511.531
1.3000	1.3000	0.619	1697.309	2.469	5249.811	0.552	1492.994	0.552	1492.994
1.3200	1.3200	0.620	1695.560	2.460	5219.353	0.547	1474.989	0.547	1474.989
1.3400	1.3400	0.622	1693.838	2.452	5189.588	0.543	1457.493	0.543	1457.493
1.3600	1.3600	0.624	1692.141	2.444	5160.491	0.539	1440.485	0.539	1440.485
1.3800	1.3800	0.625	1690.469	2.436	5132.035	0.534	1423.944	0.534	1423.944
1.4000	1.4000	0.627	1688.822	2.428	5104.198	0.530	1407.850	0.530	1407.850
1.4200	1.4200	0.629	1687.199	2.420	5076.957	0.526	1392.187	0.526	1392.187
1.4400	1.4400	0.630	1685.600	2.412	5050.291	0.522	1376.936	0.522	1376.936
1.4600	1.4600	0.632	1684.025	2.405	5024.180	0.518	1362.081	0.518	1362.081
1.4800	1.4800	0.633	1682.472	2.397	4998.604	0.514	1347.606	0.514	1347.606
1.5000	1.5000	0.635	1680.941	2.390	4973.545	0.511	1333.498	0.511	1333.498
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YIELD3
Date and time : 30APR95:19:54
Computation of ref. F: Simple mean, age 4 - 9
F-0.1 factor : 0.1857
F-max factor : 0.4393
F-0.1 reference F : 0.1857
F-max reference F : 0.4393
Recruitment : Single recruit

Table 3.3.1 Nominal catch (tonnes) of COD in Division Va, by countries, 1981-1994, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987
Belgium	1,321	236	188	254	207	226	597
Faroe Islands	6,183	5,297	5,626	2,041	2,203	2,554	1,848
Iceland	461,038	382,297	293,890	281,481	322,810	365,852	389,808
Norway	559	557	109	90	46	1	4
UK (Engl. and Wales)	-	-	-	2	1	-	-
Total	469,101	388,387	299,813	283,868	325,267	368,633	392,257
Working Group estimate	-	-	-	-	-	-	-

Country	1988	1989	1990	1991	1992	1993	1994
Belgium	365	309	260	548	222	145	135
Faroe Islands	1,966	2,012	1,782	1,323	883	664	754
Iceland	375,741	353,985	333,348	306,697	266,662	251,170	175,296
Norway	4	3	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	+	-
Total	378,076	356,309	335,390	308,568	267,767	251,979	176,185
Working Group estimate	-	-	-	-	-	-	178,822

1) Provisional.

2) Additional catch by Iceland of 2637 t included.

Table 3.3.2: Icelandic cod, catch-in-numbers (millions).

Age	1975	1976	1977	1978	1979	1980	1981
3	29.301	23.578	2.614	5.999	7.186	4.348	2.118
4	29.489	39.790	42.659	16.287	28.427	28.530	13.297
5	44.138	21.092	32.465	43.931	13.772	32.500	39.195
6	12.088	24.395	12.162	17.626	34.443	15.119	23.247
7	9.628	5.803	13.017	8.729	14.130	27.090	12.710
8	3.691	5.343	2.809	4.119	4.426	7.847	26.455
9	2.051	1.297	1.773	0.978	1.432	2.228	4.804
10	0.752	0.633	0.421	0.348	0.350	0.646	1.677
11	0.891	0.205	0.086	0.119	0.168	0.246	0.582
12	0.416	0.155	0.024	0.048	0.043	0.099	0.228
13	0.060	0.065	0.006	0.015	0.024	0.025	0.053
14	0.046	0.029	0.002	0.027	0.004	0.004	0.068
Juvenile	94.505	84.607	77.549	66.317	66.657	74.804	79.027
Adult	38.046	37.778	30.489	31.909	37.748	43.878	45.407
Sum 3- 3	29.301	23.578	2.614	5.999	7.186	4.348	2.118
Sum 4-14	103.250	98.807	105.424	92.227	97.219	114.334	122.316
Total	132.551	122.385	108.038	98.226	104.405	118.682	124.434

Age	1982	1983	1984	1985	1986	1987	1988
3	3.285	3.554	6.750	6.457	20.642	11.002	6.713
4	20.812	10.910	31.553	24.552	20.330	62.130	39.323
5	24.462	24.305	19.420	35.392	26.644	27.192	55.895
6	28.351	18.944	15.326	18.267	30.839	15.127	18.663
7	14.012	17.382	8.082	8.711	11.413	15.695	6.399
8	7.666	8.381	7.336	4.201	4.441	4.159	5.877
9	11.517	2.054	2.680	2.264	1.771	1.463	1.345
10	1.912	2.733	0.512	1.063	0.805	0.592	0.455
11	0.327	0.514	0.538	0.217	0.392	0.253	0.305
12	0.094	0.215	0.195	0.233	0.103	0.142	0.157
13	0.043	0.064	0.090	0.102	0.076	0.046	0.114
14	0.011	0.037	0.036	0.038	0.040	0.058	0.025
Juvenile	73.043	58.426	65.651	69.001	80.654	107.928	103.170
Adult	39.449	30.667	26.867	32.496	36.842	29.931	32.101
Sum 3- 3	3.285	3.554	6.750	6.457	20.642	11.002	6.713
Sum 4-14	109.207	85.539	85.768	95.040	96.854	126.857	128.558
Total	112.492	89.093	92.518	101.497	117.496	137.859	135.271

Age	1989	1990	1991	1992	1993	1994
3	2.605	5.785	8.554	12.217	20.500	6.159
4	27.983	12.313	25.131	21.708	33.078	24.136
5	50.059	27.179	15.491	26.524	15.195	19.661
6	31.455	44.534	21.514	11.413	13.281	6.966
7	6.010	17.037	25.038	10.073	3.583	4.392
8	1.915	2.573	6.364	8.304	2.785	1.257
9	0.881	0.609	0.903	2.006	2.707	0.599
10	0.225	0.322	0.243	0.257	1.181	0.508
11	0.107	0.118	0.125	0.046	0.180	0.283
12	0.086	0.050	0.063	0.032	0.034	0.049
13	0.038	0.015	0.011	0.012	0.011	0.018
14	0.005	0.020	0.012	0.008	0.013	0.006
Juvenile	82.565	65.114	60.283	48.743	45.914	26.355
Adult	38.804	45.441	43.166	43.857	46.634	37.679
Sum 3- 3	2.605	5.785	8.554	12.217	20.500	6.159
Sum 4-14	118.764	104.770	94.895	80.383	72.048	57.875
Total	121.369	110.555	103.449	92.600	92.548	64.034

Table 3.3.3: 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 3.3.4: Icelandic cod, mean weight at age in the landings (gr.).

Age	1975	1976	1977	1978	1979	1980	1981
3	1100	1350	1259	1289	1408	1392	1180
4	1770	1780	1911	1833	1956	1862	1651
5	2780	2650	2856	2929	2642	2733	2260
6	3760	4100	4069	3955	3999	3768	3293
7	5450	5070	5777	5726	5548	5259	4483
8	6690	6730	6636	6806	6754	6981	5821
9	7570	8250	7685	9041	8299	8037	7739
10	8580	9610	9730	10865	9312	10731	9422
11	8810	11540	11703	13068	13130	12301	11374
12	9780	11430	14394	11982	13418	17281	12784
13	10090	14060	17456	19062	13540	14893	12514
14	11000	16180	24116	21284	20072	19069	19069

Age	1982	1983	1984	1985	1986	1987	1988
3	1006	1095	1288	1407	1459	1316	1438
4	1550	1599	1725	1971	1961	1956	1805
5	2246	2275	2596	2576	2844	2686	2576
6	3104	3021	3581	3650	3593	3894	3519
7	4258	4096	4371	4976	4635	4716	4930
8	5386	5481	5798	6372	6155	6257	6001
9	6682	7049	7456	8207	7503	7368	7144
10	9141	8128	9851	10320	9084	9243	8822
11	11963	11009	11052	12197	10356	10697	9977
12	14226	13972	14338	14683	15283	10622	11732
13	17287	15882	15273	16175	14540	15894	14156
14	16590	18498	16660	19050	15017	12592	13042

Age	1989	1990	1991	1992	1993	1994	1995
3	1186	1290	1309	1289	1392	1443	1358
4	1813	1704	1899	1768	1887	2063	1853
5	2590	2383	2475	2469	2772	2562	2600
6	3915	3034	3159	3292	3762	3659	3526
7	5210	4624	3792	4394	4930	5117	4784
8	6892	6521	5680	5582	6054	6262	6340
9	8035	8888	7242	6830	7450	7719	7310
10	9831	10592	9804	8127	8641	8896	8867
11	11986	10993	9754	12679	10901	10847	11045
12	10003	14570	14344	13410	12517	12874	13286
13	12611	15732	14172	15715	14742	14742	14843
14	16045	17290	20200	11267	16874	17470	16453

Table 3.3.5: Icelandic cod, mean weight at age in the spawning stock (gr.).

Age	1975	1976	1977	1978	1979	1980	1981
3	978	1217	960	1031	1141	1333	967
4	1855	1604	1723	1671	1647	1680	1513
5	3292	2516	2729	2863	2532	2708	2101
6	4165	4380	4108	3920	4027	3875	3225
7	5893	5407	5957	5976	5664	5446	4520
8	7153	6985	6696	6946	6951	7106	5851
9	7905	8752	7618	9204	8234	8120	7661
10	8753	10143	9669	10833	9500	10737	9084
11	8745	11829	12578	12920	12921	12628	10833
12	9788	11518	13884	12863	13028	17528	12401
13	10081	13916	17026	19104	13308	15939	11724
14	9876	15367	24652	21183	18930	25212	14326

Age	1982	1983	1984	1985	1986	1987	1988
3	996	891	1002	1131	1182	1289	1218
4	1626	1472	1479	1597	1762	1811	1604
5	2095	2139	2257	2285	2681	2735	2499
6	3006	2918	3476	3524	3562	4202	3566
7	4339	4130	4480	5010	4824	5110	5161
8	5571	5553	5887	6195	6457	6497	6238
9	6801	7007	7660	7800	7843	7802	7302
10	9259	7770	9920	9225	9419	10220	8647
11	11550	10817	11035	11336	10674	11197	10184
12	13445	13176	14531	13277	13660	10620	11504
13	17138	14175	15378	15325	13812	15893	14159
14	16554	18543	16394	18932	18479	16514	10952

Age	1989	1990	1991	1992	1993	1994	1995
3	1012	813	1122	876	1037	1193	1057
4	1542	1330	1776	1389	1570	1748	1621
5	2423	2132	2233	2174	2518	2382	2348
6	3743	3187	3044	3185	3611	3684	3446
7	5298	4691	3891	4481	4872	5175	4845
8	6910	6627	5897	5587	6150	6210	6514
9	7725	8915	7657	6775	7538	7676	7412
10	9397	10362	10573	8225	8840	8814	9113
11	11953	12093	11230	11702	11088	10842	11216
12	9529	15453	14340	13474	12002	12595	13103
13	12195	15337	14172	15436	14402	14402	14603
14	14270	17257	20200	11267	18383	17470	16830

Table 3.3.6: Icelandic cod, sexual maturity at age (proportion).

