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International Council for the
Exploration of the Sea

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REPORT OF THE NORTH-WESTERN WORKING GROUP

Copenhagen, 2 - 10 May 1994

PART 1

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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 2-10 May 1994 to:

a) assess the status of and provide catch options for 1995 for the combined Greenland/Icelandic cod stock;

b) assess the status of and provide catch options for 1995 and 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 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 provided in 1993 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;

f) provide estimates of the stock size of Icelandic cod using a range of natural mortalities.

In addition to this at its Twelfth Annual Meeting in November 1993 NEAFC requested ICES to:

a) provide quantitative information on the distribution and migration of the "Oceanic" stock of *Sebastes mentella;*

b) evaluate, if possible, medium-term consequences of TAC levels for the "Oceanic" stock of *Sebastes mentella*, in the range of 50,000 - 150,000 tonnes and to indicate whether these levels are within safe biological limits.

In addition, in a letter dated in March 1994 to the General Secretary, the Department of Fisheries, Trade and Industry of the Government of the Faroe Islands draws the attention of ICES to the new fisheries management regime in the Faroese Fisheries Zone (FFZ). ICES is asked "to have some evaluation of the regulatory system in the FFZ as it now stands with a regime of closed areas combined with the quota suggestions for the next five years".

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 for the Faroese fleet categories fishing for cod, haddock and saithe. For all categories there has been a decreasing trend in the cod and haddock fisheries, while for saithe the fishery has been rather stable for most of the fleets. Pair trawlers larger than 1000 HP have increased their catches mainly by increasing their fishing days, Table 2.1.4.

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.

In 1977 an EEZ was introduced in the Faroe area, (Figure 2.1.1). This gave the Faroese authorities the opportunity and the responsibility of the utilization 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 Faroe Plateau cod quota for 1994 to 1998 is fixed to 7,000 tonnes, the haddock quota to 6,200 tonnes and the saithe quota to 42,000 tonnes each year. The quota year starts 1 september and ends 31 August the following year.

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 (1984-1993) 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 tonnes. Since then, the catches have steadily decreased to the point where only 5,700 tonnes were taken in 1993. This was the lowest catch on record.

In recent years, statistics for the Faroese fishery in that part of Sub-division IIa (Figure 2.1.1) which is within the Faroese EEZ, have become available. It is expected that these catches are taken from the Faroe Plateau area so they are included in the total catches used in the assessment. This is depicted in Table 2.2.2 under the row labelled "Total used in the assessment". No information on the Faroese catches in IIa were available for 1993, however. Also included are the French catches of Faroe Plateau cod 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 Figure 2.2.1 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 2.2.2 shows the catch rates per day from 1985 to 1993 for the long liners, trawlers and jiggers. The catch rates have steadily decreased in the period. 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 1994, indicates higher catch rates for the pair trawlers than in the same period in the last 4 years. The increase is partly expected to be due to introduction of a new quota management regime and by the market prices on cod compared to those of saithe. Saithe used be the target species for the pair trawlers.

2.2.2 Catch-at-age

Catch in numbers-at-age in 1993 is provided for the Faroese fishery in Table 2.2.3. 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 1993 are provided for the Faroese fishery in Table 2.2.4. 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 1993 showed a discrepancy of 3 %.

Data on the mean weight-at-age by year are available in the ICES database from 1978. It has been shown (Jakupsstovu and Reinert, 1993) that the mean weight-at-age have steadily decreased over the last three decades, Figure 2.2.3. Since 1991 an increasing trend has been observed. Information on the mean weight-at-age in the first quarter in 1994 shows still an increasing trend compared to the same period in 1993.

2.2.4 Maturity-at-age

The proportion of mature cod by age are given in Table 2.2.5. Data are available back to 1983. The data were obtained during the Faroese groundfish surveys carried out in the spawning period (March). Thus the data for 1994 are available to be used in the predictions of the spawning stock biomass.

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 groundfish surveys initiated in 1983, Table 2.2.6. The estimates of stratified catches in numbers 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 now 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 results for age groups 2 to 7 are shown in Figure 2.2.4.

The other catch and effort series are obtained from long liners and trawlers, Tables 2.2.7-2.2.13. 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 series have not been used for tuning of the Faroe Plateau cod previously.

The VPA were tuned using the Extended Survivors Analysis (XSA) with shrinkage. Several runs were made in order to obtain an estimation of the fishing mortalities with lowest possible standard errors of the mean log catchabilities. Age groups in the different tuning series with high standard errors were excluded. This procedure did not estimate the F's more accurate than when using the entire available tuning data set, however. It was therefor decided to use the complete tuning data to tune the final VPA, Table 2.2.14.

The results of a retrospective analysis are shown in Figure 2.2.5. The estimated fishing mortalities are shown in Table 2.2.15 and in Figure 2.2.6.A. The average F for age groups 3 to 7 in 1993 is estimated at 0.59 compared to $F_{(3-7)}=0.74$ in 1992. Although the average fishing mortality has decreased, it is still above F_{max}.

2.2.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.2.16. A summary of the VPA, with recruitment set at 2 years old, and biomass estimates are given in Table 2.2.17 and in Figure 2.2.6.B. The stock-recruitment relationship with an estimated Ricker curve is presented in Figure 2.2.7. 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 1993 it is estimated at 13,400 tonnes which is only a small increase compared to the lowest level on record in 1992, 12,600 t.

2.2.6 Predictions of catch and biomass

2.2.6.1 Short-term prediction

The input data for the short-term prediction are given in Table 2.2.18. 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 2.2.3). The mean weight-at-age in 1994,1995 and in 1996 were calculated by adding the average annual growth 1991-1993 by age group to the observed mean weight-at-age in 1993, to the estimated mean weight-at-age in 1994 and in 1995 respectively. The proportion mature as seen in the Faroese groundfish surveys in 1994 was used for 1994 while for 1995 and 1996 the average of the maturity ogive for 1992 to 1994 was used.

Estimates of the year classes 1989 and older were used as they are estimated in the final VPA. The year classes 1990 to 1993 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 2.2.19. The output of the RCT3 prediction of recruitment program is given in Table 2.2.20. In recent years the recruitment to the Faroe Plateau cod stock has been poor. Based on this, the average of the 1984 to 1989 year classes, as estimated from VPA(7.8 millions at an age of 2), was used as input for the 1994 and 1996 year classes.

The results of the short-term predictions are shown in Table 2.2.21 and in Figure 2.2.8.B. Assuming the same average fishing mortality in 1994 and 1995 as in 1993, the catches are predicted to be about 7,500 tonnes in both years. This is only a quarter of the long-term average. Since recruitment in recent years has been poor, the spawning stock biomass is not expected to increase substantially from the lowest known level.

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 7,000 tonnes 1994-1998.

This required first fitting the Ricker stock-recruitment curve given in Figure 2.2.7. This relationship was used for the 1994 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 (1994) 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 2.2.9. A stock-crash is not observed in any of 100 the simulations. The recovery is, however, quite slow and the target of 52,000 tonnes is unlikely to be met in 1998. The estimated probability of this is only 10 %.

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.

It should also be noted that alternative harvesting strategies are likely to perform better than a constant catch strategy in terms of lowering risk and increasing total catch.

2.2.6.3 Long-term prediction

The input data for the yield-per-recruit calculations (long-term predictions) are given in Table 2.2.22. As input for the fishing exploitation pattern, the estimated exploitation pattern for the years 1961-1993 from the final VPA was used. As input for mean weight-at-age the average for 1978 to 1993 was used and for the proportion of mature-by-age groups, the average for the years 1983 to 1993 was used as input.

The output from the yield-per-recruit calculations is shown in Table 2.2.23. and in Figure 2.2.8.A. $F_{0.1}$ and F_{max} are calculated to be 0.14 and 0.29, respectively. These values should be compared with the present average fishing mortality in 1993 of 0.59. From Figure 2.2.7, showing the spawning stock biomass per recruit relationship, the values of $F_{med}=0.56$ 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 1984, 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 the lowest level on record. 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 groundfish surveys (1983-1993) as well as on seven commercial catch/effort series (1985-1993). 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 Trend in landings and effort

Total nominal landings of the Faroe Bank cod from 1984 to 1992 as officially reported to ICES are given in Table 2.3.1. The catches reached a maximum of 5,000 tonnes in 1973. In recent years the catches have declined from 3,000 tonnes in 1987 to only 380 tonnes in 1993. Since the beginning of the 1980s, trawlers have not been allowed to fish on the Bank from 1 November to 31 May.

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 in June 1990 for depths shallower than 200 meters and is still in force. In 1992 and 1993 some long liners and jiggers were allowed to participate in an experimental fishery inside the 200 meter depth contour. The catches reported for 1992 and 1993, therefore, partly originate from the shallower parts of the Bank. The experimental fishery continues in 1994.

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.

The Faroese groundfish surveys covers waters on the Faroe Bank, Figure 2.3.1. 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. Due to inconsistency in selection of trawl stations for calculating the CPUE with regard to depths the 1985, 1986 and 1993 data have been revised.

The revised CPUE seems to be in accordance with the general trend in the fishery for cod on Faroe Bank.

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. The length distribution in the 1991 to 1994 catches are given in Figure 2.3.3. The length distribution in 1994 may indicate that a year classes is recruiting into the stock.

The length distributions in the long line fishery in 1993 and during April 1994 are shown in Figure 2.3.4 and 2.3.5, respectively. The small fish seen in the groundfish surveys 1994 also appeared in the long line fishery in April 1994.

2.3.3 Management considerations

The data presented indicate that the stock still remains at a low level of abundance. The Working Group, therefore, recommends that the fishing ban be maintained.

2.4 Faroe Haddock

2.4.1 Landings and trends in the fishery

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 1992 of only 3,500 t (Table 2.4.1). Officially reported catches 1980-1992 from the Faroe Bank have varied between 500 and 1,600 t, but dropped in 1993 to only 241 t. The closure of the fishery on the shallower parts of the Bank in 1990 and the introduction of a controlled fishery there since 1993, as described in section 2.1, have reduced the Faroese catches (Table 2.4.2) whereas Scottish catches remain relatively high in 1990-92. In the assessment only the fraction of the Scottish catches, which have been reported to the Faroese authorities, are included. In addition, some minor French catches in Division Vb, reported to the Faroese authorities, and minor Faroese catches of haddock in ICES Sub-Division IIa4 close to the boundary with Sub-Division Vb1 (Figure 2.1.1), are included in the assessment (Table 2.4.1).

Faroese vessels took almost the entire catch. Table 2.1.2 and Figure 2.4.1 show the recent Faroese catches 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 the proportion increased again due to the decline in the other fleets catches. Pair trawlers and long liners took most of the catches even if the catch by long liners below 100 GRT has declined since 1989. Due to poor catches and economic conditions, the effort of the long liners has decreased during the most recent years. 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, for some fleets an upward tendency is observed in 1993 (Figure 2.4.2-2.4.3).

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. Samples for each fleet category were first treated separately, then pooled. For each fleet category samples representing the different seasons were treated separately, then pooled. Table 2.4.3 shows the catch-at-age in numbers in 1993 by fleet category. 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 French, German and UK trawlers were assumed to have the same age composition as Faroese single 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
(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 1993 showed a discrepancy below 4%, which was not corrected for. Figures 2.4.4 and 2.4.5 show that the mean weights-at-age for most age groups, which were declining since the mid-1980s, did stabilize at a low level for 2-3 years and increased again in 1993. This increase in growth seem to continue in 1994 as the mean weight at age for the 1st quarter 1994 are considerably higher than the corresponding weights in the 1st quarter of 1993 (Figure 2.4.6).

2.4.4 Maturity at age

Maturity-at-age data were available from the Faroese Groundfish Surveys 1983-1994 (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 1983 average maturity at age from the surveys were adopted.

2.4.5 Assessment

2.4.5.1 Tuning and estimates of fishing mortality

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 the VPA (Tables 2.4.7-2.4.14). 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 consists of effort measured in number of fishing days and the corresponding catch at age in numbers for each fleet.

At the 1993 meeting of the North Western Working Group (Anon. 1993a) it was decided to apply the XSA tuning method for estimating the terminal F-values. The diagnostic output from the initial XSA-run this year 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 1) the longest series available (Figures 2.4.7-2.4.14), 2) the years 1988-93 only as was done last year with fewer fleets (Anon., 1993) and 3) 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. Retrospective analyses using shrinkages in the range 0.5-0.1 (Figure 2.4.7 - 2.4.10) showed, that XSA shrunk 0.3 gave the best retrospective pattern. Table 2.4.15 shows the diagnostic outputs from the XSA. The mean fishing mortality for age groups 3-7 is estimated to 0.275. Due to a consistent matrix of fishing mortalities from the XSA, it was decided to use the selection pattern from the XSA to start an final VPA. The resulting fishing mortalities are given in Table 2.4.16 and Figure 2.4.11A.

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.

2.4.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.4.17 and a summary of the VPA with the biomass estimates is given in Table 2.4.18 and Figure 2.4.11B. The spawning stock biomass has decreased from over 60,000 t in 1985 to 14,000 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 seem, however, to have increased again from 1993 onwards (Figure 2.4.4 - 2.4.6).

2.4.6 Prediction of catch and biomass

2.4.6.1 Input data

The input data for the short-term predictions are given in Table 2.4.19. The year classes up to 1991 are from the final VPA while the 1992-93 year classes 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 were used (Table 2.4.20). The output from the RCT3 is given in Table 2.4.21. The 1994 year class was estimated as the average of the 1986-93 year classes. The exploitation pattern used in the prediction was derived from the fishing mortality matrix from the final VPA in 1993. Mean weights-at-age in the stock and catch 1994 were predicted based on observed growth increments from the first quarter 1993 to the first quarter 1994. Mean weight at age for the two years old were based on the observed weight in the samples from the first quarter 1994 applying a similar growth for rest of 1994 as the 2-years old had in 1993. Mean annual growth rates for the cohorts for the period 1977-1994 were then assumed from 1995. For age 2 long-term averages were used from 1995 and for ages 10+ averages 1977-1994 were used for 1994 onwards. The maturity ogive for 1994 is based on samples from the Faroese

Groundfish Surveys 1994. Maturity ogives for 1995-1996 are calculated as mean values for the period 1992-1994.

The Working Group considered the consequences of implementing annual TAC's of 6,200 tonnes for 1994-1998. Two strategies were used, the single option prediction for the years 1994-98 and a medium prediction model (risk-analysis) for 1994-2003. The input data for the single option prediction are similar to those used in the short-term prediction using medium term averages for the years 1997 and 1998 (Table 2.4.23). Input parameters for the risk analysis were terminal F-values for 1993 from the XSA, mean weights at age for 1994, average maturity ogive for 1992-94 and 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 2.4.14). This relationship was applied for the year classes from 1994 onwards. Simulations were then performed by assuming random (log normal) recruitment relationship and (log normal) uncertainty in the current (1994) stock estimate. Two different approaches were made: The catches taken each year were simply fixed at a specified level, i.e. the actual quota on 6,200 tonnes, or as 1/3 of the spawning stock biomass.

The input data for the long-term yield and spawning stock biomass (yield per recruit calculations) are listed in Table 2.4.25. Mean weights-at-age are averages for the 1977-1993 period. The maturity ogives are averages for the years 1983-94. The exploitation pattern was derived from the fishing mortality matrix from the final VPA as mean F-values for the long time period.

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 2.4.26 and Figure 2.4.12C. F_{max} and $F_{0.1}$ are indicated here as 0.39 and 0.16, respectively. From Figure 2.4.-13, showing the recruit/spawning stock relationship, and from Figure 2.4.12C, F_{med} and F_{high} were calculated to be 0.2 and 0.9, respectively.

2.4.6.3 Projections of catch and biomass

The results of the short-term prediction are shown in Table 2.4.22 and Figure 2.4.12D. Assuming that the TAC of 6,200 tonnes will be taken in 1994 and 1995, the reference F has to increase to 0.46 in 1994 and 0.55 in 1995, which will result in a decline in the spawning stock biomass from 19,000 tonnes in 1994 to 18,000 tonnes in 1996.

The results of the single option prediction show (Table 2.4.24), that in order to take the annual TAC of 6,200 tonnes, the fishing mortalities have to increase considerable. The spawning stock will remain at the present low level. This is consistent with the results of the risk analysis (Figures 2.4.15 - 2.4.16) show for both strategies that the spawning stock will continue to be small. It should be noted, however, that the Ricker-curve do not fit well for the stock-recruitment data (Figure 2.4.14), and the recent change in mean weight at age has not been accounted for in the present model.

2.4.7 Managements considerations

The present assessment confirms that the stock is in a very poor condition. The spawning stock biomass 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 stock-recruitment plot (Figure 2.4.13) indicate, that spawning stock sizes below 40,000 tonnes only have produced small year classes; the predicted recent year classes are also very small. Thus it should be advisable to allow the stock to rebuild above this level. The adopted annual TAC's of 6,200 tonnes for haddock seem not to be appropriate in this respect.