Age	1975	1976	1977	1978	1979	1980	1981
3	0.007	0.049	0.000	0.049	0.000	0.056	0.000
4	0.112	0.058	0.047	0.050	0.019	0.023	0.029
5	0.342	0.281	0.213	0.185	0.189	0.165	0.085
6	0.536	0.505	0.611	0.443	0.531	0.478	0.289
7	0.857	0.629	0.881	0.877	0.793	0.807	0.659
8	0.950	0.936	0.960	0.962	0.929	0.915	0.890
9	0.986	0.988	0.990	0.982	0.982	0.979	0.952
10	1.000	1.000	1.000	1.000	0.919	0.977	0.962
11	1.000	1.000	1.000	1.000	1.000	1.000	0.988
12	1.000	1.000	1.000	1.000	1.000	0.964	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	1982	1983	1984	1985	1986	1987	1988
3	0.023	0.000	0.000	0.027	0.005	0.020	0.039
4	0.051	0.087	0.043	0.058	0.054	0.046	0.020
5	0.129	0.167	0.189	0.202	0.244	0.238	0.206
6	0.226	0.338	0.416	0.548	0.543	0.585	0.477
7	0.544	0.515	0.656	0.774	0.762	0.808	0.690
8	0.849	0.717	0.782	0.903	0.891	0.942	0.831
9	0.956	0.857	0.858	0.938	0.981	0.952	0.929
10	0.967	0.979	0.949	1.000	0.962	1.000	0.946
11	1.000	0.985	0.969	1.000	0.988	0.979	0.974
12	1.000	1.000	0.948	1.000	1.000	1.000	0.821
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	1989	1990	1991	1992	1993	1994	1995
3	0.000	0.000	0.000	0.072	0.078	0.096	0.096
4	0.048	0.075	0.063	0.225	0.246	0.281	0.281
5	0.226	0.303	0.214	0.562	0.470	0.570	0.570
6	0.550	0.633	0.543	0.706	0.714	0.796	0.796
7	0.820	0.819	0.781	0.906	0.939	0.895	0.895
8	0.858	0.912	0.887	0.961	0.984	0.919	0.919
9	0.887	0.953	0.945	0.977	0.973	1.000	1.000
10	0.991	0.986	0.842	1.000	0.968	0.852	0.852
11	1.000	1.000	1.000	1.000	1.000	0.985	0.985
12	0.903	1.000	1.000	1.000	1.000	1.000	1.000
13	0.859	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: Icelandic cod. Bottom trawlers CPUE indices used in VPA tuning (GLM indices from 1990-1994).

North region, Jun-Dec.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4							599	1143	707	1413	2030
5							976	676	851	546	1351
6							1569	755	308	272	244
7							223	452	218	96	88
8							13	77	85	46	27

South-east region, Jun-Dec.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4							94	123	170	242	1734
5							363	126	214	200	478
6							723	183	151	252	137
7							444	258	214	134	111
8							62	186	219	77	17
9							21	60	51	83	9
10							14	9	10	50	9

North region, Jan-May.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4							65	503	703	1308	822
5							779	575	1262	759	1203
6							1739	1270	698	706	566
7							681	791	243	60	335
8							72	48	104	30	59

South-east region, Jan-Dec.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
4							27	0	95	521	1335
5							535	0	377	266	1320
6							1225	147	508	318	300
7							1009	685	370	66	225
8							54	391	243	74	45
9							0	49	52	100	38
10							7	0	10	74	30

Table 3.3.8: Icalandic cod, indices from the Icelandic groundfish survey.

North region

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	54825	22073	79754	90562	69564	8067	21716	16063	33630	17996	4173
4	51526	18257	17747	50341	56152	16026	7589	10386	10065	12779	11233
5	14296	18298	10333	6908	19589	20228	9237	3737	6815	3094	7075
6	6292	4876	8510	3025	1695	6613	9393	2369	1145	1544	1379
7	1832	1420	1592	2535	571	463	1076	1366	703	229	436
8	783	389	364	274	326	140	99	161	349	100	54

South-west region

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	2095	1256	4135	3919	6370	1634	3261	1194	4437	4376	1382
4	4555	2073	1219	5830	9537	6336	2570	2019	2092	3625	4752
5	3031	3100	1361	1392	6641	9374	5040	1396	1968	1093	3725
6	1910	1225	1587	853	786	4406	7488	1674	420	594	891
7	815	511	426	853	294	433	1676	1955	370	124	364
8	455	210	118	105	223	119	330	429	254	64	25

South-east region

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	290	540	1535	9466	3934	154	222	567	2908	1618	548
4	1143	993	677	7499	11852	1001	220	763	973	1912	3442
5	1122	2004	1073	1323	9937	4049	930	717	1095	750	3543
6	951	1010	1608	835	1414	3648	2461	1281	314	563	1028
7	595	511	498	992	547	469	925	1750	381	147	436
8	512	245	174	143	448	141	205	379	288	84	100

North region, age-group 2 index on age-group 3 one year later.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3		34532	82614	91880	65640	16735	18147	15943	34874	26851	5782

North region, age-group 1 index on age-group 3 two years later.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3			36310	53926	25221	5466	15072	11627	14537	20685	2330

South-west region, age-group 2 index on age-group one year later.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3		756	2821	2486	1041	894	842	1274	2036	2424	827

South-west region, age-group 1 index on age-group two yeara later.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3			608	996	270	93	690	156	665	560	408

South-east region, age-group 2 index on age-group one year later.

Age \ Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3		66	769	1298	1921	227	123	34	660	2534	348

Table 3.3.9: Icelandic cod, XSA diagnostic output.

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Lowestoft VPA Version 3.1

   18/04/1995   2:21

 Extended Survivors Analysis

 ICELANDIC COD (Div. Va); data from 1955-94(4/95)

 CPUE data from file smb-tr-1.dat

 Catch data for  11 years. 1984 to 1994. Ages  3 to  14.

      Fleet,                  First, Last, First, Last, Alpha,  Beta
                            ,  year, year,  age ,  age
 SMB; N                     ,  1984, 1994,    3,     8,   .990,  1.000
 SMB; a2 on a3; N           ,  1985, 1994,    3,     3,   .990,  1.000
 SMB; a1 on a3; N           ,  1986, 1994,    3,     3,   .990,  1.000
 SMB; SE                    ,  1984, 1994,    3,     8,   .990,  1.000
 SMB; a2 on a3; SE          ,  1985, 1994,    3,     3,   .990,  1.000
 SMB; SW                    ,  1984, 1994,    3,     8,   .990,  1.000
 SMB; a2 on a3; SW          ,  1985, 1994,    3,     3,   .990,  1.000
 SMB; a1 on a3; SW          ,  1986, 1994,    3,     3,   .990,  1.000
 Trawl; N; J-D              ,  1990, 1994,    4,     8,   .580,  1.000
 Trawl; SE; J-D             ,  1990, 1994,    4,    10,   .580,  1.000
 Trawl; N; J-M              ,  1990, 1994,    4,     8,   .000,   .580
 Trawl; SE; J-M             ,  1990, 1994,    4,    10,   .000,   .580


 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 >=    9


 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   22 iterations

1
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Continued

Table 3.3.9 Continued

Regression weights

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

Fishing mortalities

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	.050	.070	.044	.045	.036	.050	.100	.079	.132	.094
4	.286	.221	.308	.218	.264	.234	.315	.396	.316	.226
5	.385	.578	.517	.505	.136	.443	.520	.650	.538	.315
6	.570	.694	.781	.840	.602	.638	.775	.950	.821	.509
7	.681	.883	.974	.947	.729	.789	.948	1.107	.938	.721
8	.730	.935	.997	1.400	.860	.823	.795	1.022	1.153	1.097
9	.802	.806	.975	1.124	.819	.754	.794	.630	1.233	.842
10	.768	.764	.705	.987	.553	.836	.795	.547	.999	.816
11	.612	.735	.581	1.034	.661	.640	.966	.330	.975	.697
12	.642	.672	.654	.908	.980	.765	.879	.711	.435	.796
13	.666	.445	.740	2.363	.575	.438	.369	.282	.572	.434
14	.705	.691	.738	1.300	.724	.691	.769	.506	.855	.721

1

XSA population numbers (Thousands)

	AGE									
YEAR	3	4	5	6	7	8	9	10	11	12
1985	1.46E+05	1.09E+05	1.22E+05	4.65E+04	1.95E+04	8.96E+03	4.54E+03	2.19E+03	5.24E+02	5.43E+02
1986	3.39E+05	1.13E+05	6.71E+04	6.81E+04	2.15E+04	8.08E+03	3.54E+03	1.67E+03	8.32E+02	2.33E+02
1987	2.83E+05	2.59E+05	7.44E+04	3.08E+04	2.79E+04	7.29E+03	2.60E+03	1.29E+03	6.35E+02	3.27E+02
1988	1.70E+05	2.22E+05	1.56E+05	3.63E+04	1.16E+04	8.62E+03	2.20E+03	8.01E+02	5.23E+02	2.91E+02
1989	8.25E+04	1.33E+05	1.46E+05	7.69E+04	1.28E+04	3.67E+03	1.74E+03	5.86E+02	2.44E+02	1.52E+02
1990	1.32E+05	6.52E+04	8.39E+04	1.04E+05	3.45E+04	5.07E+03	1.27E+03	6.28E+02	2.76E+02	1.03E+02
1991	9.90E+04	1.03E+05	4.22E+04	4.41E+04	4.52E+04	1.28E+04	1.82E+03	4.90E+02	2.23E+02	1.19E+02
1992	1.78E+05	7.33E+04	6.13E+04	2.06E+04	1.66E+04	1.43E+04	4.74E+03	6.74E+02	1.81E+02	6.95E+01
1993	1.84E+05	1.35E+05	4.04E+04	2.62E+04	6.51E+03	4.50E+03	4.22E+03	2.07E+03	3.19E+02	1.07E+02
1994	7.61E+04	1.32E+05	8.04E+04	1.93E+04	9.45E+03	2.09E+03	1.16E+03	1.01E+03	6.23E+02	9.87E+01

Estimated population abundance at 1st Jan 1995

0.00E+00	5.67E+04	8.60E+04	4.80E+04	9.51E+03	3.76E+03	5.70E+02	4.10E+02	3.65E+02	2.54E+02

Taper weighted geometric mean of the VPA populations:

1.48E+05	1.26E+05	7.80E+04	4.03E+04	1.75E+04	6.80E+03	2.57E+03	9.82E+02	4.10E+02	1.71E+02

Standard error of the weighted Log(VPA populations) :

Continued

Table 3.3.9 Continued

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 ,         .4695,     .4277,     .4555,     .5574,     .5974,     .6189,     .5548,     .5251,
.5978,    .6849,
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                                 AGE
 YEAR ,          13,        14,

 1985 ,     2.32E+02, 8.30E+01,
 1986 ,     2.34E+02, 9.75E+01,
 1987 ,     9.72E+01, 1.23E+02,
 1988 ,     1.39E+02, 3.80E+01,
 1989 ,     9.61E+01, 1.07E+01,
 1990 ,     4.68E+01, 4.43E+01,
 1991 ,     3.94E+01, 2.47E+01,
 1992 ,     4.05E+01, 2.23E+01,
 1993 ,     2.79E+01, 2.50E+01,
 1994 ,     5.65E+01, 1.29E+01,

 Estimated population abundance at 1st Jan 1995

    ,     3.65E+01, 3.00E+01,

 Taper weighted geometric mean of the VPA populations:

    ,     7.88E+01, 3.57E+01,

 Standard error of the weighted Log(VPA populations) :

    ,         .7603,     .8264,
1

 Log catchability residuals.


 Fleet : SMB; N

 Age  ,  1984
    3 ,   .47
    4 ,   .32
    5 ,   .35
    6 ,   .52
    7 ,   .39
    8 ,   .59
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age


 Age  ,  1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994
    3 ,  -.06,  -.19,   .04,   .41,  -.05,   .03,   .18,  -.02,  -.36,  -.30
    4 ,   .18,   .07,   .03,   .20,  -.13,   .05,  -.13,   .24,  -.26,  -.39
    5 ,   .22,   .44,  -.13,   .16,  -.11,  -.03,  -.17,   .18,  -.30,  -.38
    6 ,   .16,   .46,   .31,  -.38,   .00,   .08,  -.30,  -.09,  -.16,  -.28
    7 ,   .24,   .45,   .75,   .11,  -.42,  -.50,  -.38,   .12,  -.24,  -.18
    8 ,   .15,   .39,   .27,   .67,   .15,  -.56, -1.03,  -.14,  -.10,  -.01
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age
```

Continued

Table 3.3.9 Continued

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,	8
Mean Log q,	-1.5357,	-1.6515,	-1.9786,	-2.3571,
S.E(Log q),	.2648,	.2986,	.4054,	.5029,

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,	.55,	2.344,	6.23,	.77,	11,	.27,	-1.51,
4,	.69,	1.677,	4.66,	.79,	11,	.24,	-1.50,

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,	.86,	.846,	2.93,	.81,	11,	.23,	-1.54,
6,	.83,	1.158,	3.17,	.86,	11,	.24,	-1.65,
7,	.95,	.216,	2.36,	.71,	11,	.41,	-1.98,
8,	1.03,	-.102,	2.16,	.59,	11,	.55,	-2.36,

1

Fleet : SMB; a2 on a3; N

Age ,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
3 ,	.14,	-.15,	.08,	.38,	.24,	-.17,	.07,	-.04,	-.20,	-.31
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,	.63,	2.257,	5.33,	.83,	10,	.23,	-1.40,

1

Continued

Table 3.3.9 Continued

Fleet : SMB; a1 on a3; N

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	99.99	-.27	.12	.19	.01	.14	.31	-.16	.04	-.38
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	.59	2.362	6.13	.83	9	.24	-2.08

1

Fleet : SMB; SE

Age	1984
3	-.55
4	-.52
5	-.52
6	-.35
7	-.31
8	.14
9	No data for this fleet at this age
10	No data for this fleet at this age

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	-.27	-.58	.50	.56	-.34	-.62	.16	.38	.09	.40
4	-.03	-.27	.01	.33	-.24	-.20	-.07	.41	.06	.31
5	-.32	-.15	-.11	1.16	-.04	-.65	-.15	.03	-.04	.60
6	-.39	-.18	.04	.46	.42	-.24	.11	-.36	-.15	.45
7	-.36	-.28	.24	.50	.02	-.23	.30	-.07	-.25	.25
8	-.35	-.38	-.41	.96	.12	.14	-.20	-.36	-.31	.58
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 and constant w.r.t. time

Age	5	6	7	8
Mean Log q	-3.2069	-2.6746	-2.4085	-2.3268
S.E(Log q)	.5096	.3365	.2936	.4559

Continued

Table 3.3.9 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,	.50,	1.436,	8.33,	.51,	11,	.49,	-4.79,
4,	.44,	2.401,	8.31,	.70,	11,	.30,	-3.97,

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,	.72,	1.028,	5.44,	.63,	11,	.37,	-3.21,
6,	1.06,	-.253,	2.22,	.71,	11,	.38,	-2.67,
7,	.99,	.047,	2.47,	.81,	11,	.31,	-2.41,
8,	1.38,	-1.136,	-.14,	.53,	11,	.62,	-2.33,

1

Fleet : SMB; a2 on a3; SE

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	-1.04,	-.42,	.05,	.79,	.25,	-.57,	-1.01,	.13,	.93,	.62
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,	.59,	.760,	8.23,	.32,	10,	.76,	-5.68,

1

Fleet : SMB; SW

Age	1984
3	-.23
4	-.16
5	-.03
6	.17
7	.05
8	.30
9	No data for this fleet at this age
10	No data for this fleet at this age

Continued

Table 3.3.9 Continued

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	-.81	-.37	-.27	.76	.02	.30	-.43	.36	.37	-.02
4	-.36	-.99	-.16	.40	.55	.32	-.29	.16	.03	.23
5	-.39	-.42	-.56	.25	.29	.53	.01	.11	-.17	.15
6	-.38	-.38	-.12	-.31	.43	.69	.19	-.25	-.28	.12
7	-.32	-.40	.13	-.08	-.02	.41	.45	-.06	-.38	.11
8	-.22	-.49	-.44	.54	.23	.89	.20	-.21	-.30	-.53
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 and constant w.r.t. time

Age	5	6	7	8
Mean Log q	-2.7064	-2.4927	-2.4475	-2.6065
S.E(Log q)	.3363	.3625	.2893	.4750

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	1.07	-.205	3.18	.53	11	.47	-3.74
4	1.01	-.019	3.07	.50	11	.45	-3.13

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	.82	.861	4.22	.75	11	.28	-2.71
6	.74	1.819	4.61	.86	11	.24	-2.49
7	.76	2.409	4.20	.93	11	.18	-2.45
8	.89	.478	3.31	.69	11	.44	-2.61

1

Fleet : SMB; a2 on a3; SW

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	-.71	.05	.05	-.49	.04	-.48	.36	.31	.55	.10
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									

Continued

Table 3.3.9 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,	1.20,	-.642,	2.94,	.59,	10,	.43,	-4.42,

1

Fleet : SMB; a1 on a3; SW

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	99.99	-.40	.23	-.53	-.85	.65	-.47	.34	.19	.73
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,	.97,	.058,	5.82,	.45,	9,	.61,	-5.66,

1

Fleet : Trawl; N; J-D

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	No data for this fleet at this age									
4	99.99	99.99	99.99	99.99	99.99	-.04	.00	.05	-.12	.11
5	99.99	99.99	99.99	99.99	99.99	-.24	.14	.09	-.02	.03
6	99.99	99.99	99.99	99.99	99.99	.01	.24	.25	-.22	-.27
7	99.99	99.99	99.99	99.99	99.99	-.56	.00	.40	.38	-.24
8	99.99	99.99	99.99	99.99	99.99	-1.06	-.23	-.07	.57	.77
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 and constant w.r.t. time

Age	5	6	7	8
Mean Log q,	-1.4038,	-1.2444,	-1.4091,	-1.7993,
S.E(Log q),	.1470,	.2460,	.4098,	.7246,

Continued

Table 3.3.9 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
4,	.71,	1.915,	4.65,	.94,	5,	.10,	-1.82,

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,	1.30,	-1.125,	-1.50,	.82,	5,	.19,	-1.40,
6,	.93,	.403,	1.93,	.91,	5,	.26,	-1.24,
7,	1.29,	-.888,	-1.05,	.75,	5,	.55,	-1.41,
8,	1.69,	-.869,	-2.95,	.35,	5,	1.26,	-1.80,

1

Fleet : Trawl; SE; J-D

Age	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
3	No data for this fleet at this age									
4	99.99,	99.99,	99.99,	99.99,	99.99,	-.03,	-.34,	.16,	-.32,	.52
5	99.99,	99.99,	99.99,	99.99,	99.99,	-.01,	-.32,	-.07,	.20,	.20
6	99.99,	99.99,	99.99,	99.99,	99.99,	-.06,	-.46,	.24,	.41,	-.14
7	99.99,	99.99,	99.99,	99.99,	99.99,	.00,	-.69,	.25,	.58,	-.14
8	99.99,	99.99,	99.99,	99.99,	99.99,	-.18,	-.04,	.19,	.41,	-.38
9	99.99,	99.99,	99.99,	99.99,	99.99,	-.01,	.71,	-.53,	.54,	-.70
10	99.99,	99.99,	99.99,	99.99,	99.99,	.35,	.13,	-.28,	.56,	-.58

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,	8,	9,	10
Mean Log q,	-2.6224,	-1.9544,	-1.2752,	-1.1154,	-1.0446,	-1.0446,
S.E(Log q),	.2186,	.3415,	.4749,	.3096,	.6277,	.4665,

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,	.43,	.904,	7.96,	.46,	5,	.42,	-3.30,

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

Continued

Table 3.3.9 Continued

5,	.84,	.540,	3.95,	.80,	5,	.20,	-2.62,
6,	1.21,	-.654,	.17,	.77,	5,	.45,	-1.95,
7,	1.74,	-1.893,	-5.01,	.69,	5,	.64,	-1.28,
8,	.85,	.894,	2.26,	.92,	5,	.27,	-1.12,
9,	.87,	.272,	1.90,	.60,	5,	.63,	-1.04,
10,	.81,	.503,	2.08,	.71,	5,	.42,	-1.01,

1

Fleet : Trawl; N; J-M

Age ,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
3 ,	No data for this fleet at this age									
4 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.36,	-.03,	.44,	.05,	-.11
5 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.49,	-.08,	.36,	.24,	-.05
6 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.49,	.09,	.30,	.04,	.04
7 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.09,	.01,	-.13,	-.63,	.66
8 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.37,	-.97,	-.25,	-.30,	1.13
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 and constant w.r.t. time

Age ,	5,	6,	7,	8
Mean Log q,	-1.7082,	-1.0698,	-1.4400,	-2.0438,
S.E(Log q),	.3302,	.2922,	.4651,	.7936,

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,	.38,	1.231,	8.24,	.57,	5,	.33,	-2.87,

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,	1.96,	-1.029,	-7.23,	.28,	5,	.64,	-1.71,
6,	1.56,	-2.931,	-4.21,	.90,	5,	.27,	-1.07,
7,	.90,	.343,	2.26,	.80,	5,	.48,	-1.44,
8,	5.83,	-2.641,	-30.22,	.09,	5,	2.92,	-2.04,

1

Continued

Table 3.3.9 Continued

Fleet : Trawl; SE; J-M

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	No data for this fleet at this age									
4	99.99	99.99	99.99	99.99	99.99	-1.67	99.99	-.48	.59	1.53
5	99.99	99.99	99.99	99.99	99.99	-.25	99.99	-.23	-.19	.66
6	99.99	99.99	99.99	99.99	99.99	.01	-1.21	.84	.09	.26
7	99.99	99.99	99.99	99.99	99.99	.41	-.20	.22	-.61	.19
8	99.99	99.99	99.99	99.99	99.99	-.57	.47	-.06	-.05	.20
9	99.99	99.99	99.99	99.99	99.99	99.99	.19	-.75	.17	.39
10	99.99	99.99	99.99	99.99	99.99	-.68	99.99	-.47	.53	.29

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	8	9	10
Mean Log q	-2.3232	-1.9212	-1.3679	-1.3843	-1.2255	-1.2255
S.E(Log q)	.4444	.7494	.4085	.3850	.5129	.5926

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	.23	3.378	9.68	.91	4	.15	-3.69

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	.65	.633	5.40	.62	4	.32	-2.32
6	1.85	-.816	-5.31	.24	5	1.45	-1.92
7	.83	.788	2.80	.88	5	.36	-1.37
8	.93	.285	1.92	.84	5	.41	-1.38
9	2.22	-1.482	-6.85	.43	4	.96	-1.23
10	.51	3.193	4.06	.95	4	.15	-1.31

1

Terminal year survivor and F summaries :

Age 3 Catchability dependent on age and year class strength

Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SMB; N	42105.	.329	.000	.00	1	.162	.124
SMB; a2 on a3; N	41825.	.300	.000	.00	1	.195	.125
SMB; a1 on a3; N	38764.	.308	.000	.00	1	.184	.134
SMB; SE	84954.	.514	.000	.00	1	.066	.064
SMB; a2 on a3; SE	105103.	.798	.000	.00	1	.027	.052
SMB; SW	55716.	.524	.000	.00	1	.064	.095

Continued

Table 3.3.9 Continued

SMB; a2 on a3; SW ,	62751.,	.476,	.000,	.00,	1,	.077,	.085
SMB; a1 on a3; SW ,	117326.,	.645,	.000,	.00,	1,	.042,	.046