2.4.8 Comments on the assessment

Assessments of this stock have been unreliable in the past due to inadequate tuning data. These data were revised last year, and this year several tuning series have been used in the assessment. 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

Catches of saithe in Division Vb were stable during the period 1985-1989 at around 40,000 - 45,000 t (Table 2.5.1). Since the increase to an all time high level of 60,000 t in 1990 catches have steadily decreased and were about 33,000 t in 1993. The preliminary catch figures for the first quarter of 1994 were about 8,100 t compared to about 6,900 t in 1993. For these two periods pair trawlers greater than 1000 HP fished for about 1,250 and 1,400 day, respectively.

Catches not officially reported to ICES have been included in the assessment (Table 2.5.2).

2.5.2 Catch at age

Catch at age data in the years 1990 to 1992 were revised according to the final catch statistics. Catch in numbers at age in 1993 reflects the age composition in the Faroese catches for that year (Table 2.5.3).

2.5.3 Weight at age

The SOP for 1993 shows a discrepancy of 2% which was not corrected for by the working Group (Table 2.5.3). 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 (Table 2.5.4 and Figure 2.5.1).

2.5.4 Maturity at age

Maturity at age data are available for the period 1983-1993 and were updated for the last year (Table 2.5.5).

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 which specialize in fishery on saithe and account for 5,000-8,000 t of saithe each year, Table 2.5.6. In the 1993 Working Group report (Anon., 1993) a description is provided as to how and why this particular series was chosen. The corresponding retrospective analysis is shown in Figure 2.5.2 and the log catchability residuals in Figure 2.5.3.

The estimated fishing mortalities from the XSA tuning analysis are presented in Table 2.5.7 and the long term fishing mortalities for 1960-1993 in Table 2.5.8. The average fishing mortality for age groups 4-8 is 0.49 in 1993.

2.5.5.2 Stock estimates and recruitment

Stock in number at age as estimated by the VPA is presented in Table 2.5.9. 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 where as the recruits in 1992 are about half of the average level. Early indications are that the 1990 year class is above the average of 1980-1989. Spawning stock biomass is given in Table 2.5.10 and Figure 2.5.4B. A summary of recruitment, total biomass, spawning stock biomass etc for the period 1960-1993 is given in Table 2.5.11. Even though the level of recruitment has been high in the 1980s the spawning stock biomass is low compared to the previous decade.

2.5.6 Prediction of catch and biomass

2.5.6.1 Input data

Input data for prediction with management option are presented in Table 2.5.12. Stock in number up to but not including year class 1989 are from the final VPA where as for the 1989, 1990 and 1991 year classes the mean recruitment for 1979-1992 (these are the 1974-1989 year classes) was used.

The mean weight at ages for 3-9 were predicted using regression analysis where the mean weight at age was predicted by mean weight of the year class in the previous year using data from the period 1984-1993. For other age groups the mean weight was calculated as the average for 1991-1993. For 1994 the observed maturity ogive from the Faroese bottom trawl survey in 1993 was used and for later years the mean of 1991-1993 was used. The exploitation pattern was taken from 1993 in the final VPA.

Input data for the yield per recruit calculations are given in Table 2.5.14. Maturity ogive and mean weight at age was calculated as mean values for 1960-1993 and exploitation pattern was from the final VPA.

2.5.6.2 Biological reference points

The yield and spawning stock biomass per recruit curves are presented in Figure 2.5.5C. Compared to the fishing mortality level in age groups 4-8 in 1993 of 0.49, the reference values for F_{max} = 0.44 and $F_{0.1}$ = 0.17. F_{med} and F_{high} were estimated to 0.30 and 0.62, respectively, (Figure 2.5.6 and Figure 2.5.5C).

2.5.6.3 Projection of catch and biomass

Results from prediction with management option are presented in Table 2.5.13 and Figure 2.5.5D. If the catches reach the proposed TAC of 42,000 t the F-value is estimated to 0.54 and about 0.49 in 1994 and 1995, respectively. In 1996 the spawning stock will be some 62,000 t with the suggested TAC level.

The RISK analysis was based on two assumptions of recruitment: 1) constant at the 1979-1989 level of 31 mill and 2) a stock recruitment model (Figure 2.5.7). A quota of 42,000 t is imposed on the model. The results are shown in Figures 2.5.8 and 2.5.9. It is interesting that only when a high recruitment level is assumed the stock is less likely to collapse with the proposed quota level.

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 is still at a very low level even if mean weight at age and maturity ogive has changed in favourable directions. Even if the spawning stock recruit relationship show an inverse relationship this probably only reflect one side of the matter as there is no information on this relationship in the lower ranges of SSB values.

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 Icelandic grounds (Division Va) have been fluctuating without a trend between 50,000 and 70,000 t in the period 1978-1986 (Table 3.2.1). During 1987-1989, annual landings were stable 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. Preliminary reported landings for 1993 are 72,000 t compared to 90,000 t expected by the Working Group last year.

3.2.2 Catch in numbers

Minor changes were made to the age composition of 1992 to account for revised total landings. Data from bottom trawl and gillnets, which represented 94% of the Icelandic landings in 1993, 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 9 and lower for the age groups 6 and 7 were observed in the 1993 landings.

3.2.3 Mean weight at age

Weight-at-age data were available for the Icelandic landings in 1993 (Table 3.2.3). Increased mean weight at age was observed in 1993 for all age groups except for age 9 from the abundant 1984 year class.

For both catch predictions and stock biomass calculations, the mean weights 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 weights at age were averaged over the 1991 to 1993 period. For long-term yield and spawning stock biomass predictions, the average over 1980-1993 for all age groups was used.

Mean weights at age in 1993 were somewhat higher for age groups 3-8 than predicted but lower for older fish. The prediction was, however, better than a prediction based on simple averages.

3.2.4 Maturity at age

In 1993 an increase in the proportion mature at age was observed for all age groups except age 9 (Table 3.2.4). As has been pointed out earlier in 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 last year's 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 1980-1996 (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).

For long term predictions, averages over 1980 - 1993 were used.

3.2.5 Stock assessment

3.2.5.1 Tuning input

CPUE data, based on Icelandic trawler logbooks are available. The basic method for computing an aggregate CPUE index consists of first selecting individual tows where the catch contains over 70% saithe. 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 1993 for age groups 4-9 from those runs was 0.29 using the trawlers effort data and 0.35 using the trawlers cpue data. At last year's 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 therefore used last year. 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 the TSA was used again this year to estimate the fishing mortality in the final year. The resulting reference F's are somewhat lower (F4-9=0.28) (Table 3.2.9) than from the XSA runs and have a relatively low standard errors on the most relevant age groups.

The terminal fishing mortalities from the TSA were used to run a traditional VPA and the Fs 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 3.2.3.B and Table 3.2.12. After a decline from 1970-1980, the spawning stock biomass was at the level of about 160 - 170,000 t in 1980 - 1989 and increased to 190,000 t in 1990 and has been about 205,000 t since 1991. The estimated spawning stock biomass in the beginning of 1994 is 205,000 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 well above the 1967-1987 long-term averages (about 40 million). As no information is available for the more recent year classes, the 1989-1993 year classes were set at the same level as the average for the 1967-1987 year classes, excluding the strong year classes in the early 1960s.

3.2.6 Prediction of catch and biomass

3.2.6.1 Input data

The input data for the catch projections are shown in Table 3.2.13. The mean weights and maturity at age were predicted as described in sections 3.2.3 and 3.2.4. It is assumed that the fishing mortalities in 1994 will be the same as in 1993 with resulting catches of about

73,000 t. Based on this, options for 1995 were calculated and are given in Table 3.2.14 and Figure 3.2.3.D.

3.2.6.2 Biological reference points

The yield- and spawning stock biomass-per-recruit (age 3) curves shown in Figure 3.2.3.C. have been calculated using an exploitation pattern taken as the average of the fishing mortalities during 1980-1993 from the standard VPA run. Averages over 1980-1993 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). Compared to the 1993 fishing mortality level of F(4-9) = 0.28, the reference values for F max and F0.1 are 0.44 and 0.18 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 = 0.30 and F high = 0.84 were estimated.

3.2.6.3 Projections of catch and biomass

As can be read from the prediction table (Table 3.2.14), the same fishing mortalities in 1994 as in 1993 will result in a total catch of about 73,000 t in that year. The resulting stock size in the beginning of 1995 will be about 390,000 t which is about the same as in the beginning of 1994. The spawning stock biomass in the beginning of 1995 will be similar to that in 1994, i.e. about 200,000 t. The same reference F in 1995 compared to 1993 will result a yield of 72,000 t, and both total and spawning stock in 1996 will be at about the same level as in the three previous years. Higher fishing mortalities in 1995 will lead to a decline in both total and spawning stock biomass and correspondingly, if the Fs are lowered from that level, stock sizes will increase by 1996.

3.2.7 Management considerations

The stock seems to be in a fairly stable state, the reference F values have been slightly over F0.1 but below Fmax in recent years. Increase in the effort from 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 Fs 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, standardized, stern trawlers are leased.

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

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

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

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

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

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

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

3.3.2 Trends in landings and effort (Table 3.3.1)

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 1993 catch of only 252,000 t is the lowest catch level since 1948. Effort on cod in 1993 was unchanged compared to 1992 but catch rates of the trawler fleet increased somewhat in the latter half of 1993.

3.3.3 Catch in numbers at age

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

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

The total catch-at-age data is given in Table 3.3.2. 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 1984, 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 (Stefansson, 1992). The approach taken is, therefore, to compute the proportion mature at the time of spawning, by considering only the first part of the year (January-May), but aggregating across gears and regions.

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 analyzed as described in Stefansson (1988) to yield GLM indices of abundance (numbers) at age. The analysis takes into account catchability changes in the fleet due to vessel renewal and vessels shifting between regions, but not changes in the spatial distribution of the resource or changes within vessels in the fleet. For this reason the analysis of the logbook data was restricted to the years 1988-1993.

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 (Palsson *et al.*, 1989) are used as part of the assessment. The basic data are age-disaggregated (Palsson and Stefansson, 1991) and indices used in last assessment (Anon. 1993a) were computed using the Gamma-Bernoulli (G-B) model of Stefansson (1991). In the present assessment however, new abundance indices based on further development of the Gamma-Bernoulli (G-B) method to accommodate spatial information in an appropriate manner are used. The method is described in Working Paper by H. Björnsson (Annex I). Indices are calculated for each of the three areas separately, age groups 1 to 14 and for the years 1985-1994.

To use the latest information available in the XSA, the 1994 survey abundance indices were moved back in time of approx. three months i.e. to December 1993. 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 (Stefansson 1992) which were applied to this stock earlier (Anon, 1992b and 1993a) can estimate migration for a given year and age. As the ADAPT-method uses an average selection pattern in determining the terminal fishing mortality recent changes in fishing pattern can not be accounted for. The Group therefore decided to use instead the XSA ADAPT-type method. XSA has not been developed to account for migration but there is a way to handle this:

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

$$N_{a,y} = e^{-m}N_{a-1,y-1} - e^{-m/2}C_{a-1,y-1}$$

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

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

and in back calculation the equations will be:

$$N_{a-1,y-1} = e^{m/2}C_{a-1,y-1} + e^{m}(N_{a,y} - G) = e^{m/2}(C_{a-1,y-1} - e^{m/2}G) + e^{m}N_{a,y}$$

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:

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

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

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

which is the number used in the assessment.

3.3.6.3 Estimates of fishing mortality

Retrospective analysis for XSA with different combinations of fleets and shrinkage factors were carried out. The retrospective results of these runs were similar and the Group decided to adopt the run with the most information included i.e. all fleets. The retrospective analysis for this XSA with shrinkage of s.e.= 0.5 is given in Fig 3.3.1. The total output of the XSA is given in Table 3.3.9.

The resulting fishing mortalities from the final XSA are given in Table 3.3.10. The fishing mortality reached a peak in 1988 decreased in 1989 but has since then been increasing and the present fishing mortality is the second highest level observed.

Fishing mortalities under the assumption of different natural mortalities i.e. M=0.1; M=0.2 and M=0.3 are given in Tables 3.24-3.26.

3.3.6.4 Stock and recruitment estimates

The resulting stock size in numbers and spawning stock biomasses are given in Tables 3.3.11-12.

Stock biomasses under the assumption of different natural mortalities, i.e. M=0.1; M=0.2 and M=0.3 are given in Tables 3.24-3.26.

The current spawning stock at spawning time and recruitment levels must be considered in relation to historical sizes. These are based on a longer VPA. In this VPA, 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. This back calculation revises the 1973 and 1984 year class estimates to 433 and 334 millions, respectively. The resulting SSB and recruitment estimates are given in Table 3.3.13 (and Figure 3.3.12) along with landings and average fishing mortalities. A better estimate might be obtained by back calculating using the fishing mortality at Greenland also, but this is unlikely to have major effects on the issue at hand which is the stock-recruitment diagram.

In this table, the recruitment in the most recent years (year classes 1989-1992 as 3-year-olds in 1992-1995) are estimated using RCT3 as described in Section 3.3.8.4.

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, 1981) and this has been studied in some detail (Magnússon and Pálsson, 1989 and 1991a and Steinarsson and Stefánsson, 1991). Another important interaction is between cod and shrimp. This has been studied by Magnússon and Pálsson (1991b) and Stefánsson *et al.* (1994). Results from these studies have been used in the medium-term predictions as described in Section 3.3.8.6 and the cod-capelin interaction is used in the short-term prediction in Section 3.3.8.5.

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 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 type, region and season. Such data for cod were available to the meeting, consisting of catches at age in numbers by *metier*, i.e. gear, area and season for each of the years 1989-1992. The resulting data were used to disaggregate fishing mortality by metier. For each fleet the fishing mortality vector was separated into an overall fishing mortality and a selection pattern which averaged to 1 over ages 5-10. The selection patterns were averaged in time to produce a single selection pattern for each fleet. The resulting selection patterns are given in Table 3.3.17 and Figure 3.3.2. The time trend in fishing mortality by fleet is given in Table 3.3.18 and Figures 3.3.3-3.3.4.

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 1994-1997. For 1995 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 1988-1991 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 in 1993, and it is not felt reasonable to let this drop to the long-term average in 1994 nor is it reasonable to assume these record-high levels far into the future. Preliminary data for 1994 based on January-March samples indicate continued high maturity at age in 1994. The approach taken is therefore to use the 1993 values for 1994 and a long-term (1973-1991) average for 1997. For the purpose of obtaining an orderly development of trends in the maturity at age, linear interpolation between the 1994 and 1997 values was used for 1995 and 1996.

The exploitation pattern from the VPA (see Section 3.3.6.2) was used for the short-term predictions.

3.3.8.2 Medium-term prediction model and input data

Working paper 8 presented medium-term predictions (risk analyses) 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. In particular, cod preys 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.* (1994). Since shrimp is a relatively minor food item for cod, it is assumed not to affect cod growth. Cod also preys 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 (1983).

Other items in the biology are fairly standard in that the initial stock size of cod is as estimated in this WG report but a CV of 15% is used to reflect the uncertainty in the stock estimate; a stock-recruitment curve is used for cod (Ricker form, with cannibalism by juvenile cod, as in e.g. Bogstad *et al.*, 1993); and stocks are driven forward in time with random (independent lognormal) 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 3.3.5. 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 tonnes and that it will be reduced by 30% when the SSB reaches one million tonnes, based on indications in Schopka (1993a).

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.

Economic considerations must be taken into account in order to obtain total monetary values for the three stocks. The relevant formulae are basically as defined in Baldursson *et al.* (1993), based on current market prices of the three species. Given the economic setup, one possible long-term management aim can be defined in terms of maximising the total present value of profits from fishing and processing or by the use of a utility function which takes into account risk-aversion and aversion to interannual variation in income. As it turns out, the long-term cod stock size does not depend heavily on which of these objectives is used.

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 tonnes 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 allocation of 175 thousand tonnes in 1994 is likely to result in about 190 thousand tonnes 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 stabilizing strategy would be to put a "ceiling" on total catches and this ceiling is taken to be 450 thousand tonnes. 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 3.3.6 shows an example where the slope is taken to be 0.22. It should be noted that the input to the procedure is taken to be the biomass in **the previous year**, i.e. to determine the quota for 1995, the 4+ biomass in the beginning of 1994 is used.

The interpretation of the minimum catch may need to be emphasized: 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 alternative realistic management measures, whereas the actual catch control law, which might possibly be recommended, is a rule which 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 negative stock sizes and to avoid fishing mortalities which cannot reasonably 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 the stock size at high exploitation. A "stock collapse" is defined to have occurred in these computations when the spawning stock biomass is below 100 thousand tonnes in the final year of a simulation.