Trawl; N; J-D ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; SE; J-D ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; N; J-M ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; SE; J-M ,	1.,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean ,	125902.,	.43,,,,				.105,	.043
F shrinkage mean ,	67382.,	.50,,,,				.077,	.079

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
56748.,	.13,	.14,	10,	1.078,	.094

1
Age 4 Catchability dependent on age and year class strength

Year class = 1990

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SMB; N ,	59115.,	.213,	.014,	.07,	2,	.207,	.314
SMB; a2 on a3; N ,	70403.,	.300,	.000,	.00,	1,	.097,	.270
SMB; a1 on a3; N ,	89947.,	.300,	.000,	.00,	1,	.097,	.217
SMB; SE ,	110508.,	.272,	.095,	.35,	2,	.130,	.180
SMB; a2 on a3; SE ,	217857.,	.871,	.000,	.00,	1,	.011,	.096
SMB; SW ,	115238.,	.353,	.071,	.20,	2,	.075,	.174
SMB; a2 on a3; SW ,	149710.,	.491,	.000,	.00,	1,	.036,	.136
SMB; a1 on a3; SW ,	104186.,	.656,	.000,	.00,	1,	.020,	.190
Trawl; N; J-D ,	96159.,	.300,	.000,	.00,	1,	.110,	.205
Trawl; SE; J-D ,	144664.,	.576,	.000,	.00,	1,	.030,	.141
Trawl; N; J-M ,	77269.,	.374,	.000,	.00,	1,	.071,	.249
Trawl; SE; J-M ,	395525.,	1.539,	.000,	.00,	1,	.004,	.054
P shrinkage mean ,	78048.,	.46,,,,				.060,	.247
F shrinkage mean ,	60776.,	.50,,,,				.050,	.307

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
86015.,	.10,	.08,	17,	.797,	.226

Continued

Table 3.3.9 Continued1

Age 5 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
SMB; N ,	37676.,	.176,	.106,	.60,	3,	.205,	.387
SMB; a2 on a3; N ,	46185.,	.300,	.000,	.00,	1,	.057,	.326
SMB; a1 on a3; N ,	40797.,	.300,	.000,	.00,	1,	.057,	.362
SMB; SE ,	62363.,	.243,	.165,	.68,	3,	.102,	.251
SMB; a2 on a3; SE ,	54986.,	.805,	.000,	.00,	1,	.008,	.280
SMB; SW ,	56292.,	.252,	.077,	.31,	3,	.106,	.275
SMB; a2 on a3; SW ,	65650.,	.472,	.000,	.00,	1,	.023,	.240
SMB; a1 on a3; SW ,	67361.,	.663,	.000,	.00,	1,	.012,	.234
Trawl; N; J-D ,	46386.,	.215,	.070,	.33,	2,	.147,	.325
Trawl; SE; J-D ,	52003.,	.253,	.224,	.88,	2,	.112,	.294
Trawl; N; J-M ,	47671.,	.270,	.049,	.18,	2,	.095,	.317
Trawl; SE; J-M ,	92637.,	.475,	.019,	.04,	2,	.033,	.176
F shrinkage mean ,	30397.,	.50,,,,				.042,	.461

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
48043.,	.08,	.06,	23,	.692,	.315

1

Age 6 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
SMB; N ,	8400.,	.166,	.136,	.82,	4,	.191,	.560
SMB; a2 on a3; N ,	10208.,	.302,	.000,	.00,	1,	.030,	.481
SMB; a1 on a3; N ,	12897.,	.302,	.000,	.00,	1,	.030,	.398
SMB; SE ,	13445.,	.218,	.099,	.46,	4,	.118,	.384
SMB; a2 on a3; SE ,	3448.,	.913,	.000,	.00,	1,	.003,	1.040
SMB; SW ,	9369.,	.226,	.108,	.48,	4,	.111,	.514
SMB; a2 on a3; SW ,	13673.,	.459,	.000,	.00,	1,	.013,	.379
SMB; a1 on a3; SW ,	5959.,	.697,	.000,	.00,	1,	.006,	.722
Trawl; N; J-D ,	8330.,	.186,	.099,	.53,	3,	.168,	.563
Trawl; SE; J-D ,	9888.,	.221,	.114,	.52,	3,	.119,	.493
Trawl; N; J-M ,	11155.,	.215,	.107,	.50,	3,	.130,	.448
Trawl; SE; J-M ,	9161.,	.427,	.165,	.39,	3,	.031,	.524
F shrinkage mean ,	5490.,	.50,,,,				.051,	.765

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
9505.,	.08,	.05,	30,	.682,	.509

1

Continued

Table 3.3.9 Continued

Age 7 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
SMB; N	,	3435.,	.183,	.067,	.37,	5,	.153,	.769
SMB; a2 on a3; N	,	3187.,	.304,	.000,	.00,	1,	.016,	.810
SMB; a1 on a3; N	,	4333.,	.304,	.000,	.00,	1,	.016,	.651
SMB; SE	,	4147.,	.208,	.107,	.51,	5,	.162,	.672
SMB; a2 on a3; SE	,	2123.,	.836,	.000,	.00,	1,	.002,	1.055
SMB; SW	,	3877.,	.210,	.084,	.40,	5,	.162,	.706
SMB; a2 on a3; SW	,	2328.,	.484,	.000,	.00,	1,	.006,	.996
SMB; a1 on a3; SW	,	7180.,	.671,	.000,	.00,	1,	.003,	.441
Trawl; N; J-D	,	3257.,	.199,	.079,	.40,	4,	.135,	.798
Trawl; SE; J-D	,	3887.,	.238,	.151,	.64,	4,	.096,	.704
Trawl; N; J-M	,	5059.,	.227,	.167,	.74,	4,	.106,	.580
Trawl; SE; J-M	,	4240.,	.357,	.102,	.29,	3,	.062,	.661
F shrinkage mean	,	2668.,	.50,,,,				.078,	.912

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3761.,	.08,	.04,	36,	.514,	.721

1

Age 8 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
SMB; N	,	523.,	.226,	.044,	.19,	6,	.126,	1.155
SMB; a2 on a3; N	,	728.,	.307,	.000,	.00,	1,	.009,	.941
SMB; a1 on a3; N	,	574.,	.307,	.000,	.00,	1,	.009,	1.093
SMB; SE	,	616.,	.232,	.186,	.80,	6,	.139,	1.046
SMB; a2 on a3; SE	,	732.,	.824,	.000,	.00,	1,	.001,	.937
SMB; SW	,	395.,	.231,	.087,	.38,	6,	.136,	1.356
SMB; a2 on a3; SW	,	596.,	.486,	.000,	.00,	1,	.004,	1.068
SMB; a1 on a3; SW	,	243.,	.787,	.000,	.00,	1,	.001,	1.736
Trawl; N; J-D	,	814.,	.238,	.129,	.54,	5,	.090,	.875
Trawl; SE; J-D	,	466.,	.247,	.168,	.68,	5,	.161,	1.236
Trawl; N; J-M	,	666.,	.281,	.333,	1.19,	5,	.068,	.996
Trawl; SE; J-M	,	577.,	.324,	.225,	.70,	4,	.101,	1.089
F shrinkage mean	,	728.,	.50,,,,				.154,	.941

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
570.,	.11,	.06,	43,	.545,	1.097

Continued

Table 3.3.9 Continued

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

Year class = 1985

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
SMB; N ,	391.,	.226,	.081,	.36,	6,	.088,	.870
SMB; a2 on a3; N ,	600.,	.313,	.000,	.00,	1,	.007,	.644
SMB; a1 on a3; N ,	494.,	.313,	.000,	.00,	1,	.007,	.741
SMB; SE ,	348.,	.233,	.090,	.39,	6,	.096,	.940
SMB; a2 on a3; SE ,	903.,	.882,	.000,	.00,	1,	.001,	.470
SMB; SW ,	391.,	.236,	.129,	.55,	6,	.092,	.870
SMB; a2 on a3; SW ,	252.,	.483,	.000,	.00,	1,	.003,	1.148
SMB; a1 on a3; SW ,	242.,	.682,	.000,	.00,	1,	.001,	1.176
Trawl; N; J-D ,	547.,	.265,	.159,	.60,	4,	.055,	.689
Trawl; SE; J-D ,	381.,	.295,	.256,	.87,	5,	.173,	.884
Trawl; N; J-M ,	349.,	.298,	.118,	.40,	4,	.044,	.937
Trawl; SE; J-M ,	501.,	.346,	.133,	.39,	5,	.162,	.734
F shrinkage mean ,	401.,	.50,,,,				.272,	.855

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
410.,	.16,	.05,	42,	.301,	.842

1

Age 10 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
SMB; N ,	336.,	.190,	.079,	.41,	6,	.054,	.862
SMB; a2 on a3; N ,	396.,	.320,	.000,	.00,	1,	.006,	.771
SMB; a1 on a3; N ,	412.,	.320,	.000,	.00,	1,	.006,	.749
SMB; SE ,	356.,	.213,	.143,	.67,	6,	.053,	.828
SMB; a2 on a3; SE ,	383.,	.882,	.000,	.00,	1,	.001,	.788
SMB; SW ,	448.,	.211,	.154,	.73,	6,	.052,	.706
SMB; a2 on a3; SW ,	382.,	.518,	.000,	.00,	1,	.002,	.790
SMB; a1 on a3; SW ,	461.,	.741,	.000,	.00,	1,	.001,	.692
Trawl; N; J-D ,	359.,	.292,	.024,	.08,	3,	.025,	.825
Trawl; SE; J-D ,	265.,	.359,	.207,	.58,	5,	.236,	1.007
Trawl; N; J-M ,	280.,	.319,	.149,	.47,	3,	.021,	.972
Trawl; SE; J-M ,	440.,	.406,	.077,	.19,	5,	.166,	.715
F shrinkage mean ,	409.,	.50,,,,				.378,	.753

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
365.,	.22,	.05,	40,	.235,	.816

Continued

Table 3.3.9 Continued

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SMB; N ,	170.,	.200,	.206,	1.03,	6,	.062,	.919
SMB; a2 on a3; N ,	219.,	.331,	.000,	.00,	1,	.005,	.774
SMB; a1 on a3; N ,	193.,	.331,	.000,	.00,	1,	.005,	.844
SMB; SE ,	239.,	.213,	.153,	.72,	6,	.065,	.727
SMB; a2 on a3; SE ,	166.,	.892,	.000,	.00,	1,	.001,	.932
SMB; SW ,	340.,	.213,	.076,	.36,	6,	.064,	.561
SMB; a2 on a3; SW ,	267.,	.553,	.000,	.00,	1,	.002,	.673
SMB; a1 on a3; SW ,	170.,	.725,	.000,	.00,	1,	.001,	.918
Trawl; N; J-D ,	167.,	.425,	.158,	.37,	2,	.020,	.930
Trawl; SE; J-D ,	310.,	.301,	.236,	.78,	4,	.161,	.602
Trawl; N; J-M ,	176.,	.479,	.524,	1.09,	2,	.016,	.898
Trawl; SE; J-M ,	294.,	.326,	.324,	1.00,	4,	.125,	.627
F shrinkage mean ,	242.,	.50,,,,				.473,	.721

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
254.,	.25,	.06,	36,	.245,	.697

1

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SMB; N ,	25.,	.214,	.092,	.43,	6,	.036,	1.007
SMB; a2 on a3; N ,	42.,	.346,	.000,	.00,	1,	.003,	.722
SMB; a1 on a3; N ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; SE ,	40.,	.220,	.081,	.37,	6,	.040,	.747
SMB; a2 on a3; SE ,	13.,	.994,	.000,	.00,	1,	.000,	1.489
SMB; SW ,	44.,	.224,	.249,	1.11,	6,	.039,	.702
SMB; a2 on a3; SW ,	18.,	.563,	.000,	.00,	1,	.001,	1.243
SMB; a1 on a3; SW ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; N; J-D ,	13.,	.804,	.000,	.00,	1,	.005,	1.509
Trawl; SE; J-D ,	33.,	.332,	.242,	.73,	3,	.108,	.856
Trawl; N; J-M ,	53.,	.880,	.000,	.00,	1,	.004,	.608
Trawl; SE; J-M ,	27.,	.373,	.224,	.60,	3,	.079,	.975
F shrinkage mean ,	39.,	.50,,,,				.683,	.761

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
36.,	.35,	.05,	30,	.151,	.796

1

Continued

Table 3.3.9 Continued

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1981

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SMB; N ,	37.,	.238,	.054,	.23,	6,	.045,	.363
SMB; a2 on a3; N ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; a1 on a3; N ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; SE ,	38.,	.239,	.104,	.43,	6,	.051,	.361
SMB; a2 on a3; SE ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; SW ,	30.,	.240,	.090,	.38,	6,	.049,	.432
SMB; a2 on a3; SW ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; a1 on a3; SW ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; N; J-D ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; SE; J-D ,	33.,	.433,	.056,	.13,	2,	.119,	.399
Trawl; N; J-M ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; SE; J-M ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	29.,	.50,,,,				.736,	.450

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
30.,	.37,	.04,	21,	.103,	.434

1

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 9

Year class = 1980

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
SMB; N ,	9.,	.248,	.093,	.37,	5,	.005,	.472
SMB; a2 on a3; N ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; a1 on a3; N ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; SE ,	8.,	.243,	.256,	1.05,	5,	.006,	.532
SMB; a2 on a3; SE ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; SW ,	6.,	.246,	.172,	.70,	5,	.005,	.631
SMB; a2 on a3; SW ,	1.,	.000,	.000,	.00,	0,	.000,	.000
SMB; a1 on a3; SW ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; N; J-D ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; SE; J-D ,	7.,	.518,	.000,	.00,	1,	.020,	.555
Trawl; N; J-M ,	1.,	.000,	.000,	.00,	0,	.000,	.000
Trawl; SE; J-M ,	3.,	.671,	.000,	.00,	1,	.012,	1.129
F shrinkage mean ,	5.,	.50,,,,				.952,	.724

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5.,	.48,	.04,	18,	.079,	.721

Table 3.3.10: Icelandic cod, fishing mortality.

Age	1975	1976	1977	1978	1979	1980	1981
3	0.131	0.083	0.020	0.030	0.033	0.034	0.016
4	0.299	0.263	0.212	0.169	0.195	0.176	0.137
5	0.521	0.363	0.355	0.351	0.211	0.358	0.388
6	0.569	0.617	0.368	0.333	0.513	0.378	0.470
7	0.643	0.596	0.810	0.494	0.487	0.442	0.635
8	0.808	0.938	0.657	0.660	0.503	0.554	0.839
9	1.069	0.764	0.995	0.505	0.507	0.514	0.802
10	1.176	1.270	0.608	0.530	0.339	0.453	0.950
11	1.348	1.363	0.562	0.343	0.531	0.425	0.982
12	1.767	0.940	0.547	0.719	0.200	0.700	0.904
13	0.821	2.490	0.078	0.806	1.020	0.171	1.076
14	1.236	1.365	0.558	0.580	0.519	0.453	0.943
W.Av 5-10	0.569	0.521	0.438	0.372	0.403	0.404	0.528
Ave 5-10	0.798	0.758	0.632	0.479	0.427	0.450	0.681

Age	1982	1983	1984	1985	1986	1987	1988
3	0.027	0.017	0.055	0.051	0.070	0.045	0.045
4	0.221	0.120	0.211	0.288	0.222	0.310	0.222
5	0.400	0.433	0.323	0.388	0.580	0.519	0.507
6	0.541	0.622	0.539	0.572	0.697	0.782	0.839
7	0.581	0.767	0.598	0.683	0.883	0.976	0.946
8	1.046	0.852	0.900	0.730	0.936	0.994	1.393
9	1.187	0.930	0.746	0.801	0.806	0.975	1.112
10	0.910	1.082	0.634	0.770	0.763	0.707	0.986
11	0.479	0.671	0.639	0.612	0.740	0.581	1.030
12	0.404	0.678	0.587	0.641	0.672	0.665	0.902
13	0.417	0.533	0.685	0.711	0.445	0.739	2.332
14	0.679	0.779	0.658	0.707	0.685	0.733	1.272
W.Av 5-10	0.582	0.609	0.479	0.486	0.688	0.697	0.629
Ave 5-10	0.777	0.781	0.623	0.658	0.777	0.826	0.964

Age	1989	1990	1991	1992	1993	1994	1991-1994
3	0.036	0.050	0.101	0.079	0.132	0.094	0.101
4	0.266	0.236	0.317	0.397	0.316	0.226	0.314
5	0.485	0.446	0.523	0.651	0.538	0.315	0.507
6	0.603	0.640	0.778	0.951	0.820	0.509	0.764
7	0.730	0.789	0.949	1.107	0.939	0.721	0.929
8	0.858	0.823	0.795	1.023	1.149	1.097	1.016
9	0.819	0.753	0.794	0.632	1.229	0.842	0.874
10	0.546	0.836	0.792	0.549	0.996	0.816	0.788
11	0.663	0.624	0.963	0.330	0.973	0.697	0.741
12	0.970	0.768	0.828	0.710	0.435	0.796	0.692
13	0.572	0.434	0.375	0.360	0.571	0.434	0.435
14	0.714	0.683	0.750	0.516	0.841	0.717	0.706
W.Av 5-10	0.544	0.597	0.759	0.810	0.735	0.406	0.632
Ave 5-10	0.674	0.715	0.772	0.819	0.945	0.717	0.813

Table 3.3.11: Icelandic cod, stock in numbers (millions).

Age	1975	1976	1977	1978	1979	1980	1981
3	263.225	326.296	143.293	221.658	245.524	144.036	143.276
4	125.194	189.100	245.880	114.958	176.062	194.531	114.001
5	118.923	75.994	119.035	162.909	79.448	118.551	133.572
6	30.450	57.836	43.280	68.303	93.925	52.650	67.877
7	22.158	14.113	25.539	24.515	40.088	83.049	29.534
8	7.251	9.536	6.364	9.306	12.250	20.159	50.702
9	3.386	2.646	3.055	2.700	3.939	6.065	9.481
10	1.177	0.951	1.009	0.925	1.335	1.942	2.970
11	1.300	0.297	0.219	0.450	0.446	0.778	1.011
12	0.538	0.276	0.062	0.102	0.261	0.214	0.417
13	0.117	0.075	0.088	0.030	0.041	0.175	0.087
14	0.070	0.042	0.005	0.067	0.011	0.012	0.121
Juvenile	476.849	563.481	499.603	491.743	526.242	477.625	450.111
Adult	96.939	113.682	88.226	114.180	127.087	144.537	102.937
Sum 3- 3	263.225	326.296	143.293	221.658	245.524	144.036	143.276
Sum 4-14	310.563	350.867	444.535	384.265	407.805	478.126	409.772
Total	573.788	677.164	587.828	605.923	653.329	622.162	553.048

Age	1982	1983	1984	1985	1986	1987	1988
3	133.575	226.325	139.131	143.952	335.543	277.539	168.349
4	115.392	106.396	182.089	107.819	112.030	256.095	217.299
5	81.352	75.744	77.274	120.679	66.202	73.425	153.836
6	74.180	44.654	40.215	45.818	67.038	30.362	35.762
7	34.736	35.351	19.622	19.204	21.167	27.346	11.368
8	12.818	15.903	13.438	8.836	7.942	7.168	8.435
9	17.940	3.687	5.554	4.472	3.485	2.551	2.172
10	3.480	4.482	1.191	2.156	1.643	1.274	0.788
11	0.940	1.147	1.244	0.517	0.817	0.627	0.515
12	0.310	0.476	0.480	0.538	0.230	0.319	0.287
13	0.138	0.170	0.198	0.219	0.232	0.096	0.134
14	0.024	0.075	0.081	0.082	0.088	0.122	0.038
Juvenile	383.315	444.548	406.093	361.287	531.192	607.731	515.801
Adult	91.571	69.862	74.426	93.004	85.224	69.195	83.184
Sum 3- 3	133.576	226.324	139.131	143.952	335.543	277.540	168.349
Sum 4-14	341.311	288.085	341.388	310.340	280.873	399.386	430.635
Total	474.886	514.410	480.519	454.291	616.416	676.926	598.985

Age	1989	1990	1991	1992	1993	1994	1995
3	81.494	130.347	98.086	176.944	182.761	60.000	110.000
4	131.773	64.370	101.498	72.592	133.848	131.154	44.717
5	142.518	82.720	41.622	60.517	39.953	79.861	85.659
6	75.880	102.826	43.355	20.204	25.843	19.106	47.717
7	12.651	33.993	44.380	16.308	6.391	9.321	9.403
8	3.616	4.994	12.639	14.066	4.415	2.045	3.711
9	1.715	1.255	1.795	4.674	4.139	1.145	0.559
10	0.585	0.619	0.484	0.665	2.033	0.991	0.404
11	0.241	0.278	0.220	0.180	0.314	0.615	0.359
12	0.150	0.102	0.122	0.069	0.106	0.097	0.251
13	0.095	0.047	0.039	0.044	0.028	0.056	0.036
14	0.011	0.044	0.025	0.022	0.025	0.013	0.030
Juvenile	343.603	308.919	242.095	259.595	239.933	147.046	142.779
Adult	107.127	112.673	102.169	106.688	159.921	157.360	160.066
Sum 3- 3	81.494	130.347	98.086	176.944	182.761	60.000	110.000
Sum 4-14	369.236	291.246	246.178	189.339	217.094	244.406	192.845
Total	450.730	421.592	344.264	366.283	399.855	304.406	302.845

Table 3.3.12: Icelandic cod, spawning stock ('000 tonnes).

Age	1975	1976	1977	1978	1979	1980	1981
3	1.744	18.341	0.000	10.689	0.000	10.271	0.000
4	23.444	16.044	18.155	8.826	5.033	6.867	4.674
5	111.993	46.708	60.349	75.078	34.391	46.055	20.608
6	54.649	101.364	92.719	102.240	164.297	82.994	52.345
7	83.233	36.343	93.539	101.232	142.178	293.393	65.636
8	32.934	39.358	29.197	44.333	60.424	97.902	174.045
9	15.076	15.111	13.639	18.244	23.794	35.896	44.875
10	5.594	5.008	6.946	7.402	9.432	15.614	15.691
11	5.684	1.747	2.002	4.695	4.251	7.633	6.445
12	2.158	1.935	0.634	0.887	2.946	2.469	3.193
13	0.756	0.304	1.381	0.365	0.317	2.450	0.582
14	0.365	0.320	0.092	1.024	0.152	0.233	1.052
Total	337.631	282.583	318.652	375.016	447.213	601.776	389.146

Age	1982	1983	1984	1985	1986	1987	1988
3	2.917	0.000	0.000	4.163	1.875	6.780	7.578
4	8.747	12.670	10.555	9.020	9.741	19.194	6.371
5	18.925	23.102	28.990	48.126	35.680	39.969	66.435
6	40.896	34.835	47.190	71.051	100.355	56.320	45.138
7	62.440	53.323	43.628	54.569	52.825	73.973	26.835
8	36.503	41.484	39.724	34.169	28.878	27.027	22.627
9	62.994	13.517	24.330	21.239	17.363	11.324	8.247
10	19.197	19.366	7.882	13.103	9.842	8.843	3.833
11	8.216	8.440	9.327	4.166	5.759	4.957	2.971
12	3.271	4.322	4.755	5.001	2.165	2.349	1.678
13	1.845	1.773	2.090	2.271	2.464	1.020	0.595
14	0.277	0.906	0.928	1.051	1.115	1.347	0.213
Total	266.227	213.739	219.398	267.930	268.064	253.102	192.522

Age	1989	1990	1991	1992	1993	1994
3	0.000	0.000	0.000	10.545	13.905	6.485
4	8.845	5.854	10.203	20.091	46.451	58.837
5	65.820	45.508	16.619	59.848	39.361	95.392
6	124.302	163.257	54.148	32.613	49.725	45.841
7	39.564	91.889	89.278	41.266	19.426	31.180
8	14.013	20.037	44.433	45.935	15.380	6.874
9	7.560	7.081	8.463	21.765	16.067	5.596
10	3.995	4.036	2.809	4.002	10.292	4.799
11	1.996	2.371	1.482	1.707	2.083	4.480
12	0.775	1.035	1.119	0.627	0.980	0.797
13	0.724	0.554	0.435	0.539	0.288	0.624
14	0.103	0.523	0.333	0.182	0.291	0.151
Total	267.698	342.144	229.322	239.121	214.251	261.056

Table 3.3.13: Icelandic cod, average fishing mortality of 5-10 years old, recruitment (age 3, millions), spawning stock at time of spawning ('000 tonnes) and juvenile (immature at time of spawning, '000 tonnes)

Year	*F 5-10*	*Recruitment*	*SSB*	*Juvenile*
1955	0.31	260	1261	1091
1956	0.26	307	1199	970
1957	0.32	153	1145	839
1958	0.32	191	1034	826
1959	0.33	143	928	900
1960	0.38	163	825	831
1961	0.33	292	760	798
1962	0.40	255	729	717
1963	0.45	273	683	630
1964	0.54	328	569	697
1965	0.61	174	454	787
1966	0.54	255	412	902
1967	0.49	186	476	1054
1968	0.67	178	594	994
1969	0.53	136	693	944
1970	0.56	303	684	836
1971	0.62	170	615	719
1972	0.71	265	477	584
1973	0.71	432	436	638
1974	0.76	145	329	680
1975	0.81	224	339	710
1976	0.78	248	282	867
1977	0.66	145	318	804
1978	0.49	145	374	861
1979	0.43	135	449	872
1980	0.46	229	605	880
1981	0.69	141	390	704
1982	0.79	146	265	623
1983	0.79	339	212	584
1984	0.63	338	218	605
1985	0.66	170	268	574
1986	0.78	82	270	769
1987	0.83	131	256	929
1988	0.97	98	194	833
1989	0.67	177	271	600
1990	0.72	183	346	399
1991	0.77	60	232	397
1992	0.82	110	241	273
1993	0.95	180	214	373
1994	0.717	60	261	

Table 3.3.14: Icelandic cod. Capelin biomass ('000 tonnes) used for prediction of cod mean weights.

Year	*immature*	*mature*	*total*
1979	1028	1358	2386
1980	502	980	1482
1981	527	471	998
1982	292	171	463
1983	685	315	1000
1984	984	966	1950
1985	1467	913	2380
1986	1414	1059	2473
1987	1003	1355	2358
1988	1083	993	2076
1989	434	1298	1732
1990	291	904	1195
1991	501	544	1045
1992	487	1106	1593
1993	662	1017	1679
1994	573	1063	1636
1995	696	914	1610
Average			1650

Table 3.3.15: Icelandic cod, input file for the RCT3 program.