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 more recent results in Schopka (1993a) contain indications of some density dependence of growth and this will affect the long-term results at low fishing mortalities.

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.

3.3.8.4 Recruitment

The Gamma-Bernoulli (G–B) method for the analysis of the Icelandic Groundfish Survey was used earlier for recruitment prediction and as tuning data for this stock (Stefánsson, 1991; Anon., 1993a). The work described in section 3.3.6.1 produced indices which correlated well with stock sizes and are based on a further development of the (G–B) method, as described in Annex I. The resulting indices given in Table 3.3.15 have, therefore, been used for recruitment prediction.

The size of the year classes 1989-1992 has been estimated using RCT3, with the output as given in Table 3.3.16. The choice of age groups from the survey to be used in the regression procedure has some impact. Since the 4-group survey occurs after the year classes have entered the fishery and the fishing mortality on the 3-group is quite variable, it was decided to use only indices for ages up to the 3-group. Regressions seem to indicate that the 1-group index is considerably poorer than the 2- and 3-group indices and may well be biased at low recruitment values.

Therefore only ages 2 and 3 are used as input to the RCT3 program, except for the 1993 year class where only a 1-group index exists. Default values were used in RCT3. The revised recruitment estimates are then discounted with natural and fishing mortalities for use in predictions.

For years not covered by surveys, the average of the 1985-1990 year classes has been used.

3.3.8.5 Short term prediction ("projections of catch and biomass")

Input to the projections is given in Table 3.3.22. Results from projections up to the year 1995 with different fishing mortalities are given in Table 3.3.23.

It is seen that fishing at 1993 levels of fishing mortality (F=0.82) will reduce the spawning stock to a new historic low level.

A 20% reduction in fishing mortality from 1993 (to 0.65) will decrease the SSB up to 1996. In 1995, catches will stay at the expected 1994 level, 190,000 t.

A 40% decrease in fishing mortalities from 1993 (0.49) will slightly decrease the SSB to 1996. This will require an initial catch limit of about 152,000 t.

Only reductions of catches in 1995 to below 140,000 t (F = >0.45) will result in an SSB in 1996 which is at least of the same size as the SSB in 1994 (45% reduction in fishing mortality from the 1993 level).

The average size of the incoming year classes (1985-1992) is 128 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 230,000 t. Since the fishing mortality is currently far above F_{max}, the expected yield is lower than or close to 210,000 t. 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

The following table lists results from medium-term simulations for the years 1994-2023 for different values of *Qmin* and *Qslop* in the catch control law. Given is the probability of stock collapse (i.e. SSB below 100 thousand tonnes in 2023), the average yield for each species (cod, capelin, and shrimp) over the entire time period, the present value of total profits (in billions of kroner) from fishing and fish processing for the three species and associated variance. Since the current stock estimate is about 600 thousand tonnes, a catch control law with a slope of 0.22 will result in a catch of about 130 thousand tonnes. If this is lower than *Qmin*, then a catch of *Qmin* is used instead.

Qmin	*Qslop*	Probability of collapse	Average annual yields 1993-2023			Profits	Standard error of profits
			Cod	Shrimp	Capelin		
0	0.22	0.00	298	28	571	152	14
150	0.22	0.00	293	29	592	143	19
190	0.22	0.15	259	35	665	94	86
225	0.22	0.64	180	51	799	-25	112
0	0.15	0.00	236	30	343	140	13
0	0.20	0.00	284	28	503	153	13
0	0.25	0.00	307	28	659	139	16
0	0.30	0.01	288	34	757	92	24
0	0.35	0.20	239	44	819	25	31

As is to be expected, the higher the minimum TAC for cod, the lower the medium-term yields of cod due to the lower stock size. At higher rates of utilisation of the cod stock, there are increased expected catches of shrimp and capelin due to the reduced predation. The probability of collapse of the cod stock is increased as the minimum catch is increased above 150 thousand tonnes. Overall profits from fishing and fish processing goes down as the minimum catch is raised and also goes down as the slope of the catch control law is moved away from about 0.22.

Figures 3.3.7-10 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

The yield-per-recruit curve along with biological reference points is given in Figure 3.3.11 (Tables 3.3.19-20). A plot of the spawning stock biomass and recruitment is given in Figure 3.3.13. When using the period 1955-1992, the reference points F_{med} and F_{high} are about 0.45 and 0.73, respectively. 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 F_{high} an equilibrium is available at roughly SSB=200 thousand tonnes giving an expected recruitment of about 170 millions individuals is obtained if the stock-recruitment curve is assumed.

It is also seen that the S-R curve over predicts recruitment in recent years. It is also seen that the S-R curve over predicts recruitment in recent years. This is a result of the 1983 and 1984 year classes having been large but appeared at low SSB levels. This is of considerable concern since the net effect may be, e.g., to overestimate sustainable yield in a reduced-production environment. However, this will to some extent be captured by the use of random parameters in the S-R relationship.

3.3.8.8 Relating 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 3.3.14 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 as well as one possible catch control law 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 3.3.14, corresponding to recruitment of 136 millions, high is the level predicted from the stock-recruitment relationship using equilibrium corresponding to the current 4+-biomass value. This is very close to the average, 133 millions, of observed recruitment in the years 1985-1990. These long-term lines and medium-term lines intersect (point B) approximately at current biomass values (point A) when 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. 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 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 0.78, so a 40% reduction corresponds to a fishing mortality of about 0.47 in 1995 and thus catches of some 145,000 t.

The inclusion of 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 it 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 summarized as follows:

a) Keeping 1994 catch levels of about 190,000 t into 1995 and beyond, increasing catches later when (if) the biomass increases. This entails a probability of some 12% of stock collapse in the long run, or, equivalently, a downwards revision of this catch limit;

b) Reducing the catches to some 150,000 t (40% reduction in fishing mortality from 1993). In this case the spawning stock is expected to decrease in the immediate future although there is high probability of a recovery of the stock.

c) An immediate reduction of catches to such levels (about 130,000 t) that the stock biomass will increase with high certainty and 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.

3.3.10 Comments on the assessment

All short-term results depend heavily on the assumed development in maturity at age, which is hard to estimate and predict accurately.

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. 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. Tagging experiments at Iceland show that migration of cod from Iceland to Greenland waters occurs very seldom and can be ignored in stock assessments. 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 continuous belt from Iceland to East Greenland, along the East Greenland coast, round Cape Farewell and over the banks at West Greenland. 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.

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, 1993b) and it cannot therefore be ignored in the assessments.

A combined assessment of both Greenland and Icelandic cod stocks was carried out in order to avoid migration effects and to review the historical development of the Greenland stock. Any projection of catch levels seemed unnecessary as the recent status of the Greenland stock is considered as severely depleted. Input parameters and results are described in chapter 5.3.3.4.

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 last year's report (Anon., 1993a). 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.

Table 5.1.4 and 5.1.5 list abundance and biomass indices by stratum off West, East Greenland and the total surveyed area. Indices vary significantly between strata and years. Trends of estimates are shown in Figure 5.1.2 and 5.1.3 illustrating the increase in stock abundance and biomass from 23 million individuals and 45,000 tonnes in 1984 to 828 million individuals and 690,000 tonnes in 1987. This was caused exclusively by the strong year classes of 1984 and 1985, which were mainly distributed in the northern strata 1.1, 2.1 and 3.1 off West Greenland during 1987-1989. Such high indices of abundance and biomass have not been observed in strata off East Greenland although their estimates increased during the period 1989-91 suggesting an eastward migration. Since 1987 and 1989, stock abundance and biomass off West and East Greenland have decreased dramatically to only 5 and 10 million individuals, and 5,000 and 33,000 tonnes, respectively in 1991. During the period 1987-89 with high stock abundance, precision of survey indices is low due to enormous variations in catch per tow data.

In 1992 when technical problems caused incomplete and reduced sampling, West Greenland estimates indicated a continuous decline by 57% to 2 million individuals and by 88% to 607 tonnes. These results represent record minimum values since 1982. Six hauls covering stratum 7.2 off East Greenland in 1992 resulted also in record minimum estimates for this stratum. In 1993, survey indices confirmed the severely depleted status of the cod stock. Over the total survey area, the estimates of abundance and biomass amounted to 5 million individuals and 6,000 tons, respectively.

Length compositions are illustrated for the period 1990-93 in Figure 5.1.4. With decreasing trend in abundance, overall mean length increased from 53.1cm in 1990 to 58.0 cm in 1991 due to growth of dominant cohorts 1984 and 1985. In 1992, very small cod ranging between 25.5-34.5 cm dominated off West Greenland while length composition in stratum 7.2 off East Greenland showed no pronounced peak and ranged from 10.5 cm to 82.5 cm. In 1993, mean length decreased significantly to 45.6cm with peaks at 22.5cm and 40.5cm with a loss of larger fish (>52.5 cm). During 1990-93, smaller individuals (<52.5 cm) were relatively more abundant off West Greenland. The occurrence of small cod (peak length at 40.5 cm) off East Greenland in 1993 is atypical and may suggest an immigration of cod from West Greenland.

During 1990-91, the overall mean age increased with decreasing abundance and poor recruitment. Mean age amounted to 5.3 and 5.7 years, respectively (Tab. 5.1.6, 5.1.7 and 5.1.8). The predominance and disappearance of the 1984 and 1985 year classes is well illustrated in Fig. 5.1.5. In 1993, mean age decreased significantly to 3.7 years as a result of the loss of the older fish. The relative change in abundance of age groups from West to East Greenland with increasing age points again to eastward migration. In 1992, age groups 0-8 were found in stratum 7.2 off East Greenland, while cod stock off West Greenland was rejuvenated by occurrence of the recruiting cohort 1990 determining 72% of abundance. In 1993, this year class changed its geographic distribution pattern and was found predominantly off East Greenland at an age of 3 years. Although age groups <=3 years contributed 70% to total stock abundance in 1993, recruitment is considered to be low. The recruiting year classes were all very poor.

Coefficients of total mortality Z are listed in Table 5.1.9 and reveal pronounced age and year effects. Pre-recruits and recruits were caught more efficiently with increasing age and seemed to be fully recruited to the gear at an age of 5 years. Figure 5.1.6 illustrates these Z-values as difference to the mean over years (periods 1991-92 and 1992-93 disregarded due to incomplete survey coverage in 1992). The years of positive trend in stock abundance 1985-89 display negative coefficients when compared to the average Z, while periods of stock decline in 1983-84 and 1988-91 are characterized by positive deviations. In particular the latter time period shows unrealistic mortality rates. These effects reduce the applicability of survey indices for VPA tuning purposes.

5.1.2 Greenland trawl survey

A stratified-random trawl survey was carried out by Greenland off East and West Greenland during July--October 1993, 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, hence the haul density was higher in the shrimp fishing areas off West Greenland than off South and East Greenland. The same stratification was used as in previous surveys (Anon. 1993a). A total of 198 hauls were made within the 200 nm zone of Greenland (Figure 5.1.7).

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 0.3 million fish and 123 t, respectively. For the East Greenland area the total abundance index was estimated to be 0.1 million fish equivalent to a biomass index of 551 t (Tab. 5.1.10).

1993 was the second year for the Greenland survey. The abundance estimates were lower than reported in 1992. The biomass estimates for West Greenland decreased further, while the East Greenland biomass increased. However the catches of cod off East Greenland consisted of very few large fish. 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 1993 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 5.1.11.

The 1984 and 1985 year classes, which are considered to have drifted from Iceland to Greenland, show high age 2 abundance in all areas. For the southern area, no other year classes of any significance have been observed. Recruitment fluctuates independently in the central and northern areas. The 1990 year class, recruiting in 1994, is about average in both areas, however, whereas the 1991 year class is very poor.

Inshore spawning is well documented in the central area and is also known to occur in the Northern area so it may be assumed that the persistent recruitment found since the appearance of the 1984 and 1985 year classes derives from local spawning populations. No spawning areas are known in the southern area. The pattern of year class occurrence in this area resembles that which has been found offshore indicating that the cod in this area also originate from the Iceland area.

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). Since the spring of 1991, however, no offshore fishery has taken place. Catches in 1993 amounted to only 1,924 (Table 5.2.2).

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 7,000 t in 1986. With the recruitment of the exceptional 1984 year class, the landings increased to 112,000t in 1989. Thereafter the catches declined to 5,665t in 1992.

The catch in 1993 was record low, only 1,924t. This exceptional low figure can partly be ascribed to a general decline in the local inshore fishing effort directed to cod.

Cod in East Greenland waters have been taken mostly 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 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 27,000t in 1982 to 2,000t 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 33,000t in 1990 at East Greenland. Since then the nominal catches has declined and catches in 1993 amounted to only 1,125 tonnes (Table 5.2.3).

In 1993, 53% of the catch was taken offshore by Norwegian long-liners in the area between 61°00'N and 66°30'N. Directed cod fishery failed totally although the trawlers spent a lot of time searching for concentrations. Due to low catch rates, fishing activities were directed to redfish only. The by-catch of cod in this fishery amounted to 17% of the total catch of cod in 1993. Greenland, UK (England and Wales) and UK (Scotland) accounted for 14%, 14% and 1% respectively, all taken as by-catch in the shrimp fishery.

5.3 Assessment

5.3.1 Catch in numbers

In West Greenland, 10 samples from poundnet landings were used to convert the total inshore catch into numbers at age. Sampling in 1993 was difficult to perform due to the low catch levels. Seventy percent of the catch was broken down by samples in 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 5 and 6 (60% and 25% of the total catch in numbers, respectively) and indicated low recruitment of the 1989 year class.

At East Greenland, eight biological samples were taken from German commercial trawl catches (two samples from the first quarter, two from the second and 4 from the third). Total numbers of length measurements and age determinations amounted to 3,099 and 1,659, respectively. German catches were converted to numbers at age on a quarterly basis. This age structure was used to calculate the total catch of all nations in numbers at age (Tab. 5.3.8). The SOP-check resulted in 96% of the total catch. The catch in numbers off East Greenland in 1993 was still dominated by the 1984 and 1985 year classes which accounted for 65% of the total.

Catch in numbers for West, East Greenland and aggregated for Greenland are listed in Tables 5.3.1 - 4.

5.3.2 Weight at age

Weights-at-age for West Greenland cod were based on samples from commercial fisheries. 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 approximately the same level as in 1992, but low compared to the long term mean.

Mean weights at age in the East Greenland catch were derived from German commercial samples. Because of a lack of weight data in 1993, the values for East Greenland were calculated using a length-weight relationship based on survey data and commercial samples. The overall average was determined by weighting the catch in numbers at age by quarter.

Mean weights-at-age for West, East Greenland and weighted by numbers for Greenland are listed in Tables 5.3.1, 5.3.5, 5.3.6 and 5.3.7, respectively.

5.3.3 Assessment of Stock Size and Fishing Mortalities

In the last two assessments of cod off Greenland the Working Group has experienced considerable difficulty caused by changes in stock composition in the area. The main problem has been the sudden disappearance of most 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 of the 1984 year class declined recently to very low numbers, the Working Group tried to estimate the historical development of this stock by three different methods, i.e.

- to calibrate two VPAs separately for the total Greenland stock and its offshore component by XSA using the German survey (section 5.3.3.1)
- to conduct a traditional VPA for the total Greenland stock (section 5.3.3.2)
- to conduct a traditional VPA for the combined Iceland-Greenland stock complex and subtract the Icelandic of stock in numbers (section 5.3.3.3)

5.3.3.1 Separate Tuning of VPAs for the Total Greenland Stock and its Offshore Component

The German survey does not cover the entire distribution of the Greenland cod. Mainly the inshore component, which contributed substantial portions to the total catch, is not reflected by survey indices. In order to investigate this, it was decided to compare the results of two tuning runs based on the offshore and the total catch at age figures. In order to determine the offshore catch, the inshore catch was recalculated from original data and subtracted from the total catch at age matrix. This attempt resulted in negative values for few weak year classes at young ages (3-4 years). Negative catches were replaced by a catch of zero and the tuning was restricted to the period 1982-1991 and age groups 4-11 to minimize effects of slightly incorrect catch at age figures.

Table 5.3.8 and Table 5.3.9 list the tuning diagnostics of the XSA for the offshore component only and the total Greenland stock, respectively. Standard errors of log--transformed qs of the first run (i. e. the offshore component only) are considerably lower as compared to the values of the total stock, especially for the age groups 4 and 5. In view of high variations and severe trends of log-transformed q-values, the Working Group decided not to use the resulting terminal Fs for calibration purposes. Nevertheless, the comparison of both runs underlines that the improvement in resulting diagnostics by disregarding the inshore stock component is encouraging and could enable an analytical assessment for the offshore stock component. The Working Group therefore requires recalculations of age disaggregated figures for both inshore and offshore catches.