```
ÞORSKUR. S.E. 0.2. Án CN3 (SMB-nýliðunarvísitala: HB-index, norðursvæði
1985-95; hb95.inn3)
4 20 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    54825  -11    -11    -11
82     144    22073  34532  -11    -11
83     336    79754  82614  36310  -11
84     278    90562  91880  53926  16775
85     168    69564  65640  25221  13289
86     81      8064  16735  5466   2653
87     130    21716  18147  15072  1699
88     98     16063  15943  11627  1933
89     180    33630  34874  14537  3505
90     180    17996  26851  20685  1750
91     -11    4173   5782   2330   233
92     -11    -11    17393  10968  1319
93     -11    -11    -11    28643  8579
94     -11    -11    -11    -11    492
```

Table 3.3.16: Icelandic cod, output from the RCT3 program.

```
hb95.inn3

 ÞORSKUR. S.E. 0.2. Án CN3 (SMB-nýliðunarvísitala: HB-index, norðursvæði 1985-
95;

 Data for    4 surveys over   20 years :    75 -   94

 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

          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 SUR4      0.61  -1.32   0.27  0.786     8  10.42    5.05    0.337    0.225
 SUR3      0.72  -2.46   0.24  0.845     7  10.46    5.03    0.309    0.267
 SUR2      0.72  -2.01   0.23  0.885     6   9.58    4.88    0.304    0.275
 SUR1      0.53   0.50   0.37  0.686     5   8.16    4.79    0.534    0.089

                                        VPA Mean =   5.09    0.421    0.144

 Yearclass =     90

          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 SUR4      0.62  -1.36   0.26  0.780     9   9.80    4.68    0.323    0.238
 SUR3      0.72  -2.52   0.23  0.832     8  10.20    4.87    0.292    0.292
 SUR2      0.74  -2.13   0.25  0.838     7   9.94    5.18    0.316    0.249
 SUR1      0.58   0.10   0.41  0.591     6   7.47    4.45    0.585    0.072

                                        VPA Mean =   5.09    0.408    0.149

 Yearclass =     91

          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

 SUR4      0.64  -1.57   0.31  0.684    10   8.34    3.79    0.478    0.186
 SUR3      0.74  -2.67   0.25  0.782     9   8.66    3.76    0.412    0.250
 SUR2      0.74  -2.13   0.23  0.838     8   7.75    3.58    0.406    0.258
 SUR1      0.69  -0.67   0.57  0.387     7   5.46    3.09    1.083    0.036