5.3.3.2 Traditional VPA for the Total Greenland Stock

Table 5.3.10 and Table 5.3.11 list the resulting fishing mortalities and stock numbers by applying a traditional VPA to the total Greenland stock during the period 1982-93 and for age groups 3-12. Input data are the catch at age for the total stock (Table 5.3.4) and a natural mortality $M=0.2$ for age groups 3-4 and an increased natural mortality $M=0.3$ for age groups 5-12 to account for emigration to Iceland (standard input).

An arbitrarily selected $F=0.1$ was used as initial input to the VPA. Determination of terminal Fs were derived by several VPA iterations. The average selection patterns of the last three years (FBAR by age) were always used as initial values. This procedure was iterated to minimize the differences between the calculated Fs of the last year (1993) and the selection pattern of the last three years.

Based on these data (a reported catch of 190 million at age 3-9), the strength of dominant year class 1984 amounted to 333 million individuals at age 3. The second dominant cohort 1985 is indicated to amount to 95 million at this age (a reported catch of 53 million at age 3-8). Consequently, the catch equation of the VPA attributes the dramatic decrease in stock abundance to the fishing mortality, the FBAR for 1991-93 exceeds 1.1 for all age groups >3 and <11.

5.3.3.3 Traditional VPA for the Combined Iceland-Greenland Stock Complex

In order to avoid migration effects, a traditional VPA was conducted for the combined Iceland-Greenland stock complex. The underlying idea is to determine the historical development of the total Greenland stock by substraction of the stock in numbers matrix of the Icelandic stock (Table 3.3.2) from the resulting combined assessment. The Icelandic assessment is described in section 3.3.6 and takes into account an immigration of 30 million at age 6 in 1990 (year class 1984). Input data for the combined assessment are the aggregated catch at age matrix of the Iceland and Greenland stocks and a natural mortality of M=0.2.

An arbitrarily selected F=0.1 was used as initial input to the VPA. Determination of terminal Fs were derived by several VPA iterations. The average selection patterns of the last three years (FBAR by age) were always used as initial values. This procedure was iterated to minimize the differences between the calculated Fs of the last year (1993) and the selection pattern of the last three years.

The fishing mortalities and stock in numbers of the combined assessment are given in Table 5.3.12 and Table 5.3.13, respectively. The cohort strengths at ages 3-9 during the period 1974-1989 for all three variants, i.e. Iceland-Greenland stock complex, Iceland and Greenland stock, are listed in Table 5.3.14. Estimates for the dominating year classes 1984 and 1985 off Greenland amount to 341 million (30 million immigrants subtracted from that already included) and 92 million individuals, respectively. These values are in very good agreement with the estimates of the same year classes derived from the traditional VPA for the Greenland cod stock (section 5.3.3.3, 333 million and 95 million).

5.4 Management Considerations

The 1993 German survey data confirmed the severely depleted status of the cod stock off Greenland as indicated by results based on incomplete survey coverage in 1992. These abundance estimates are by far the lowest on record and are about 1% of the 1987 values. Very low abundance and biomass indices derived from the Greenland trawl survey underline the evidence of these results. The trends in the fisheries are consistent with this picture as in 1993, the directed cod fishery failed offshore and cod were taken mainly 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 were observed during the surveys. Consequently, no substantial recruitment is expected in the foreseeable future.

Short-term prospects for the offshore stock component and fisheries cannot be more pessimistic. Additional catches taken both by the directed fishery and as by--catches by the extended shrimp or redfish fisheries will substantially increase the probability of stock extinction. Therefore, no fishing should take place until a substantial increase in recruitment and biomass is evident.

The inshore fishery exploiting self-sustained local fjord populations has historically been small. The inshore stock component has never been assessed separately. A further reduction of the recent catch level amounting to 2.000 tonnes (historically 5,000-10.000t) may be expected in the West Greenland areas due to low recruitment indices derived from the young cod survey.

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 1981-1993 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. In 1993 catches increased again to about 41,000 t. Catches not officially reported to ICES have been included in the assessment.

More than 90% of the total annual catch is taken by Icelandic trawlers in Division Va. In 1993 the Faroese Islands reported catches of about 4,000 t taken in Division Vb. Faroese catches in this area are expected to increase in 1994.

6.2 Trends in Effort and CPUE

Updated estimates of CPUE from the Icelandic trawler fleet for the period 1977-1992 are presented in 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. This index is used to estimate the total effort from the total catch.

In the period 1977 to 1982 CPUE increased yearly, reaching a maximum in 1982. In 1984-1989 the CPUE was relatively stable. Since then it has been decreasing and was the lowest on record in 1993, about 60% of the 1984-1989 level. The effort increased each year during the last decade, reaching a maximum in 1989. From then to 1991 it decreased but has increased during the last 2 years and reached the 1989 level in 1993.

6.3 Catch in Numbers

The catches in number at age were updated according to the final catch figures for 1993 using the Icelandic catch-at-age data raised to the total catch for each year as no other length distributions or age/length keys were available (Table 6.6). The length-weight relationship used was W = 0.01758 * exp (2.84387).

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 data. The average weight of 5-year olds in 1992 was estimated from the mean of 1980-1991. The average mean weights (1991-1993) were used in the catch predictions. 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 1991-1993, based on samples from Icelandic trawling. Icelandic 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).

6.6 Stock Assessment

6.6.1 Tuning and estimates of fishing mortalities

Natural mortality was assumed to be 0.15. The proportions of F and M before spawning are both set to zero. Estimates of total effort from Table 6.5.1 were used to tune the VPA (with weighted regressions). The XSA tuning method was used following the results of the retrospective analysis made by members of NW Working Group in the spring 1993. A shrinkage of 0.5 was used in the tuning. The results are shown in Tables 6.9, 6.10 and Figure 6.1.

6.6.2 Spawning stock and recruitment

The recruitment shows a decrease from 40 million in 1980 and 1981 to 29 million in 1983. In 1985 it reached 43 million, decreasing to 32 million in 1989. The 1990 recruitment is again 40 million and just below average in 1991 (Table 6.11). Spawning stock biomass as well as 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 predictions are given in Table 6.13. Annual recruitment of 34 million at age 5 in 1992-1993 is based on the average recruitment for the years 1976-1990. Stock size in 1994 is derived by assuming average recruitment in 1992-1994 and using fishing mortalities from the VPA to estimate values for ages 6 and 7 year old in 1994. Mean weights were derived from the average over the years 1991-1993. Maturity at age was derived by averaging over the same period. A catch level of 41,000 t, equal to the total catch in 1993, was used as the predicted total catch in 1994. The fishing pattern for the short- and long-term projections was based on the average F levels from 1991-1993 and standardized with the average F level for 8-12 year olds.

6.7.2 Biological reference points

$F_{0.1}$ was estimated to be 0.17 and F_{max} 0.35. Due to inadequate sexual maturity at age data for this stock, it was not 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 1994, the total stock is estimated to be about 210,000 t and the spawning stock to be about 70,000 t. The assessment, shows that fishing effort at the present level will lead to a reduced stock in 1996. A catch of 25,000 t in 1995 will lead to a slight increase in stock size in 1996, with a spawning stock of 75,000 t and total stock biomass of 220,000 t.

6.8 Management Considerations

Continuation of the present fishing mortality will reduce the SSB in 1996. In order to increase the SSB a TAC of 25,000 t is needed.

6.9 Comments on the Assessment

The use of only one commercial fleet for tuning is a cause for concern because of possible catchability changes. Further, there is considerable uncertainty about the recruitment. Repeated surveys could be used for examining these issues. Information about the age composition from the Faroese Greenland Halibut fishery is needed, as the catch composition is likely to differ from the trawl fishery.

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

7.1 Species and Stock Identification

7.1.1. Stocks dealt with in the Working Group

In the northeast Atlantic there are at least three species of redfish: *Sebastes viviparus*, *S. marinus*, and *S. mentella*. Since *S. viviparus* has never been the subject of a commercial fishery, this species is not dealt with further in this report. The other two species have a wide distribution in the North Atlantic.

The North-Western Working Group has to deal with and assess the following three stocks:

S. marinus	-	Greenland/Iceland/Faroes stock.
S. mentella	-	Greenland/Iceland/Faroes stock.
S. mentella	-	Irminger Sea Oceanic stock.

Many aspects of the migration pattern of these stocks are still uncertain. The migration of maturing fish to the spawning areas is obvious although the migration route is still not fully known. Movements of the fishing fleet and survey results show some shifts in the location of aggregations of fish which suggest a migration pattern.

7.1.2 Some recent biological information on the oceanic *S. mentella*

The population of oceanic redfish inhabits the pelagic waters of the Irminger Sea both within the 200-mile economic zones of Iceland and East Greenland and in international waters (Magnusson, 1983; Pavlov and Shibanov, 1991). The spawning stock is fished by numerous countries. In March–May, the "spawning" redfish concentrations consist mainly of females. They are aggregated in the north-eastern part of the area where the fishing season usually starts close to the EEZ of Iceland in the vicinity of the Reykjanes Ridge and even extending into Division Va. The fishing season has started earlier in recent years. Thus, in 1994, the Icelandic fleet was operating within the EEZ of Iceland in March and April as far north as 63°N and having good catches consisting mainly of females in spawning condition or spawning. In June–July, feeding concentrations of oceanic *S. mentella* migrate in a south-western direction and become distributed in the open part of the Irminger Sea as well as in the 200 mile zone of East Greenland.

In an Icelandic survey in September 1993 (Magnusson, WP 14 and Anon 1994a), however, the greatest concentrations were met more to the east suggesting an eastward migration of fish after June/July. It is, therefore, likely that there is a back and forth migration of oceanic *S. mentella* in the Irminger Sea. This back and forth migration was also indicated by the movements of the fishing fleet.

During the period of Russian investigations from 1982 to 1993, only minor year-to-year variations in redfish length distribution have been noted (Figure 7.1.1). Most of the concentrations have consisted of fish 33–38 cm long. No difference was registered in length of redfish taken from the open part or from the East Greenland zone (Figure 7.1.2).

It was pointed out earlier (Anon., 1990a,b) that there appears to be a partial overlap of the "spawning" areas of the two stocks of *S. mentella* (oceanic and traditional) and that the stocks select different depths for the extrusion of larvae. Russian ichthyoplankton investigations in 1993 showed that all redfish larvae were distributed in the upper 50 meter layer and not below. This means that larvae of both stocks, both deep-sea and oceanic *S.mentella*, had mixed after the extrusion.

During the 1991 to 1993 Icelandic cruises, hauls were taken in depths greater than 500 m at different localities in the survey area. Deep sea redfish were caught in all of these hauls. Thus, the distribution area of deep sea redfish in this region seems to be much more extensive than previously assumed and is not only overlapping during "spawning" time. These findings might put this stock into a new perspective in terms of its distribution.

Hydrographical observations carried out during the annual Russian trawl-acoustic surveys, indicated that redfish feeding aggregations formed within the East-Greenland waters of divergence. Such concentrations were registered in waters where temperatures ranged from 2.1° to 6.4°C and salinity of 34.72 - 35.07. Redfish concentrations were higher in areas where high horizontal gradients of these parameters existed. It has been suggested that the density of redfish aggregation increases as the variation in physical oceanographic conditions increases. During the formation of feeding concentrations, a movement from areas optimal for larvae extrusion to areas of lower temperatures and salinity was noted. It is evident that the redfish aggregation migration during the feeding period is the result of both abiotic factors and the distribution of available food over the area.

7.2 Stock distribution and splitting of the landings into stocks

7.2.1 Stock distribution

The distribution of *S. marinus* and the deep sea *S. mentella* stocks in the national fisheries zones is to some extent reflected in the catch statistics. All catches taken in ICES Sub-area XIV are within the national fisheries zone of Greenland. Likewise, catches reported in Divisions Va and Vb were taken within the national fisheries zone of Iceland and the Faroes, respectively. In Sub-area VI, the catches could be taken within the fisheries zone of the European Community (EC) or the Faroe Islands.

Conditions are different for the oceanic *S. mentella* stock. Reported catches have so far mainly be taken in Sub-areas XII and XIV in international waters, i.e., outside the national fisheries zone of the neighbouring countries. The catches within the national fisheries zones of both Greenland and Iceland have, however, increased in 1992 and 1993. Thus, Iceland took about 1,500 t and 1,700 t within its EEZ in 1992 and 1993, respectively, and corresponding figures for Greenland are 150 t and 6,300 t (according to log-books).

7.2.2. Splitting of catches

Since 1990, attempts to split the redfish catches in Division Va into *S. marinus* and *S. mentella* have not been satisfactory. A new attempt was made this year for the years 1989–1993. A description of the new approach is presented as a working paper to the Working Group (Sigurdsson, WP 11).

The following data were used:

1. Samples from the fresh fish trawlers taken by the MRI and the Icelandic Catch Supervision (ICS).

2. Landing statistics from Germany.

3. Information on landed products from freezing trawlers.

Splitting of the catches from the fresh fish trawlers: The samples from the 5-year period were pooled into rectangles (30′ latitude by 1° longitude) on monthly bases for each year. The reported catches during this period from this fleet were 47% of the total landings of the same fleet. The catches from each rectangle were splitted according to the composition in the samples and raised to the total catches from that fleet.

Splitting of catches from freezing trawlers: In the freezing fleet the products are usually labeled according to species. Reliable data on this issue could only be obtained from a few vessels. These data were considered representative for the whole fleet and the results of the analyses used to split the total catches of redfish of this fleet.

The landings in Germany are splitted at the market and the data were obtained from the German authorities.

The splitting values (%) for the years 1989–1993 are given in Tables 7.2.1-7.2.3. There are some differences in the splitting percentages between the overlapping years (1989 and 1990) and the former splitting used in the Working Group. It was decided to use the new splitting also for these two years in spite of the differences (9.1% and 5.5% for these two years, respectively).

In Sub-area XIV (East-Greenland) the landings of Germany, Greenland, Japan and UK for 1992 and 1993 have been splitted between *S.marinus* and deep-sea *S.mentella* according to the German trawl survey at East-Greenland.

For Division Vb and Sub-area VI the splittings are based on biological information to the Working Group and/or log-books (Shibonov *et al.* Working paper no. 19) (Tables 7.2.2-7.2.3).

7.3 Landings and Trends in the Fisheries

7.3.1 Landings and trends in the fisheries on *S.marinus* and deep-sea *S.mentella*.

The total catch of redfish in 1993 (approx. 124 000 t), excluding catch figures from the oceanic *S.mentella* fishery, increased by about 5% from the catch in 1992 (118 000 t) to about the 1991 level (123 000 t).

In Division Va (Iceland), the landings of the Icelandic fleet have remained relatively stable. The catch was 97 000 t both in 1991 and 1993, but about 95 000 t in 1992 (Tables 7.3.1-7.3.2). However, the proportion of *S. marinus* has declined steadily during recent years and the proportion of *S. mentella* exceeded 50% of the landings in 1993 for the first time on record (Tables 7.3.11-7.3.12). Length-distributions from the Icelandic landings of both species are given in Tables 7.3.15-7.3.16.

In Division Vb (Faroes) (Tables 7.3.3-7.3.4) the biggest landings on record were taken in 1986 (about 21,000 t). Since then the catches decreased steadily to about 12,000 t in 1990, but increased to about 15,000-16,000 t in 1991 and 1992. A decrease to less than 10,000 t in 1993 is reported. This decrease is reported for all countries fishing in this area. About 78% of the Faroes landings in 1993 (9,690 t) were *S.mentella*, and this was the same percentage as the year before. Decreased catches from traditional fishing grounds is one reason for the reduction. Length-distributions from the Faroese landings for both species are given in Tables 7.3.17-7.3.18.

Landings from Sub-area VI have been of minor importance in recent years (Tables 7.3.5-7.3.6).

The landings of *S.marinus* in Sub-area XIV have declined from the very high catch of 31,000 t in 1982 to a level of less than 2,000 t since 1989 except in 1991 when the catch was 4,000 t. The landings of deep-sea *S.mentella* were at a level of 15,000 t in the beginning of the 1980'ies, decreased to a level of 6,000 t in the years 1987-1992 and increased to 15,000 t in 1993.

7.3.2 Landings and trends in the fishery on oceanic *S.mentella.*

The fishery on oceanic *S.mentella*, which started in 1982, was in 1993 generally conducted in the international waters of Sub-areas XII and XIV, outside the 200-mile Economic Zones of Iceland and Greenland (Table 7.3.13). Iceland reported about catches of oceanic *S.-mentella* taken within the Icelandic EEZ, 1,536 t in 1992 (of which 614 t were taken in Sub-area Va) and 1,674 t in 1993. Within the Greenland EEZ, 150 t and 6,300 t were taken in 1992 and 1993, respectively. After the landings decreased in 1988-1991, the total international landings increased to 59,738 t in 1992 and 87,246 t in 1993 (Table 7.3.14). The main reason for dropping landings in 1988-1991 was a decrease in the Russian fleet effort. Most of the countries participating in this fishery, increased their oceanic *S.mentella* landings in 1992-1993. The total catch of oceanic *S.mentella* in 1993 was taken in Sub-areas XII and XIV in almost equal proportions. Age composition and length-distribution of the Norwegian landings are given in Table 7.3.19.

7.4 Juvenile Redfish

7.4.1 Recruitment indices

Indices for 0-group redfish in the Irminger Sea and at East Greenland are available from the Icelandic 0-group surveys since 1970 (Table 7.4.1). During 1972–1974, the indices were well above the overall average of 15.1 suggesting good year classes in those years. During the ten-year period 1975–1984, the index was below average, particularly in 1976 and from 1979 to 1984. Values were high in 1985, 1987, and 1990. Although the 1986 and 1989 indices were slightly below average, the indices suggest generally strong year classes from 1985 to 1991 following a period of poor ones (1975–1984).

In 1991, the area surveyed was extended to include an area surveyed in earlier surveys. The 1991 index of 26.4 is the second highest on record while the 1992 and 1993 indices of 11.6 and 4.0 respectively are below the overall average of 15.1.

Length frequencies of *S. marinus* from the German groundfish survey in 3rd quarter in 1993, show a distinct peak at 25–30 cm (Kosswig and Ratz, Working paper no. 17).

Length distributions of redfish from the Greenland shrimptrawl survey in July-October 1993 showed that fish around 10 cm dominated the catches at West-Greenland, while a distinct mode at 15 cm was seen at East-Greenland (Bech, Working paper no. 4).

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 7.4.1. 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 generalized additive model (GAM) with several degrees of freedom. Yearclasses 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.

7.4.2 Discards of redfish in Subarea XIV

Discards of redfish in the shrimp fishery in East Greenland Waters has been reported in logbooks to Greenland authorities and the amounts reported were 81 tonnes and 162 tonnes in 1992 and 1993 respectively (Table 7.4.2). This table also shows that 36 tonnes and 139 tonnes of redfish were discarded in the directed redfish fishery for *S.marinus* and deep-sea *S.mentella* in 1992 and 1993, respectively.

7.4.3 Regulations of small redfish at East- and West-Greenland.

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.

An offshore shrimp fishery with small meshed trawls (40 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 'Dorhn 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 used for shrimp fishery is also a part of the nursery area for redfish. Observers have noted, that big shrimp catches often are followed by big by-catch of small redfish.

Trial fishery for shrimp have frequently been carried out in the redfish box in the last three or four years. The shrimp fishermen claims that very often the by-catches of small redfish are much less than outside the redfish box.

The Working Group was also informed that in 1993 a trawl fishery utilising small redfish at East Greenland took place.

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

First of all the abundance of small redfish in the redfish box should be estimated by including a number of trawl hauls in this area during the trawl surveys in Subarea XIV, and the logbook information of redfish discards during the trial fishery should be analyzed to compare the fishery inside and outside the redfish box.

It could be argued that other methods than fixed closed areas could protect small redfish.

The Working Group considered the following possibilities:

- Legislate use of a 'fish grid' as in the case in the Bare nts Sea;

- Temporary closure of areas when by-catch of small fish exceed a defined level as onforced at Iceland and in the Barents Sea;

- Observes on board the vessels.

It should also be noted that an experiment will take place in 1994 to estimate the survival rate of fish and shrimp exposed to shrimp trawling.

7.5 Redfish Assessment

7.5.1 Traditional stocks

7.5.1.1 CPUE analysis

Results from a fairly comprehensive analysis of CPUE data from Icelandic trawlers was presented in Working Paper 12 (Johannusson, G and Th. Sigurdsson). A summary of the results is seen in Figure 7.5.1**[fig 5 from WP]**. The figure shows the trends in CPUE from commercial trawlers as well as the trend in a groundfish survey abundance index of *S. marinus*. It is important to note that the CPUE numbers is computed on total redfish catches whereas the groundfish survey uses only one species.

The CPUE indices are computed by simple aggregations of tows with at least a given percentage of redfish in each tow. The different CPUE lines correspond to different percentages.

The groundfish survey abundance 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.

These results seem to indicate that the CPUE and survey data both show the same peaks and troughs. However, the slope of the survey-based line is considerably steeper than the one from the CPUE data. This is likely to be a reflection of increased catchability of the trawlers, but attempts to extract these changes using GLMs did not prove to be fruitful (WP 12).

In summary, the groundfish survey seems to indicate a considerable (over 50%) decline in fishable biomass of *S. marinus* since 1986.

7.5.1.2 State of the *S. marinus* stock and projections

Working Paper 13 (by Stefansson, G and Th. Sigurdsson) introduced a possible method for computing TAC values corresponding to different reductions in real effort.

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 tonnes 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 7.5.1 and Figure 7.5.2, along with the projection for 1994 assuming constant effort.

7.5.1.3 Management considerations

The *S. marinus* stock seems to be at a low level and fishable biomass may have decreased by 50% in the past decade, 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.

It is important to reduce effort from the present level since this level does not seem sustainable. Since there are indications of improved recruitment and in fact the last groundfish survey index was an improvement on the previous one, it may be feasible to bring on this effort reduction by e.g. taking an initial 25% reduction and then further reductions if no improvement is seen in the groundfish survey.

Within the present management regime there is little potential of bringing about an effort reduction in the fishery for *S. marinus* without a corresponding effort reduction in *S. mentella.* Assuming the same proportional split between catches of the species, an equal effort in 1994 from 1993 would correspond to a total catch of 105,000 t whereas a 25% reduction in effort would correspond to a total catch of approx. 80,000 t and a 50% reduction would be expected to yield a total catch of approx. 50,000 t.

7.5.2 Oceanic *S.mentella*

7.5.2.1 CPUE

CPUE data for the oceanic *S.mentella* fisheries in Subareas XII and XIV are given in Table 7.5.2. The CPUE for the Russian fleet has declined more or less continuously since the fishery started in 1982. However, the BMRT-trawlers now only contribute about 25% of the Russian fleet fishing for oceanic *S.mentella*, and are thus not fully representative for the whole fleet. The shorter series for Iceland and Norway, both show, on the contary, an increasing trend. The Working Group believe that the latter fact is explained by technical modifications of the fishing procedure and by gaining experience about the fish distribution. The Working Group realizes that this explanation may be less valid as more years are added to the series. The Icelandic and Norwegian fleet is also more effective, showing considerable higher catch rates. Since the CPUE-series are so different, it is difficult to use the CPUE data as reflecting the stock situation.

7.5.2.2 Surveys

A regular **Russian ichthyoplankton survey** to assess the commercial stock size of *S. mentella* was conducted both in the international area of the Irminger Sea and in the Icelandic Economic Zone by RV "PINRO" from 19 April to 29 May 1993. One hundred and nine ichthyoplankton stations were completed (Fig. 7.5.3). The distribution of larval redfish was defined and areas where larval extrusion occurred were identified. Total number of extruded larvae was estimated and the commercial size of the stock of redfish was calculated.

Ichthyoplankton was collected using a BONGO net with an opening diameter of 19.7 cm. Catchability of the net was assumed, to equal 1. Samples were collected over a 10-14 min. period through step-by-step fishing in the 0-50 m depth range at a vessel speed of 3.0-3.6 knots. Subsampling and primary processing were accomplished following standard methods. Deep plankton hauls did not show any larval redfish deeper than 50 m (below the transition layer) (Shibanov and Melnikov, Working paper no. 16).

During the survey, the redfish larvae concentrations (and redfish spawning aggregations correspondingly) were distributed between 62° and 53° N and from 40° to 25° W. The highest larvae densities were observed in the south-western part of area investigated (Fig. 7.5.4). Major concentrations were located at temperatures of 4.0-6.5°C, most of them at 4.5-5.5°C. Studies on redfish larvae showed that the mean age of larvae caught during the survey was 11 days, hence, the average mortality rate of larvae between extrusion and day of capture was 80.6 % (Fig. 7.5.5). Results of larvae numbers calculations are presented in Table 7.5.3. The ichthyoplankton survey in the offshore of the Irminger Sea and adjacent part of the Icelandic economic zone over the area of 125.500 sq. miles estimated the commercial stock of oceanic <u>S. mentella</u> at 3.1 million t or $4.45*10^9$ fish (Table 7.5.4). Biological parameters of redfish spawning concentrations are presented in Table 7.5.5.

The traditional **Russian trawl-acoustic survey** (TAS) for the commercial stock of the oceanic *S. mentella* of the Irminger Sea was conducted using the RV "PINRO" also. The route of the survey is shown in Fig. 7.5.6.

The TAS for the *S. mentella* stock was carried out from June, 07, till July, 08, 1993, offshore in the Irminger sea and inside the 200-mile zone of Eastern Greenland using the EK/ES-400 (38 kHz frequency) echo sounder and a SIORS echo-integrator. An interval of integral averaging (ESDU) was considered equal to one nautical mile. A new equation of redfish target strength (TS) was used in 1993 (Reynisson, 1992).

$$TS = 12.5 \text{ LOG } (L) - 59.5,$$

where L - fish length.

The new target strength function gives a considerable lower number of small redfish (e.g., about 80 % for fish less than 27 cm) for a given integrator value compared to the previous used TS. For fish bigger than 40 cm the new TS gives a hifher number of fish (10-15 % more). Comparison of the two target strength functions using the average length distribution (Table 7.5.6) from the 1993-survey showed that the new TS gave a 14 % <u>lower</u> estimate (in numbers) than the former used TS would have given.

The commercial pelagic trawl with a vertical opening of about 50m was used for the collection of biological data and for echo-registrations interpretation. A total of 21 haul were taken. Oceanographic observations were made on tracks of the TAS every 35-40 miles using a CTD "Smart" and a series of bathometers down to a depth of 1000 m. In June, observations were conducted at 13 stations in the 3-K section located north of 60° N also (Fig. 7.5.6).

Redfish abundance in the Irminger Sea amounted to 1693.8 million specimens with a biomass of 999,300 t. In East Greenland zone, redfish abundance was estimated at 2493.5 million specimens with a biomass of 1,557,700 t (Table 7.5.7). Distribution of the redfish concentrations is presented in Fig. 7.5.7.

In the early June in the areas north of 59° N, few redfish concentrations were registered in the 70-450 m depth range with small densities in the 100-250 m depth range. Redfish density did not exceed 5-8 t per sq. mile. The acoustic scattering layer was observed and consisted predominantly of jellyfish, *Myctophidae* and *Entomostraca*. Jellyfish constituted 25-75 % of the catches. South of 59°, the redfish density was slightly higher than in the southern area. On the fishing grounds, the density of concentrations reached 100-1800 t per sq.mile in small areas. Schools 3-5 miles in area and from 200 to 250 m depth were registered in the 100 to 700 m depth layer. The distributional area of these concentrations did not exceed 600 sq. miles.

Within the 200-mile zone of the East Greenland, scarce concentrations of redfish were registered in the 70-300 m depth layer, increasing in number at 100-200 m depths. Species composition of acoustic scattering layer and correlation of its components were similar to those in the off-shore. By-catches of jellyfish constituted 30-75 %. Diel vertical migrations of redfish were not registered in any of the survey areas.

Mature males predominated (60.7 %) in redfish concentrations throughout the area of the TAS. The length range of the males was 33-38 cm long and females 34-39 cm long with mean sizes of 35.1 cm and 36.1 cm, respectively (Table 7.5.6). The age of males (from scale readings) ranged from 6 to 21 and from 6 to 23 for females (Table 7.5.8). Most of the mature females in summer were either migrants from the coastal areas (specimens maturing for the first time) or females which did not spawn in 1993.

It was noted that redfish mean length decreased with depth. At depths less than 150 m, mean length of males was 35.9 cm and females - 37.6 cm; deeper than 200 m, mean length were 34.3 and 35.4 cm, respectively.

Redfish fed intensively during the TAS period. The main redfish prey in summer were Calanus and euphausids, *Sagitta*, young squid, octopus and *Myctophidae*.

In parasitological investigations, 13 species of parasites were noted in redfish belonging to 5 taxonomic groups. The fauna of parasites present indicates that redfish dwell and feed in the pelagic waters of the area.

The level of the redfish infestation by the copepoda *S. lumpi* was similar to the mean long-term level. Overall average intensity of infestation was 16.0 % of all fish sampled with 0.54 parasites per investigated fish. Including old cephalothoraxes, these indices increased to 34.2 % and 0.70 cases of infestation respectively. As in previous years, infestation increased with the age of fish, and it was 2-3 times higher in redfish females than in males.

Black and red pigment spots of non-parasitic origin (Bogovski and Bakay, 1989) were located on fish skin 3.7 times greater, on average, in females than in males of redfish. Occurrence of such pigments increased with length of investigated specimens and reached a maximum in males 37-38 cm long and in females 39 cm long.

The area of the survey in summer 1993 were characterized by a lack of warmth in the surface waters. The oceanographic conditions in 1993 in the Irminger Sea were similar to those of the "cold years" of 1983 and 1984 (Pedchenko, 1994). The temperature at the sea surface in spring 1990-1993 declined with lower rates of seasonal warming in the active layer. In 1990 and in previers years in the 0-50 m layer (at stations 1-6 of the 3-K section) the difference in temperatures between June and April constituted 3.0°C. In 1992 and 1993 this difference did not exceed 1.0°C. In the lower layers, the change of temperatures from spring to summer was not so evident, but the tendency of minimal warming occured. Because of weak advection of the Atlantic waters by the Irminger Current, the warmness of waters of the intermediate structure (200-500 and 500-1000 m layers) in June 1993 was lower than that in April.

Because of weakened advection of Atlantic waters, the waters of Arctic origin predominated in the Northerh area of the TAS. Dense redfish schools were absent there. In the southern areas, the oceanic conditions for fish concentrations were more favourable than in the northern area. The formation of fattening concentrations of redfish was noted there under lower thermohaline indices and with smaller amplitude of changeability than in previous years. This led to changes in conditions for the formation of redfish concentrations which coincided with interannual changes of rates of seasonal warming and advection of Atlantic waters. The redfish concentrations were mainly located in the cold periphery of the frontal zone south of 59° N.

Redfish distribution in the survey area coincides well with areas of local upwelling of the intermediate structure. Fish concentrations were noted in the peripheries of local upwellings, and the density of concentrations was determined by the intensity of water upwelling with temperatures between 3.4-3.8°C and salinity 34.80-34.85.

Each summer since 1982, the Russian trawl-acoustic surveys which have assessed the commercial oceanic *S. mentella* stock size, have covered an area of 73 to 190 thousand square miles both in the off-shore of the Irminger Sea and in 200-mile zone of Eastern Greenland. Results from trawl-acoustic surveys 1989-1993 showed considerable variation in redfish biomass (from 400 thousand to 2.5 million t) (Table 7.5.9). Analogous variation in redfish biomass (from the TAS results) was also registered in the years 1982-1988 (Pavlov *et al.*,-1989). It is difficult to find any main reason for this redfish biomass changeability, but some indications of changes in fish size distribution in 1991 were registered. Average length of males was bigger than for females (opposite to all other years) (Fig. 7.1.1). The Russian survey results also showed that interannual changes in hydrographical conditions might have affected the TAS results.

Differences in estimates of oceanic redfish total biomass is thought to be related to the fact that in different years trawl-acoustic surveys did not cover the entire area of fish distribution. The second possible reason of this redfish biomass variability is the high interannual changeability of the water conditions during the survey period.

An inverse relationship between salinity of the Atlantic waters in the upper 500 m layer in the 3-K Section (April) and redfish abundance (total and in Greenland fishing zone separately) was revealed by the data from the trawl-acoustic surveys for 1989-1993.

The relationship found between abiotic conditions and results of Russian TAS were used in a regression model to estimate redfish abundance. Salinity of the Atlantic waters in 200 - 500 m layer was used as a predictor. The obtained linear equation of regression is the following:

$$Y = 1.27223 * 10^6 * X - 36200$$

where

Y – redfish abundance, (billions of specimens);

X – average salinity of the Atlantic waters in 200 - 500 m depth in the 3-K section, stations 1-6, in April.

Mean error of the forecast (difference between real and calculated values) was 25.3 %, which indicates a satisfactory forecasting accuracy. Fig. 7.5.8. gives the fluctuations of redfish abundance and its forecast, as well as its error for 1982-1993.

The Working Group is of the opinion that different area coverage each year may explain the great variation in the acoustic estimation from year to year. The design of the surveys may, due to fish migration, also have resulted in that the fish have either migrated out of the surveyed area or have been counted twice.

It is our contention that results from the trawl-acoustic surveys for oceanic redfish carried out earlier by Russian scientists in 1982-1993 may serve as a good basis for developing principals of international search for rational stock exploitation.