                                        VPA Mean =   5.09    0.397    0.270
```

Continued

Table 3.3.16 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									
SUR3	0.74	-2.66	0.26	0.780	9	9.76	4.58	0.329	0.320
SUR2	0.74	-2.12	0.23	0.837	8	9.30	4.72	0.290	0.412
SUR1	0.70	-0.73	0.58	0.380	7	7.19	4.28	0.798	0.054
					VPA Mean =		5.08	0.402	0.214

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									
SUR2	0.74	-2.12	0.23	0.836	8	10.26	5.43	0.292	0.607
SUR1	0.71	-0.80	0.59	0.371	7	9.06	5.60	0.803	0.080
					VPA Mean =		5.08	0.407	0.313

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									
SUR1	0.72	-0.90	0.60	0.359	7	6.20	3.57	1.030	0.138
					VPA Mean =		5.07	0.412	0.862

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
89	145	4.98	0.16	0.05	0.09	180	5.20
90	134	4.90	0.16	0.11	0.52	180	5.20
91	57	4.05	0.21	0.32	2.45		
92	113	4.73	0.19	0.12	0.43		
93	206	5.33	0.23	0.13	0.31		
94	129	4.86	0.38	0.52	1.83		

Table 3.3.17: Icelandic cod, ...

NO SUCH TABLES.

Table 3.3.18: Icelandic cod, ...

NO SUCH TABLES.

Table 3.3.19: Icelandic cod, input data to the long-term predictions.

13:05 Thursday, May 11, 1995

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	0.0200	0.0850	0.2500	1.054	0.0600	1.255
4	.	0.2000	0.0680	0.1800	0.2500	1.620	0.3300	1.783
5	.	0.2000	0.2490	0.2480	0.2500	2.529	0.6100	2.579
6	.	0.2000	0.5130	0.2960	0.2500	3.698	0.8600	3.623
7	.	0.2000	0.7690	0.3820	0.2500	5.075	1.0500	4.898
8	.	0.2000	0.9010	0.4370	0.2500	6.450	1.1600	6.302
9	.	0.2000	0.9520	0.4770	0.2500	7.785	1.1600	7.685
10	.	0.2000	0.9940	0.4770	0.2500	9.343	1.1600	9.346
11	.	0.2000	0.9830	0.4770	0.2500	11.132	1.1600	10.923
12	.	0.2000	0.9930	0.4770	0.2500	12.629	1.1600	12.767
13	.	0.2000	0.9930	0.4770	0.2500	14.457	1.1600	14.520
14	.	0.2000	1.0000	0.4770	0.2500	16.839	1.1600	17.235
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YIELD-95
Date and time: 11MAY95:13:11

Table 3.3.20: Icelandic cod, long-term predictions.

Cod in the Iceland Grounds (Fishing Area Va) 13:05 Thursday, May 11, 1

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.016	23564.436	2.341	18079.310	2.227	17197.572
0.0500	0.0500	0.131	806.611	4.574	19254.448	1.942	13968.187	1.809	12963.852
0.1000	0.1000	0.225	1267.207	4.232	16114.368	1.641	11005.116	1.498	9977.533
0.1500	0.1500	0.293	1526.056	3.962	13786.512	1.409	8836.199	1.263	7836.295
0.2000	0.2000	0.345	1667.327	3.746	12029.633	1.227	7223.118	1.083	6274.850
0.2500	0.2500	0.386	1740.192	3.568	10679.493	1.082	6003.938	0.941	5116.543
0.3000	0.3000	0.419	1773.415	3.421	9623.161	0.965	5067.558	0.828	4242.492
0.3500	0.3500	0.446	1783.841	3.296	8782.149	0.869	4336.968	0.736	3571.790
0.4000	0.4000	0.468	1781.344	3.189	8101.288	0.790	3758.204	0.661	3048.722
0.4500	0.4500	0.488	1771.709	3.096	7541.336	0.723	3293.019	0.599	2634.440
0.5000	0.5000	0.505	1758.322	3.014	7074.032	0.666	2913.987	0.547	2301.511
0.5500	0.5500	0.520	1743.159	2.942	6678.767	0.617	2601.201	0.502	2030.307
0.6000	0.6000	0.533	1727.361	2.877	6340.315	0.574	2340.030	0.464	1806.597
0.6500	0.6500	0.545	1711.580	2.818	6047.281	0.537	2119.594	0.430	1619.927
0.7000	0.7000	0.556	1696.177	2.765	5791.025	0.504	1931.698	0.401	1462.517
0.7500	0.7500	0.566	1681.342	2.717	5564.914	0.475	1770.094	0.375	1328.499
0.8000	0.8000	0.575	1667.167	2.672	5363.794	0.449	1629.966	0.353	1213.398
0.8500	0.8500	0.584	1653.681	2.631	5183.609	0.425	1507.556	0.332	1113.753
0.9000	0.9000	0.592	1640.884	2.593	5021.131	0.404	1399.901	0.314	1026.863
0.9500	0.9500	0.599	1628.754	2.557	4873.766	0.385	1304.640	0.298	950.594
1.0000	1.0000	0.606	1617.262	2.524	4739.405	0.368	1219.873	0.283	883.242
1.0500	1.0500	0.613	1606.371	2.492	4616.318	0.352	1144.059	0.269	823.437
1.1000	1.1000	0.619	1596.046	2.463	4503.072	0.337	1075.932	0.257	770.062
1.1500	1.1500	0.625	1586.250	2.435	4398.471	0.323	1014.450	0.246	722.204
1.2000	1.2000	0.630	1576.948	2.409	4301.509	0.311	958.744	0.236	679.107
1.2500	1.2500	0.635	1568.108	2.384	4211.332	0.300	908.085	0.226	640.144
1.3000	1.3000	0.640	1559.698	2.361	4127.214	0.289	861.860	0.217	604.787
1.3500	1.3500	0.645	1551.690	2.338	4048.528	0.279	819.547	0.209	572.592
1.4000	1.4000	0.649	1544.056	2.317	3974.735	0.270	780.700	0.201	543.183
1.4500	1.4500	0.654	1536.772	2.297	3905.365	0.261	744.938	0.194	516.239
1.5000	1.5000	0.658	1529.815	2.277	3840.010	0.253	711.931	0.188	491.482
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