Iceland conducted an acoustic survey 14 Sept.- 1 Oct. 1993 on the oceanic redfish in the Irminger Sea in order to:

1. examine whether it was feasible to conduct an acoustic survey at that time of the year and to

2. examine the distribution of the oceanic redfish at that time.

The latitudinal transactions which are usually used as cruise tracks were omitted and a southerly course was laid in the westerly part of the Irminger Sea through regions where relatively dense concentrations of oceanic redfish were observed during the acoustic survey in June 1992.

The route back was laid farther to the east. Finally, at the end of the cruise some search for oceanic redfish was conducted in the Skjerjadúp area of the SW coast of Iceland (Fig. 7.5.9)

Following results could be established:

1. It is possible to assess the oceanic redfish by acoustic methods also at this time of the year, i.e. September.

2. The movements of the scattering layer at dawn and dusk and during the night caused more difficulties than in June/July because of the longer dark period in September.

3. The highest concentrations were observed farther to the east than in June/July 1992. In September 1993, the densest concentrations were observed along the cruise track between 59° N and 61°N but west of 37°W i.e. within the EEZ of Greenland while in September 1993, these were found outside the EEZ, i.e. east of it.

4. As expected most of the females were beyond the newly spent stage (IV) and were with maturing gonads (stage II) while the males were mostly in the state of emptying the sex glands (stage III) but very few had finished it (stage IV).

5. The length distribution of oceanic redfish was similar to that observed during earlier surveys with an overall av. lenght of 36.6. cm.

6. The incidence of abnormalities (e.g. *Sphyrion lumpi* etc.) was variable or between 14%-54% in the various hauls.

7. Males were in majority (65%).

The observation of acoustic densities of oceanic redfish in the month September outside the EEZ of Greenland i.e. in areas where in June/July 1992 the densities were rather scattered, indicate that an eastward migration has taken place in this period (June-September).

During the Icelandic surveys in June/July 1991 and in 1992, concentrations of oceanic redfish were established within the EEZ of Greenland. However, according to the cruise in September 1993 described above an eastward migration had obviously taken place and the concentrations of oceanic redfish within the EEZ of Greenland had weakened compared to those observed in June/July 1992. Similarly, the concentrations east of the EEZ of Greenland had considerably gained in strength compared to the observations in 1992.

A Faroes acoustic survey was carried out at the same time as the Icelandic survey in September 1993. Fish distribution was similar to that reported from the Icelandic survey. The redfish catches taken by the pelagic trawl (Norwegian herring trawl) were small, but this may have to do with scattered fish registrations, the trawl-geometry and the towing speed (2.5 knots). No acoustic estimate was given.

7.5.2.3 Stock trajectories for oceanic *S.mentella*

Due to uncertainties regarding this stock, simulations with various input parameters were performed in order to examine the possible response of this stock to fishing. A similar approach was made during last year's assessment, and the method was described in last year's Working Group report (Anon. 1993).

The basic assumption made is that the initial stock size in 1982 was in a virgin state with an equilibrium stock composed of age groups from a constant number of recruits. The virgin stock is thus computable based on knowledge of the number of recruits and the annual natural mortality. The number of ages is taken to be very large (65), so that natural and fishing mortalities define the effective age range. Projections of the stock are then possible for any given value of the parameters (i.e., natural mortality, constant recruitment, fishing selection and growth) (Figure 7.5.10) based on the usual catch equations and the given catches taken in 1982-1993. The idea behind the model is that the projection of the fishable stock from 1982 onwards should match the present acoustic biomass estimate. The system of equations can thus be made to fit the catches and acoustic estimate. The only unestimable parameter is then the natural mortality and it is left as such, with scenarios considered for values of M=0.03, M=0.05 and M=0.1.

The model (EXCEL spreadsheet) was updated by revised catches for 1991-1993. No new information about natural mortality, recruitment or fishing selection was presented to the Working Group. There are still great discrepancies between ageing methods, and new information about growth was only confirming the input used last year. Last year's trajectories were based on the combined results from the Icelandic and the Russian acoustic survey in June-July 1992 which yielded a biomass estimate of 1.9 million tonnes. In 1993 Russia conducted both an ichthyoplankton survey and an acoustic survey, and these yielded a biomass estimate of 3.0 million tonnes and 2.5 million tonnes, respectively.

In 1993, the Russian acoustic estimate was based on a fish target strength (TS) function different from previous years, but similar to that used in the Icelandic survey in 1992. In numbers, and based on the average length distribution of the oceanic *S.mentella*, the Russian estimate of 2.5 million tonnes would have been approx. 14% higher if the old TS had been used. Likewise, if the Russian estimate in the 1992-survey had been calculated using the Icelandic TS-value, the combined estimate would have been somewhat less than 1.9 million tonnes. Other surveys for oceanic *S.mentella* in 1993 and the first half of 1994 have not added any new information about the total biomass.

Since a joint international trawl-acoustic survey for oceanic *S.mentella* will be conducted in June-July 1994 by Iceland, Norway and Russia, the opinion of the Working Group is to wait for the results from this survey before any changes of the stock evaluation are made.

Although acoustic surveys on this stock have been conducted for 12 years, the area of coverage has been different. It is the opinion of the Working Group that since this stock is distributed over a very wide area, it is important that the design of the survey is such that no fish will be "lost" or counted twice. Results from Russian scientists also suggest that different hydrographical conditions may have affected the acoustic estimates. The Working Group therefore decided to rerun the model with only revised catches and, since there are some variance and uncertainties connected with the acoustic estimate, projections were made using a 1993-biomass of 1.5, 1.9, 2.5 and 3.0 (ichthyoplankton survey) tonnes. The results are given in Table 7.5.10. If we also this year base our projections on the acoustic estimate of 1.9 million tonnes, an annual TAC of 100 thousand tonnes for each year 1994-2000 will not reduce the stock (in 2001) below 50% of its virgin biomass level. If the current biomass is 2.5 million tonnes, then an annual TAC of up to 150 thousand tonnes would be acceptable.

7.5.2.4 Management considerations

In view of the uncertainties concerning the oceanic *S.mentella* stock dynamics, it must be monitored regularly with acoustic surveys (e.g., every 3 years) while harvesting continues, in order to determine more precisely the effects of catches on the stock. The different biomass estimates of this stock are not due to similar changes in the stock itself, but rather due to circumstances (biotic and abiotic) which the surveys and research so far have not been capable of quantifying. Under the current state of knowledge, and until the results from the most comprehensive survey (summer 1994) so far on this stock are available, the Working Group therefore come up with the same recommendation as last year. It is conceivable that a TAC of over 100 thousand tonnes would reduce the stock towards 2001 to below 50% of its virgin state. It is therefore recommended that this (precautionary) TAC should not be exceeded.

The results of the planned international acoustic survey in June-July 1994 in the Irminger Sea and adjacent waters will, however, be available to ACFM November 1994 meeting for further evaluation.

7.5.2.5 Future international research work on oceanic *S. mentella*

The Working Group emphasizes that the oceanic *S. mentella* fisheries in Subareas XII and XIV has the status of being a large international fishery. The migration processes, formation of fishable concentrations and spawning of oceanic *S. mentella* generally take place in the International waters and within both the 200-mile economic zones of Greenland and Iceland. For this reason North-Western Working Group in 1993 and Study Group on Redfish stocks in 1993 recommended to continue the investigations on abundance and migration patterns for this stock (Anon, 1993a and 1993b). Further emphasis should be laid on investigations leading to better understanding of the recruitment for this stock. For future international research, the Study Group on Redfish stocks in 1993 recommended to conduct an international trawl-acoustic survey (TAS) in summer 1994. A coordinating meeting between the three countries participating in the TAS (Russia, Iceland and Norway), was held in Bergen, 6-7 April 1994 and further elaborated by the Study Group on Redfish Stocks in the same year (Anon, 1994a). During the survey period (June, 20 - July, 18) it is aimed to cover the total area of oceanic *S. mentella* distribution. The report of the International TAS will be presented at the ICES 82nd Statutory Meeting in 1994.

Based on the Report from this year's Study Group on Redfish Stocks (Anon. 1994a), the North-Western Working Group makes the following recommendation for further research:

1. All countries, participating in the oceanic *S. mantella* fisheries, should participate in the investigations on this stock. It is important to coordinate this research work in order to find more objective results.

3. Research on stock identification of redfish, using different approaches, should be emphasized.

4. Joint international trawl-acoustic surveys should be conducted on a regular basis in the future.

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ANNEX I

Description of method to calculate survey indexes for cod from the Icelandic groundfish survey

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ABSTRACT

This paper describes a method used for analysing groundfish survey data using scatterplot smoothers. Two variables are smoothed , the binary variable fish - no fish and the number of fish per station which is assumed to have Gamma distribution. Prior to the smoothing numbers at age for each station are calculated and the smoothing, is done on each year class. Finally, the values are interpolated on to a rectangular grid. Calculating the indices involves summing up the grid values inside the area of interest.

1. Introduction

The Icelandic groundfish survey has now been done for 10 years in sequence. It has become a major part of the stock assessment for cod and several other stocks with its weight increasing as the time series becomes longer. Survey indices have been calculated using various methods, for example the Gamma-Bernoulli method by Stefánsson (1991). The method described here can be looked at as a smoother version of the Gamma-Bernoulli method.

The method was originally developed for making contour plots of the distribution of the fish. The method is applied to each year class separately. Therefore the first step prior to applying the method is to calculate the numbers at age per station.

2. Calculating the number at age per station.

Calculation of the number at age per station involves the following steps.

Calculating the age-length keys for each area.

Using the appropriate age-length key and the length distribution for each station to get the number at age per station.

The areas used in calculating the age-length-keys are shown in figure 1. The terminology used here is described in Anon (1994) and Johannesson (1994). The groundfish survey involves only one gear and one season so the *g* and *s* subscript can be cancelled from the notation in these papers.

The models used for calculating the mean and variance in length at age for each area are:

$$\ln(\mu_{ar}) = \alpha + \beta_r + \gamma_a + \zeta_r \ln(a)$$
$$\ln(\sigma^2_{ar}) = \alpha + \beta\, \mu_{ar} + \gamma_r$$

Number at age for each area was calculated from:

$$\ln(\kappa_{ar}) = \alpha + \beta_r + \gamma_{ar}$$

This equation really calculates the number at age in otholith samples in all areas for it uses all the degrees of freedom.

The age-length keys are than calculated by using a normal distribution with mean m and variance _^{2} along with the numbers at age. The number at age for each station are then calculated from :

$$N_a = \sum_l K_{al} N_l$$

Where N_a is the number of age a at the station, K_{al} the appropriate age-length keys and N_l the number of length l at the station.

Looking at figure 1 some of the regions are quite small so using more years could be a logical step to improve the method especially when using it where sampling is sparser than for the Icelandic cod.
Another step that can be attempted is to incorporate maturity in the model at least for the year classes where a substantial number of immature and mature fish are present.

2. Calculating indices.

When the number at age for each station is available the next step is to calculate survey indexes. The method described here was originally developed to make contour maps of the distribution of the fish so it calculates the number of fish on a rectangular grid. Calculating the indices involves the summing of the values on the appropriate grid points.

The model is based on dividing the problem into finding the probability of fish at a station and the number of fish at a station where fish is. The probability of getting fish at a station is modelled as a Bernoulli variable and the number of fish at a station is modelled by a Gamma model. This is much along the same lines as the model described by Stefansson (1991).

Both parts of the model are then modelled separately using a surface smoother. The smoother used is the loess smoother available in the Splus software. (Chambers et. al, 1992) The loess smoother fits a local n^{th} order polynomial in the neighbourhood of each data point weighting points less with increasing distance from the data point where the value is calculated. The weighting function is called tricubic weight function

$$T(u,t) = (1 - (u/t)^3)^3 \quad \text{for } 0 < u < t$$
$$T(u,t) = 0 \text{ for } u > t$$

t in this equation is the distance beyond which points have no weight. Selecting neighbourhood size is always a compromise between getting a local neighbourhood and getting enough number of points in the neighbourhood.

When calculating the survey indexes for the Icelandic cod the degree of the polynomial was 2 and the span was 0.3. This span means that the nearest 30% of the data points were used in the smoothing. The distance t is the distance of the point in that subset that is farthest away.

The loesss smoother is nonparametric so it calculates new values at each station but does not calculate any parameters for the user to predict at other points. When interpolating on the grid the Gamma and Bernoulli part were interpolated separately. Also the "additive predictors" were interpolated. After the interpolation they were transformed back by the inverse link functions and then the Gamma and Bernoulli part were multiplied together to get the value at the station. The interpolating function used was ordinary kriging with very low nugget effect using for each grid point the 8 nearest data points.

In reality the interpolating method is not very critical for the output of the loess smoothers does not change much over a distance similar to typical distance between stations in the groundfish survey. The interpolation does on the other hand give more weight to each data point in areas where the sampling is sparse, independent of interpolating method.

There are number of parameters that can be adjusted in calculations of the indexes, among them:

Setting the limits between 0 and 1 in the Bernoulli variable for each station. The age-length-keys cause a small fraction of a fish at a station to be a possibility. The same number was used to mark the stations to include in the Gamma distribution. The effect of changing the number is complicated for reducing it increases the mean of the Bernoulli variable but decreases the Gamma part. Here the limits were one fish per station for 2 - 6 years old cod but 0.5 for other ages (including one year old).

The Bernoulli part is set to 0 where is calculated less than some number . 0.05 was used here for all age groups.

The smoothing parameters and the degree of the polynomial in the loess smoother are of importance. 2^{nd} order polynomial and smoothing parameters = 0.3 were used here.

The area that is interpolated over is of primary importance especially where high values occur near the edges of the area. The grid points used here are shown in figure 2 along with the stations in the groundfish survey 1988 which was the year with the fewest stations.

3. Summary and possible extensions.

Using smoothers like described here has some important advantages over traditional method.

Possibility to incorporate location dependent changes.
Contour maps showing the distribution of the stock can be made from the indexes.

This latter point can be of value in checking the indexes. An example of contour plot is shown in figure 3 which shows the distribution of 5 year old cod in the groundfish survey 1985 - 1994.

Possible future work can involve :

Testing other smoothers than loess.

Trying another co-ordinate system. Here polar co-ordinates are attempting. The main change is in distance calculations of the smoother. Where the depth gradient is large points very near each other can be considered distant.

Separating each year class in mature and immature part. This has to be done when calculating the age-length keys.

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Stefansson G. 1991. Analysis of groundfish survey data: Combining the GLM and delta approaches.

Chambers John M, Hastie Trevor Statistical Models In S. Wadsworth & Brooks 1992.

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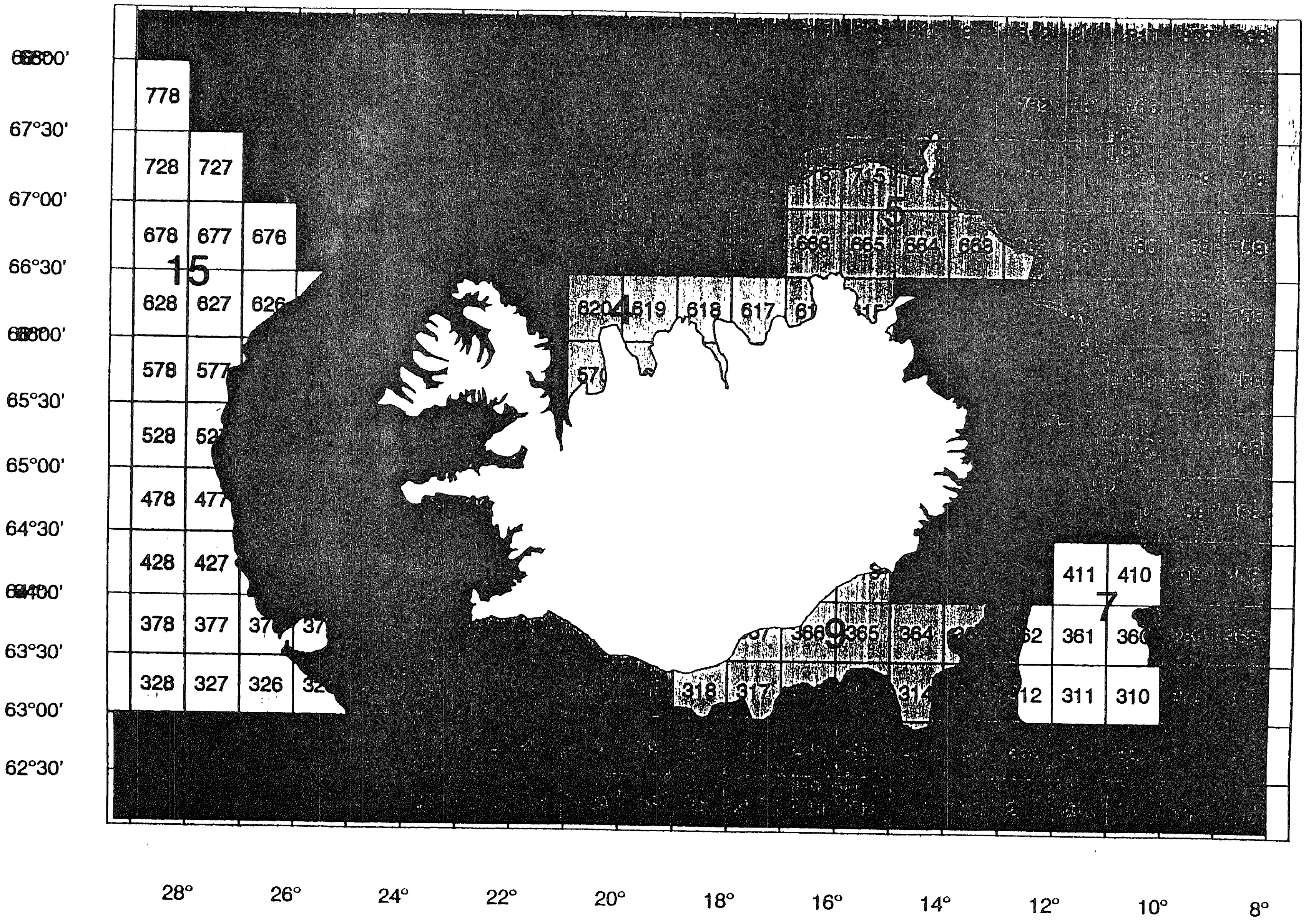
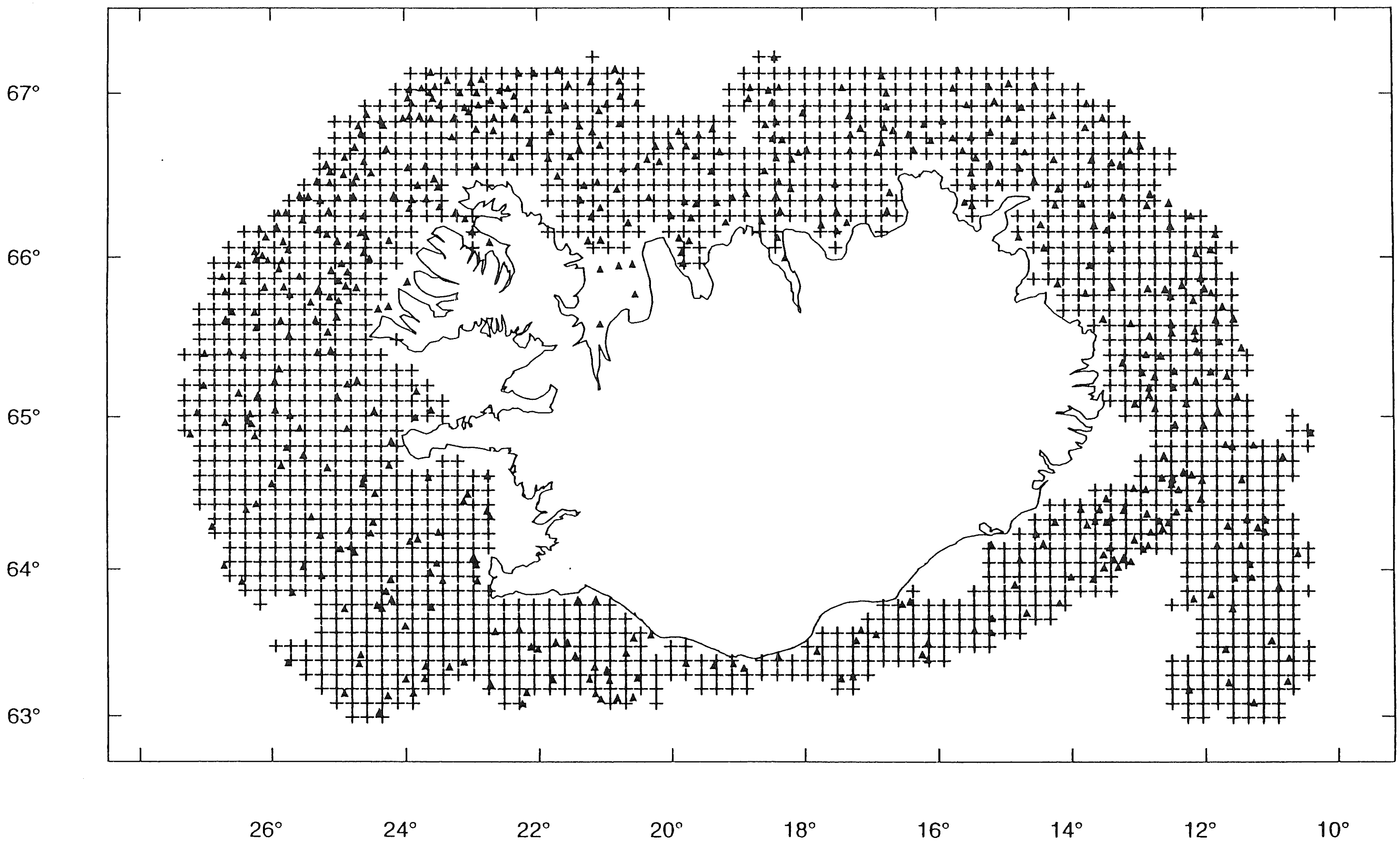


Figure 1. Ar division used in calculating the a -length keys

Figure 2. Stations in the groundfishsurvey 1988 along with the grid used in calculating indexes



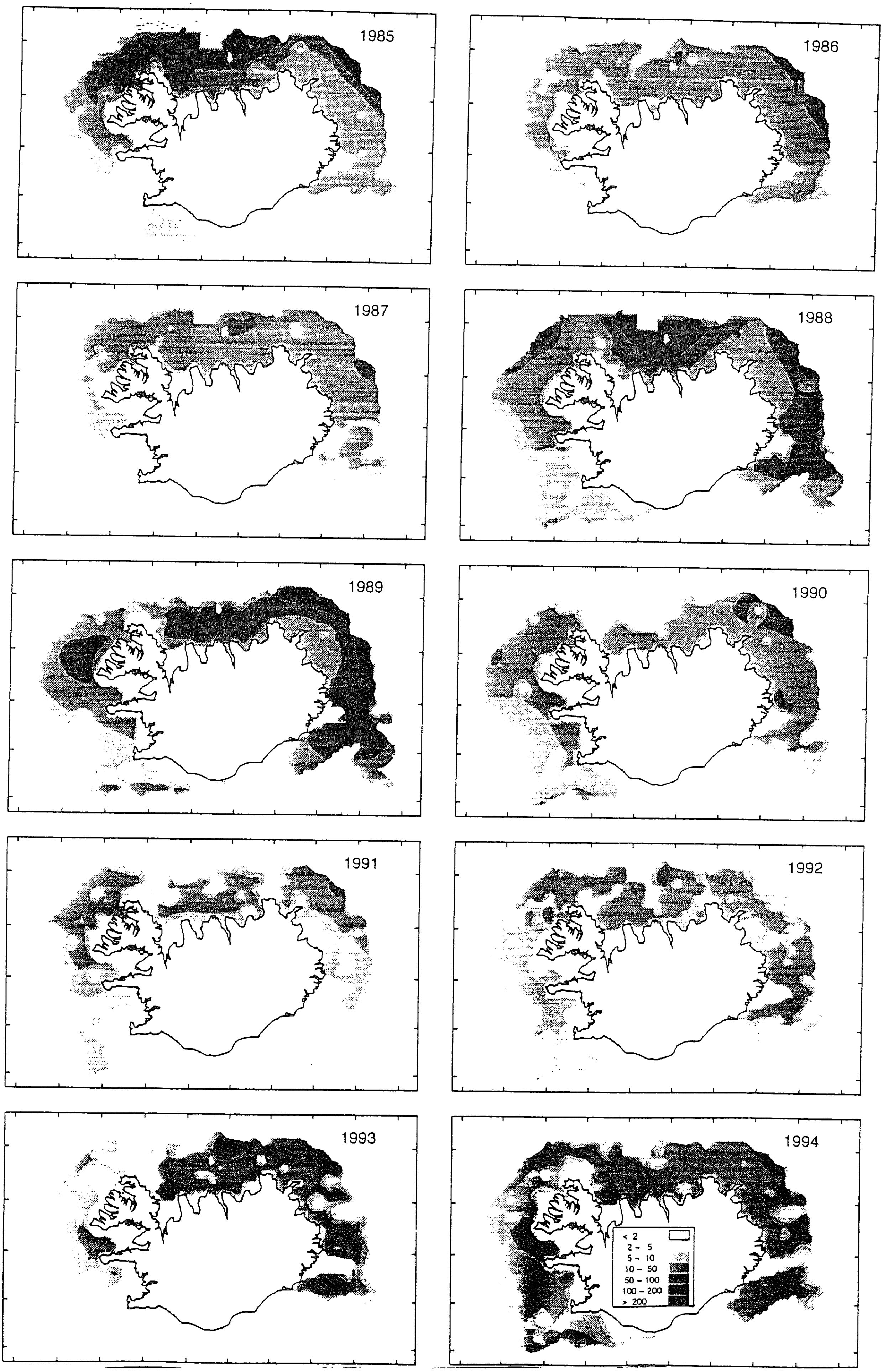


Figure 3. Distribution of 5 year old cod in the Icelandic ground fish survey.

Table 2.1.1 Catches of Faroe Plateau cod by various fleet categories. Tonnes gutted weight.

Year	Open boats	Longliners >100 GRT	Singletrawl >400 HP	Gill nett	Jiggers	Singletrawl 400-1000HP	Singletrawl >1000 HP	Pairtrawl 400-1000HP	Pairtrawl >1000 HP	Longliners >100 GRT
1985	5,650	9,651	2,371	201	1.518	2,787	3,980	4,367	1,998	2,643
1986	2,945	4,697	1,595	409	908	1,930	2,628	9,202	4,619	1,591
1987	2,149	3,209	1,355	116	631	1,445	1,726	5,631	3,139	2,145
1988	589	3,027	1,071	564	1.633	1,612	1,494	5,542	3,427	2,788
1989	946	6,008	1,173	654	1.896	1,179	1.143	2,185	1,728	3,674
1990	458	4,240	576	171	978	442	512	845	1,247	2,329
1991	326	2,490	554	160	619	263	369	652	1,016	1,349
1992	127	1,360	361	1	366	116	187	623	1,079	697
1993	100	800	763		446	283	178	625	1,078	642

Table 2.1.2 Catches of Faroe haddock by various fleet categories. Tonnes gutted weight.

Year	Open boats	Longliners >100 GRT	Singletrawl >400 HP	Gill nett	Jiggers	Singletrawl 400-1000HP	Singletrawl >1000 HP	Pairtrawl 400-1000HP	Pairtrawl >1000 HP	Longliners >100 GRT
1985	903	5,299	196	18	86	780	1,055	2,546	832	1,816
1986	951	5,039	250	4	62	354	664	2,654	1,313	1,535
1987	1,520	5,418	313	3	47	625	288	2,340	1,251	1,796
1988	209	5,215	167	2	50	430	259	1,205	914	2,076
1989	453	7,431	138	2	175	409	213	862	749	2,257
1990	235	6,153	76	1	134	294	192	534	800	1,815
1991	194	4,228	116	0	41	95	131	495	799	1,321
1992	68	1,903	64	0	13	30	45	439	576	917
1993	23	791	261	0	6	150	41	375	708	829

Table 2.1.3 Catches of Faroe saithe by various fleet categories. Tonnes gutted weight.

Year	Open boats	Longliners >100 GRT	Singletrawl >400 HP	Gill nett	Jiggers	Singletrawl 400-1000HP	Singletrawl >1000 HP	Pairtrawl 400-1000HP	Pairtrawl >1000 HP	Longliners >100 GRT
1985	89	38	23	13	982	2,509	12,930	10,822	10,805	28
1986	107	67	31	54	1.296	1,004	9.872	9,921	13,173	21
1987	244	52	116	157	1.985	1,458	7,289	8,134	15,790	37
1988	173	101	40	113	2.576	2,660	8.257	7,748	17,266	31
1989	352	55	133	90	3.723	2,144	7,118	9,440	16,513	60
1990	306	132	110	122	4,041	2,096	10,742	13,127	23,442	101
1991	281	55	78	281	4,801	585	6,791	12,978	22,584	64
1992	130	121	18	0	3,294	135	2,254	7,677	17,486	37
1993	150	56	57	0	2.714	301	1,879	6,080	17,639	30

Table 2.1.4 Fishing days by various Faroese fleet categories on the Faroe Plateau.

Year	Open boats	Longliners >100 GRT	Singletrawl >400 HP	Gill nett	Jiggers	Singletrawl 400-1000HP	Singletrawl >1000 HP	Pairtrawl 400-1000HP	Pairtrawl >1000 HP	Longliners >100 GRT
1985	372	7,530	1,987	83	3.277	1,969	5,296	4,906	3,064	2,740
1986	453	6,622	1,477	112	2.701	1,133	5,232	5,953	4,336	2,085
1987	556	6,669	1,259	155	2,930	1,463	4,181	5,575	5,420	2,444
1988	2,709	8,680	1.196	226	7,917	2,175	4,481	5,736	5,973	2,831
1989	3,909	12,774	1,376	173	10,586	1,952	4.572	4,987	5,111	3,220
1990	2,913	14,440	1.144	136	9,449	1,853	3,601	5,273	7,424	3,367
1991	2,961	14.780	1,106	183	10.150	1,013	3.644	5,626	7,673	3,442
1992	1,747	10,523	1.148	181	9,506	465	3,580	3,832	6,853	2,829
1993	1,413	7,326	1,977	561	7,748	963	3,547	2,771	5,953	1,754

Table 2.2.1	Faroe Plateau COD in Subdivision Vb1. Nominal catches (t) by countries 1983-1993, as officially reported to ICES.									
Nation/Year	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Faroe Islands	36,914	39,422	34,492	21.303	22,272	20,535	12.232	8,203	5,938	5524
France	34	29	4	17	17				318	
Germany	9	5	8	12	5	7	24	16	12	
Norway	22	28	83	21	163	285	124	89	41	34
UK England				8				1	79	177
UK Scotland										
Denmark			8	30	10					
Total	**36,979**	**39,484**	**34,595**	**21,391**	**22,467**	**20,827**	**12,380**	**8,309**	**6,388**	**5,735**

1) Preliminary
2) Sub-division Vb2 included
3) Included in Sub-division Vb2
4) Quantity unknown 1989-19091 and 1993

Table 2.2.2	Faroe Plateau COD in Subdivision Vb1. Nominal catches (t) by countries 1983-1993, as used in the assessment.									
Nation/Year	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Faroe Islands	36,914	39,422	34,492	21,303	22,272	20,535	12,232	8,203	5,938	5524
France	34	29	4	17	17				318	
Germany	9	5	8	12	5	7	24	16	12	
Norway	22	28	83	21	163	285	124	89	41	34
UK England				8				1	79	177
UK Scotland										
Denmark			8	30	10					
Total	36,979	39,484	34,595	21,391	22,467	20,827	12.380	8.309	6,388	5,735
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	**36,979**	**39,484**	**34,595**	**21,391**	**23,182**	**22,068**	**13,487**	**8,660**	**6,542**	**5,735**

1) Preliminary
2) Sub-division Vb2 included
3) Included in Sub-division Vb2

Run title : Cod in the Faroe Plateau (Fishing Area Vb1) (run name: CODR40)

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Table 2.2.3

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
2,	4396,	998,	210,	257,	509,	2237,	243,	190,	209,	113,
3,	5234,	9484,	3586,	1362,	2122,	2151,	2849,	446,	465,	733,
4,	3487,	3795,	8462,	2611,	1945,	2187,	1481,	2130,	476,	565,
5,	1461,	1669,	2373,	3083,	1484,	1121,	852,	615,	932,	209,
6,	912,	770,	907,	812,	2178,	1026,	404,	300,	360,	309,
7,	314,	872,	236,	224,	492,	997,	294,	141,	135,	90,
8,	82,	309,	147,	68,	168,	220,	291,	92,	55,	31,
9,	34,	65,	47,	69,	33,	61,	50,	52,	30,	21,
+gp,	66,	80,	38,	26,	25,	9,	26,	24,	35,	24,
TOTALNUM,	15986,	18042,	16006,	8512,	8956,	10009,	6490,	3990,	2697,	2095,
TONSLAND,	36979,	39484,	34595,	21391,	23182,	22068,	13487,	8660,	6542,	5735,
SOPCOF %,	97,	95,	96,	96,	101,	98,	99,	106,	99,	103,

Run title : Cod in the Faroe Plateau (Fishing Area Vb1) (run name: CODR40)