```
Notes: Run name               : YIELD-95
       Date and time          : 06MAY95:17:29
       Computation of ref. F: Simple mean, age 5 - 10
       F-0.1 factor           : 0.1970
       F-max factor           : 0.3616
       F-0.1 reference F      : 0.1970
       F-max reference F      : 0.3616
       Recruitment            : Single recruit
```

Table 3.3.21: Icelandic cod, input data to the medium-term predictions.

Stock and recruitment parameters $R = \alpha S e^{-S/K} e^{-\gamma J}$, where S=spawning stock biomass, R=recruitment and J=juveniles:

α	K	γ
0.85	747	0.00002654

Stock CV values

On 1995 stock numbers	0.15
On 1992 yearclass abundance	0.20
On 1993 yearclass abundance	0.25
On 1994 yearclass abundance	0.30
On 1995 yearclass abundance	0.35

Table 3.3.22: Icelandic cod, input data to the short-term predictions.

13:05 Thursday, May 11, 1995

Cod in the Iceland Grounds (Fishing Area Va)

Prediction with management option table: Input data

Year: 1995								
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	110000.00	0.2000	0.0960	0.0850	0.2500	1057.000	0.0617	1358.000
4	44717.000	0.2000	0.2810	0.1800	0.2500	1621.000	0.1982	1853.000
5	85659.000	0.2000	0.5700	0.2480	0.2500	2348.000	0.3045	2600.000
6	47717.000	0.2000	0.7960	0.2960	0.2500	3446.000	0.4616	3526.000
7	9403.000	0.2000	0.8950	0.3820	0.2500	4845.000	0.5602	4784.000
8	3711.000	0.2000	0.9190	0.4370	0.2500	6514.000	0.6618	6340.000
9	559.000	0.2000	1.0000	0.4770	0.2500	7412.000	0.5472	7310.000
10	404.000	0.2000	0.8520	0.4770	0.2500	9113.000	0.4780	8867.000
11	359.000	0.2000	0.9850	0.4770	0.2500	11216.000	0.3735	11045.000
12	251.000	0.2000	1.0000	0.4770	0.2500	13103.000	0.3735	13286.000
13	36.000	0.2000	1.0000	0.4770	0.2500	14603.000	0.3735	14843.000
14	30.000	0.2000	1.0000	0.4770	0.2500	16830.000	0.3735	16453.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Year: 1996								
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	210000.00	0.2000	0.0750	0.0850	0.2500	1057.000	0.0617	1358.000
4	.	0.2000	0.2270	0.1800	0.2500	1621.000	0.1982	1830.000
5	.	0.2000	0.4920	0.2480	0.2500	2349.000	0.3045	2554.000
6	.	0.2000	0.7360	0.2960	0.2500	3438.000	0.4616	3558.000
7	.	0.2000	0.8710	0.3820	0.2500	4722.000	0.5602	4687.000
8	.	0.2000	0.9160	0.4370	0.2500	6270.000	0.6618	6146.000
9	.	0.2000	0.9850	0.4770	0.2500	7414.000	0.5472	7310.000
10	.	0.2000	0.8850	0.4770	0.2500	9113.000	0.4780	8867.000
11	.	0.2000	0.9870	0.4770	0.2500	11216.000	0.3735	11045.000
12	.	0.2000	0.9900	0.4770	0.2500	13103.000	0.3735	13286.000
13	.	0.2000	0.9950	0.4770	0.2500	14603.000	0.3735	14843.000
14	.	0.2000	1.0000	0.4770	0.2500	16830.000	0.3735	16453.000
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	130000.00	0.2000	0.0550	0.0850	0.2500	1057.000	0.0617	1358.000
4	.	0.2000	0.1720	0.1800	0.2500	1621.000	0.1982	1830.000
5	.	0.2000	0.4150	0.2480	0.2500	2349.000	0.3045	2548.000
6	.	0.2000	0.6760	0.2960	0.2500	3439.000	0.4616	3532.000
7	.	0.2000	0.8480	0.3820	0.2500	4717.000	0.5602	4713.000
8	.	0.2000	0.9130	0.4370	0.2500	6175.000	0.6618	6086.000
9	.	0.2000	0.9700	0.4770	0.2500	7412.000	0.5472	7310.000
10	.	0.2000	0.9170	0.4770	0.2500	9113.000	0.4780	8867.000
11	.	0.2000	0.9900	0.4770	0.2500	11216.000	0.3735	11045.000
12	.	0.2000	0.9800	0.4770	0.2500	13103.000	0.3735	13285.000
13	.	0.2000	0.9900	0.4770	0.2500	14603.000	0.3735	14843.000
14	.	0.2000	1.0000	0.4770	0.2500	16830.000	0.3735	16453.000
Unit	Thousands	-	-	-	-	Grams	-	Grams

Notes: Run name : PRED-95
Date and time: 11MAY95:13:09

Table 3.3.23: Icelandic cod,short-term predictions.

Cod in the Iceland Grounds (Fishing Area Va)　　　13:05 Thursday, May 11, 1995

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
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	0.5022	640218	298126	165000	0.0000	0.0000	772807	343183	0	1035109	483966
.	.	.	.	.	0.0500	0.0251	.	340558	11181	1022009	470095
.	.	.	.	.	0.1000	0.0502	.	337958	22135	1009185	456700
.	.	.	.	.	0.1500	0.0753	.	335383	32866	996632	443763
.	.	.	.	.	0.2000	0.1004	.	332832	43380	984343	431267
.	.	.	.	.	0.2500	0.1256	.	330305	53682	972312	419195
.	.	.	.	.	0.3000	0.1507	.	327802	63777	960532	407534
.	.	.	.	.	0.3500	0.1758	.	325322	73670	948997	396266
.	.	.	.	.	0.4000	0.2009	.	322866	83365	937702	385379
.	.	.	.	.	0.4500	0.2260	.	320433	92868	926641	374858
.	.	.	.	.	0.5000	0.2511	.	318022	102182	915808	364691
.	.	.	.	.	0.5500	0.2762	.	315635	111313	905198	354863
.	.	.	.	.	0.6000	0.3013	.	313269	120264	894805	345363
.	.	.	.	.	0.6500	0.3264	.	310926	129040	884625	336180
.	.	.	.	.	0.7000	0.3516	.	308604	137644	874652	327301
.	.	.	.	.	0.7500	0.3767	.	306305	146081	864881	318716
.	.	.	.	.	0.8000	0.4018	.	304027	154355	855309	310414
.	.	.	.	.	0.8500	0.4269	.	301769	162469	845929	302385
.	.	.	.	.	0.9000	0.4520	.	299533	170428	836737	294619
.	.	.	.	.	0.9500	0.4771	.	297318	178234	827730	287108
.	.	.	.	.	1.0000	0.5022	.	295124	185891	818902	279840
.	.	.	.	.	1.0500	0.5273	.	292949	193403	810250	272809
.	.	.	.	.	1.1000	0.5524	.	290795	200772	801769	266006
.	.	.	.	.	1.1500	0.5775	.	288661	208003	793455	259421
.	.	.	.	.	1.2000	0.6027	.	286546	215099	785305	253049
.	.	.	.	.	1.2500	0.6278	.	284451	222061	777315	246881
.	.	.	.	.	1.3000	0.6529	.	282376	228894	769480	240910
.	.	.	.	.	1.3500	0.6780	.	280319	235601	761798	235129
.	.	.	.	.	1.4000	0.7031	.	278282	242184	754265	229531
.	.	.	.	.	1.4500	0.7282	.	276263	248646	746877	224111
.	.	.	.	.	1.5000	0.7533	.	274263	254990	739632	218861
.	.	.	.	.	1.5500	0.7784	.	272281	261218	732525	213776
.	.	.	.	.	1.6000	0.8035	.	270317	267334	725553	208850
.	.	.	.	.	1.6500	0.8287	.	268371	273339	718714	204077
.	.	.	.	.	1.7000	0.8538	.	266444	279236	712005	199452
.	.	.	.	.	1.7500	0.8789	.	264533	285027	705422	194971
.	.	.	.	.	1.8000	0.9040	.	262640	290716	698963	190627
.	.	.	.	.	1.8500	0.9291	.	260765	296304	692624	186417
.	.	.	.	.	1.9000	0.9542	.	258906	301793	686403	182335
.	.	.	.	.	1.9500	0.9793	.	257065	307185	680298	178378
.	.	.	.	.	2.0000	1.0044	.	255240	312484	674306	174540
.	.	.	.	.	2.0500	1.0295	.	253432	317690	668424	170819
.	.	.	.	.	2.1000	1.0547	.	251640	322806	662649	167209
.	.	.	.	.	2.1500	1.0798	.	249864	327833	656980	163707
.	.	.	.	.	2.2000	1.1049	.	248105	332775	651414	160310
.	.	.	.	.	2.2500	1.1300	.	246361	337632	645948	157013
.	.	.	.	.	2.3000	1.1551	.	244633	342406	640581	153814
.	.	.	.	.	2.3500	1.1802	.	242921	347100	635310	150709
.	.	.	.	.	2.4000	1.2053	.	241224	351715	630133	147695
.	.	.	.	.	2.4500	1.2304	.	239542	356252	625048	144769
.	.	.	.	.	2.5000	1.2555	.	237876	360714	620053	141928
.	.	.	.	.	2.5500	1.2807	.	236225	365102	615146	139168
.	.	.	.	.	2.6000	1.3058	.	234588	369418	610325	136489
.	.	.	.	.	2.6500	1.3309	.	232966	373662	605588	133885
.	.	.	.	.	2.7000	1.3560	.	231358	377837	600933	131356
.	.	.	.	.	2.7500	1.3811	.	229765	381945	596359	128899
.	.	.	.	.	2.8000	1.4062	.	228186	385986	591863	126511
.	.	.	.	.	2.8500	1.4313	.	226622	389962	587445	124190
.	.	.	.	.	2.9000	1.4564	.	225071	393875	583101	121934
.	.	.	.	.	2.9500	1.4815	.	223534	397725	578832	119740
.	.	.	.	.	3.0000	1.5066	.	222010	401514	574634	117607
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name　　　　　　: PRED-95
Date and time　　　　　: 11MAY95:13:09
Computation of ref. F: Simple mean, age 5 - 10
Basis for 1995　　　　: TAC constraints

Table 3.3.24: Icelandic cod, estimated stock-numbers for different assumption about natural mortality (M = 0.10, 0.15, 0.20, 0.25 and 0.30).

Estimated Stock-Numbers when assuming M = 0.10.

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	106660	108601	255614	202688	127541	61974	100906	77402	136844	153645	62199	
4	147921	90089	92125	211654	172934	109019	53599	85801	61899	112200	119524	50423
5	65130	103830	58161	64019	132412	119072	72026	36786	53730	35360	70058	85191
6	35072	40459	60283	27282	32061	66643	91760	39318	18549	23387	17541	44689
7	17191	17156	19233	25212	10296	11257	30380	40666	15112	5928	8528	9245
8	12117	7867	7237	6546	7883	3230	4469	11283	12979	4092	1955	3539
9	4951	3986	3122	2324	1967	1542	1101	1596	4155	3845	1053	574
10	1039	1931	1453	1140	711	501	558	417	585	1852	904	383
11	1081	453	736	549	469	211	239	198	146	285	552	335
12	428	467	204	293	256	134	89	104	60	88	87	230
13	175	202	201	87	130	82	40	33	34	24	48	32
14	72	73	86	109	35	9	38	21	19	22	11	26

Estimated Stock-Numbers when assuming M = 0.15

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	122199	125395	293462	238890	147098	71453	115299	88193	157542	176109	70611	
4	164742	98915	101938	233435	195408	120380	59083	93872	67973	124264	132559	55064
5	71231	112521	62359	68878	143279	131707	77651	39430	57481	38365	76267	91704
6	37736	43292	64013	28954	34057	71465	97776	41620	19566	24867	18924	47404
7	18451	18261	20315	26486	10887	11998	32328	42840	15863	6253	9082	9826
8	12838	8383	7636	6897	8236	3434	4751	12019	13644	4308	2058	3742
9	5275	4244	3318	2452	2078	1636	1179	1703	4441	4039	1125	605
10	1117	2054	1552	1212	753	540	591	450	628	1961	965	412
11	1164	487	782	589	494	226	256	210	162	302	592	360
12	461	502	217	309	272	142	96	111	65	96	93	247
13	187	216	216	92	134	89	43	36	37	26	51	34
14	77	78	91	116	36	10	41	23	21	24	12	28

Estimated Stock-Numbers when assuming M = 0.20

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	140701	145556	339015	283283	170475	82737	132386	101115	182431	203092	80594	
4	184286	109088	113329	258884	221977	133499	65382	103154	75046	138308	147729	60416
5	78214	122330	67098	74390	155739	146159	83979	42389	61716	41800	83306	99113
6	40748	46464	68131	30827	36301	76932	104463	44164	20689	26529	20474	50416
7	19878	19494	21513	27877	11552	12834	34525	45231	16692	6612	9703	10460
8	13648	8962	8079	7286	8622	3668	5070	12851	14377	4552	2171	3970
9	5639	4536	3536	2596	2202	1742	1270	1822	4763	4257	1207	640
10	1206	2191	1665	1293	802	586	629	489	675	2085	1036	446
11	1258	524	832	635	523	245	276	223	180	320	638	389
12	499	543	233	327	291	152	103	119	70	106	99	266
13	201	232	234	97	139	96	47	39	41	28	56	37
14	82	83	97	123	38	11	44	25	22	25	13	30

Continued

Table 3.3.24 Continued

Estimated Stock-Numbers when assuming $M = 0.25$

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	162894	169937	394312	338050	198588	96247	152813	116704	212560	235734	92520	
4	207111	120905	126648	288874	253564	148736	72658	113906	83340	154761	165499	66627
5	86257	133453	72494	80693	170146	162774	91141	45720	66532	45748	91337	107594
6	44177	50039	72700	32945	38847	83182	111942	46995	21936	28408	22219	53784
7	21508	20880	22850	29403	12308	13784	37023	47880	17614	7012	10404	11157
8	14567	9618	8574	7724	9049	3938	5431	13799	15193	4828	2299	4226
9	6048	4871	3783	2758	2345	1861	1377	1959	5130	4504	1303	681
10	1307	2345	1796	1383	857	639	672	535	729	2225	1119	486
11	1368	566	888	688	555	266	299	239	202	341	691	423
12	542	590	250	346	312	163	113	129	76	117	107	288
13	217	250	254	103	144	105	51	44	45	31	61	40
14	89	89	105	131	40	12	48	27	24	27	14	32

Estimated Stock-Numbers when assuming $M = 0.30$

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
3	189742	199663	462081	406066	232630	112523	177435	135676	249331	275571	106940	
4	233920	134755	142356	324551	291352	166559	81117	126468	93149	174194	186504	73923
5	95590	146134	78697	87962	186958	181993	99304	49495	72059	50322	100575	117392
6	48109	54100	77797	35367	41759	90392	120364	50173	23334	30553	24201	57586
7	23384	22448	24356	31090	13181	14873	39891	50837	18652	7463	11203	11933
8	15622	10367	9133	8220	9523	4257	5845	14888	16111	5148	2445	4519
9	6512	5259	4064	2943	2510	1996	1505	2116	5552	4788	1417	729
10	1425	2518	1947	1487	921	702	721	591	790	2386	1217	534
11	1495	615	950	750	592	291	326	257	229	364	751	464
12	592	645	269	367	338	176	123	140	83	130	115	313
13	235	270	277	111	149	115	56	48	50	34	67	43
14	96	96	113	140	42	13	52	29	26	29	15	34

Table 3.3.25: Icelandic cod, five retrospective XSA-runes were done for five different values of natural mortality (M = 0.10, 0.15, 0.20, 0.25 and 0.30). The longest XSA-run (1984-94) was taken as base-run and the shorter runes (1984-90, -91, -92 and -93) compared to the base-run. The log-residuals (log(shorter run / base run)) were computed for the fishable stock and the average F of 4-8.

Log-difference in the fishable stock (4+)

M \ year	1990	1991	1992	1993	SSE
0.10	0.015	0.091	0.161	0.055	0.0375
0.15	0.014	0.097	0.161	0.049	0.0379
0.20	0.012	0.104	0.160	0.044	0.0385
0.25	0.011	0.110	0.159	0.038	0.0389
0.30	0.012	0.117	0.156	0.033	0.0393

Log-difference in average F of 4-8

M \ year	1990	1991	1992	1993	SSE
0.10	0.041	-0.044	-0.105	-0.047	0.0169
0.15	0.049	-0.047	-0.107	-0.046	0.0182
0.20	0.057	-0.051	-0.107	-0.045	0.0193
0.25	0.065	-0.054	-0.108	-0.043	0.0207
0.30	0.072	-0.058	-0.107	-0.042	0.0218

Table 3.3.26: Icelandic cod, five XSA-runes were done each with different value for natural mortality (M = 0.10, 0.15, 0.20, 0.25 and 0.30). For the resulting stock-numbers of each run, two types of log-log models were fitted, regressing abundance indices on stock-numbers, and the total SSE calculated.

The log-deviance of $I_{a,y,f} = q_{a,f} N_{a,y,f}$ for different fleets (f) and M.

Fleets \ Mortality	0.10	0.15	0.20	0.25	0.30
Survey	59.01	58.54	58.09	57.66	57.29
CPUE	52.52	52.23	51.95	51.68	51.39
CPUE + Survey	111.53	110.78	110.04	109.34	108.68

The log-deviance of $I_{a,y,f} = q_{a,f} N_{a,y,f}^{\gamma_{a,f}}$ for different fleets (f) and M.

Fleets \ Mortality	0.10	0.15	0.20	0.25	0.30
Survey	47.66	47.15	46.69	46.30	45.99
CPUE	38.42	38.17	37.93	37.71	37.93
CPUE + Survey	86.08	85.32	84.62	84.01	83.48

Table 3.3.27. Icelandic cod. Summary of various CPUE and effort data sources, based on bottom trawl CPUE, total survey index, gillnet CPUE and Danish seine CPUE. The last line indicates the implied total F/effort in 1994 as a percentage of the total F/effort in 1993.

Year	Total Yield	Trwl, Jun-Dec U	Trwl, Jun-Dec E	Trwl, Jan-May U	Trwl, Jan-May E	Survey Z	Gillnets U	Gillnets E	Danish seine U	Danish seine E
90	335	1	335	1	335	0.95				
91	309	0.9693	319	0.8831	350	1.33	49	6.3	249	1.24
92	268	0.7196	372	0.7873	340	0.93	55	4.9	165	1.62
93	251	0.8487	296	0.7083	354	1.44	51	4.9	200	1.26
94	178	1.2148	147	0.8977	198	0.92	41	4.3	398	0.45
95	165						43	3.8	124	1.33
%93-94			0.50		0.56	0.64		0.88		0.36