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Table 2.2.4

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
2,	1.1950,	.9050,	1.0990,	1.0930,	1.0610,	1.0100,	.9450,	.7790,	.9890,	1.1550,
3,	1.8880,	1.6580,	1.4590,	1.5170,	1.7490,	1.5970,	1.3000,	1.2710,	1.3640,	1.7040,
4,	2.9800,	2.6260,	2.0460,	2.1600,	2.3000,	2.2010,	1.9590,	1.5700,	1.7790,	2.4210,
5,	3.6790,	3.4000,	2.9360,	2.7660,	2.9140,	2.9340,	2.5310,	2.5240,	2.3120,	3.1320,
6,	4.4700,	3.7520,	3.7860,	3.9080,	3.1090,	3.4680,	3.2730,	3.1850,	3.4770,	3.7230,
7,	5.4880,	4.2200,	4.8990,	5.4610,	3.9760,	3.7500,	4.6520,	4.0860,	4.5450,	4.9710,
8,	6.4660,	4.7390,	5.8930,	6.3410,	4.8960,	4.6820,	4.7580,	5.6560,	6.2750,	6.1590,
9,	6.6280,	6.5110,	9.6990,	8.5090,	7.0870,	6.1400,	6.7040,	5.9730,	7.6190,	7.6140,
+gp,	10.9810,	10.9810,	8.8150,	9.8110,	8.2870,	9.1560,	8.6890,	8.1470,	9.7250,	9.5870,
SOPCOFAC,	.9685,	.9491,	.9612,	.9642,	1.0061,	.9773,	.9897,	1.0601,	.9879,	1.0276,

Run title : Cod in the Faroe Plateau (Fishing Area Vb1) (run name: CODR40)

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Table 2.2.5

Table 5 Proportion mature at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
2,	.4000,	.0000,	.0000,	.0000,	.0600,	.0500,	.0000,	.0000,	.0600,	.2500,
3,	.9600,	.5000,	.3800,	.6700,	.7200,	.5400,	.6800,	.7200,	.5000,	.7300,
4,	.9800,	.9600,	.9300,	.9100,	.9000,	.9800,	.9000,	.8600,	.8200,	.7800,
5,	.9700,	.9600,	1.0000,	1.0000,	.9700,	1.0000,	.9900,	1.0000,	.9800,	.9100,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9600,	1.0000,	1.0000,	.9900,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	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 2.2.6

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	4.72	26.02	17.93	14.49	5.32	1.48	0.51	0.08
1984	100	11.57	22.65	16.85	5.34	3.47	1.40	0.14	0.00
1985	100	3.96	43.99	16.34	6.72	1.43	1.78	0.67	0.00
1986	100	0.84	27.80	101.60	29.68	12.90	6.40	4.41	1.37
1987	100	1.28	20.38	46.80	66.15	10.38	1.13	1.50	0.00
1988	100	1.98	14.14	25.31	17.83	19.00	3.70	0.92	0.28
1989	100	4.46	6.17	10.65	8.94	4.42	7.20	0.71	0.00
1990	100	1.35	8.45	16.63	15.21	4.84	5.65	3.89	0.67
1991	100	2.55	3.55	12.32	3.17	1.51	0.52	0.12	0.23
1992	100	1.48	2.10	4.74	18.33	4.03	1.29	0.66	0.13
1993	100	0.44	4.80	2.43	1.69	3.38	1.21	0.44	0.12

Table 2.2.7

Cod in the Faroe Plateau (Fishing Area Vb1)

LONGLINERS < 100 GRT (code: FLT14)

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
1985	7530	550	3110	799	375	181	282	73	17
1986	6622	47	646	1239	352	148	43	26	6
1987	6669	166	223	427	528	130	29	11	11
1988	8680	315	532	236	73	273	67	23	5
1989	12774	1466	931	672	303	270	216	34	4
1990	14440	181	1302	481	317	119	86	85	14
1991	14780	152	255	984	185	79	28	15	10
1992	10523	109	198	164	230	50	22	9	6
1993	7326	46	178	85	28	53	11	5	3

Table 2.2.8

Cod in the Faroe Plateau (Fishing Area Vb1)

TRAWLERS < 400 HP (code: FLT15)

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
1985	1987	96	1120	257	82	33	27	11	1
1986	1477	37	398	466	68	16	4	3	1
1987	1259	28	266	295	214	28	4	1	1
1988	1196	36	188	144	71	91	14	4	0
1989	1376	105	221	175	66	49	57	11	4
1990	1144	1	274	141	29	10	6	4	0
1991	1106	3	41	197	54	22	8	4	2
1992	1148	18	33	27	59	22	9	4	1
1993	1977	29	169	90	31	42	10	4	3

Table 2.2.9

Cod in the Faroe Plateau (Fishing Area Vb1)

SINGLE TRAWLERS 400-1000 HP (code: FLT17)

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
1985	1969	29	665	339	118	57	41	13	2
1986	1133	5	239	658	141	38	9	6	2
1987	1463	12	91	257	245	36	10	3	3
1988	2175	23	169	142	113	165	38	11	2
1989	1952	122	171	156	58	51	59	11	4
1990	1853	2	112	55	19	15	10	10	2
1991	1013	0	1	52	27	15	8	3	3
1992	465	4	9	10	18	6	3	1	1
1993	963	4	44	39	11	11	3	1	1

Table 2.2.10 Cod in the Faroe Plateau (Fishing Area Vb1)

SINGLE TRAWLERS > 1000 HP (code: FLT18)

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
1985	5296	26	706	520	230	91	62	25	9
1986	5232	2	258	813	206	62	17	10	5
1987	4181	9	41	154	275	92	27	6	7
1988	4481	16	105	92	98	152	47	13	4
1989	4572	8	44	90	82	75	75	18	5
1990	3601	10	120	63	36	17	12	12	2
1991	3644	0	8	51	28	16	9	6	2
1992	3580	7	15	15	29	10	4	2	1
1993	3547	1	9	16	7	10	4	1	1

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Table 2.2.11 Cod in the Faroe Plateau (Fishing Area Vb1)

PAIR TRAWLERS 400-1000 HP (code: FLT19)

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
1985	4906	61	802	424	201	94	120	43	12
1986	5953	20	848	2667	747	265	54	37	15
1987	5575	46	383	755	927	221	54	16	21
1988	5736	52	558	698	467	663	108	31	4
1989	4987	49	139	265	148	122	114	30	8
1990	5273	1	77	92	68	35	28	24	4
1991	5626	0	13	92	53	29	15	11	6
1992	3832	2	16	33	97	38	17	6	3
1993	2771	4	52	60	26	38	15	4	3

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Table 2.2.12 Cod in the Faroe Plateau (Fishing Area Vb1)

PAIR TRAWLERS > 1000 HP (code: FLT20)

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
1985	3064	14	370	218	98	39	47	17	6
1986	4336	17	267	1001	388	166	44	27	8
1987	5420	7	117	319	484	173	46	10	8
1988	5973	9	217	263	247	377	91	34	6
1989	5111	10	73	152	119	104	99	25	7
1990	7424	2	139	149	92	47	29	29	5
1991	7673	1	21	134	82	45	25	17	8
1992	6853	2	29	55	158	64	29	12	5
1993	5953	4	79	106	48	64	24	7	5

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Table 2.2.13 Cod in the Faroe Plateau (Fishing Area Vb1)

LONGLINERS > 100 GRT (code: FLT21)

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
1985	2740	33	468	231	124	69	103	39	9
1986	2085	2	95	300	128	67	20	14	4
1987	2444	5	25	132	232	117	56	21	18
1988	2831	27	191	183	173	229	69	35	10
1989	3220	314	306	290	163	192	189	54	16
1990	3367	33	344	179	133	88	77	77	14
1991	3442	14	47	289	98	52	30	23	13
1992	2829	19	47	47	89	33	16	8	5
1993	1754	3	78	76	26	47	12	6	3

Table 2.2.14

VPA Version 3.1 (MSDOS)

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Extended Survivors Analysis

Cod in the Faroe Plateau (Fishing Area Vb1) (run name: CODR40)

CPUE data from file /users/ifad/ifapwork/wg_109/cod_farp/FLEET.R40

Data for 8 fleets over 10 years
Age range from 2 to 9

Fleet,	Alpha,	Beta
FLT12: R/V Magnus H	, .200	, .300
FLT14: LONGLINERS <	, .000	, 1.000
FLT15: TRAWLERS < 40	, .000	, 1.000
FLT17: SINGLE TRAWLE	, .000	, 1.000
FLT18: SINGLE TRAWLE	, .000	, 1.000
FLT19: PAIR TRAWLERS	, .000	, 1.000
FLT20: PAIR TRAWLERS	, .000	, 1.000
FLT21: LONGLINERS >	, .000	, 1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 8

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 3 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 32 iterations

Regression weights

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

Fishing mortalities

Age,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
2,	.108,	.066,	.025,	.029,	.068,	.205,	.110,	.079,	.056,	.057
3,	.373,	.356,	.358,	.226,	.357,	.452,	.437,	.303,	.283,	.284
4,	.581,	.511,	.627,	.482,	.583,	.776,	.655,	.695,	.618,	.664
5,	.665,	.617,	.711,	.491,	.563,	.814,	.816,	.634,	.770,	.613
6,	.469,	.938,	.837,	.567,	.793,	1.017,	.807,	.783,	1.002,	.634
7,	.476,	1.200,	.873,	.502,	.833,	1.127,	.960,	.752,	1.058,	.747
8,	.492,	1.317,	.650,	.674,	.910,	1.238,	1.362,	.958,	.764,	.750
9,	.482,	.954,	.709,	.744,	.844,	1.074,	1.139,	1.006,	1.022,	.766

Continued...

Table 2.2.14 (Cont'd)

XSA population numbers

YEAR	AGE 2	3	4	5	6	7	8	9
1984 ,	4.76E+04,	1.86E+04,	8.74E+03,	3.32E+03,	2.69E+03,	9.17E+02,	2.33E+02,	9.82E+01,
1985 ,	1.72E+04,	3.50E+04,	1.05E+04,	4.00E+03,	1.40E+03,	1.38E+03,	4.66E+02,	1.17E+02,
1986 ,	9.33E+03,	1.32E+04,	2.01E+04,	5.15E+03,	1.77E+03,	4.48E+02,	3.40E+02,	1.02E+02,
1987 ,	9.83E+03,	7.45E+03,	7.54E+03,	8.78E+03,	2.07E+03,	6.27E+02,	1.53E+02,	1.45E+02,
1988 ,	8.55E+03,	7.81E+03,	4.87E+03,	3.81E+03,	4.40E+03,	9.62E+02,	3.11E+02,	6.40E+01,
1989 ,	1.33E+04,	6.54E+03,	4.48E+03,	2.22E+03,	1.78E+03,	1.63E+03,	3.42E+02,	1.02E+02,
1990 ,	2.57E+03,	8.89E+03,	3.40E+03,	1.69E+03,	8.06E+02,	5.26E+02,	4.32E+02,	8.13E+01,
1991 ,	2.76E+03,	1.89E+03,	4.70E+03,	1.45E+03,	6.11E+02,	2.95E+02,	1.65E+02,	9.06E+01,
1992 ,	4.24E+03,	2.09E+03,	1.14E+03,	1.92E+03,	6.29E+02,	2.29E+02,	1.14E+02,	5.18E+01,
1993 ,	2.24E+03,	3.28E+03,	1.29E+03,	5.04E+02,	7.28E+02,	1.89E+02,	6.50E+01,	4.34E+01,

Estimated population abundance at 1st Jan 1994

,	.00E+00,	1.73E+03,	2.02E+03,	5.43E+02,	2.23E+02,	3.16E+02,	7.34E+01,	2.51E+01,

Taper weighted geometric mean of the VPA populations:

,	7.00E+03,	6.75E+03,	4.59E+03,	2.47E+03,	1.33E+03,	5.54E+02,	2.19E+02,	8.31E+01,

Standard error of the weighted Log(VPA populations) :

,	.9483,	.9197,	.8961,	.8090,	.6817,	.7525,	.6513,	.3813,

Log catchability residuals.

Fleet : FLT12: R/V Magnus H

Age	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
2 ,	-.10,	-.17,	-1.12,	-.75,	-.16,	.24,	.67,	1.23,	.25,	-.33
3 ,	-.16,	-.13,	.39,	.61,	.23,	-.40,	-.39,	.26,	-.37,	.00
4 ,	-.54,	-.77,	.44,	.61,	.46,	-.28,	.41,	-.20,	.24,	-.54
5 ,	-.97,	-.94,	.31,	.53,	.07,	-.02,	.79,	-.67,	.83,	-.25
6 ,	-1.10,	-1.21,	.73,	.29,	.19,	-.30,	.53,	-.37,	.64,	.23
7 ,	-1.03,	-1.02,	1.30,	-.86,	-.02,	.19,	1.04,	-.82,	.42,	.47
8 ,	-1.86,	-.78,	1.25,	.98,	-.16,	-.43,	1.06,	-1.55,	.48,	.63
9 ,	99.99,	99.99,	1.30,	99.99,	.22,	99.99,	.92,	-.29,	-.30,	-.26

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-12.7472,	-11.0120,	-10.1262,	-9.8489,	-9.9960,	-9.8878,	-9.9912,	-9.9912,
S.E(Log q),	.6795,	.3595,	.4959,	.6604,	.6628,	.8503,	1.0823,	.7356,

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
2,	1.42,	-1.230,	14.39,	.54,	10,	.94,	-12.75,
3,	1.00,	.029,	11.00,	.87,	10,	.38,	-11.01,
4,	.95,	.237,	10.05,	.78,	10,	.50,	-10.13,
5,	.91,	.312,	9.67,	.65,	10,	.64,	-9.85,
6,	1.26,	-.581,	10.72,	.41,	10,	.87,	-10.00,
7,	1.58,	-.922,	11.94,	.26,	10,	1.35,	-9.89,
8,	1.20,	-.267,	10.89,	.20,	10,	1.37,	-9.99,
9,	.43,	1.683,	6.59,	.69,	6,	.25,	-9.75,

Continued...

Table 2.2.14 (Cont'd)

Fleet : FLT14: LONGLINERS <

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	.26	-1.48	-.28	.26	1.03	.42	.13	-.30	-.16
3	99.99	.35	-.12	-.68	-.06	.33	.23	.07	.04	-.15
4	99.99	-.03	-.06	-.22	-.59	.23	.00	.39	.32	-.08
5	99.99	.25	.10	-.13	-.64	.18	.38	-.11	.23	-.25
6	99.99	.59	.24	-.17	-.35	.25	.01	-.15	-.21	-.09
7	99.99	1.12	.37	-.53	-.24	.13	.15	-.50	-.02	-.29
8	99.99	.88	.02	-.04	-.17	-.14	.47	-.48	-.36	-.03
9	99.99	.66	-.22	.04	-.15	-1.13	.25	-.27	.13	-.13

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-12.4975	-11.4277	-11.1360	-11.1644	-11.0419	-11.0183	-10.9945	-10.9945
S.E(Log q)	.6771	.3115	.3029	.3183	.2851	.4942	.4091	.4950

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
2	.95	.146	12.31	.59	9	.69	-12.50
3	.95	.432	11.28	.91	9	.31	-11.43
4	1.10	-.722	11.41	.89	9	.34	-11.14
5	1.00	-.023	11.18	.87	9	.34	-11.16
6	1.00	.012	11.03	.85	9	.31	-11.04
7	.77	1.372	9.91	.84	9	.36	-11.02
8	.75	1.721	9.59	.88	9	.27	-10.99
9	1.04	-.078	11.36	.38	9	.54	-11.10

Fleet : FLT15: TRAWLERS < 40

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	.15	.09	-.08	.38	.93	-1.94	-.89	.42	.99
3	99.99	-.27	-.03	.23	-.05	.19	.28	-.10	-.46	.18
4	99.99	-.79	-.49	.12	-.06	.16	.35	.42	-.23	.33
5	99.99	-.63	-.73	-.06	-.24	.19	-.17	.56	.39	.47
6	99.99	-.30	-1.00	-.55	.02	.26	-.44	.65	.67	.48
7	99.99	-.26	-.88	-1.21	-.19	.66	-.34	.47	.94	.56
8	99.99	-.01	-.97	-1.10	-.27	.63	-.38	.46	.71	.72
9	99.99	-1.17	-.84	-1.02	99.99	.76	99.99	.38	.22	.85

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-12.8040	-10.4991	-10.1809	-10.4710	-10.5293	-10.6516	-10.6632	-10.6632
S.E(Log q)	.9429	.2529	.4029	.4623	.5860	.7347	.7094	.8652

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
2	.67	1.106	11.45	.64	9	.62	-12.80
3	.96	.355	10.43	.93	9	.26	-10.50
4	1.27	-1.385	10.66	.81	9	.48	-10.18
5	1.59	-2.363	12.07	.71	9	.58	-10.47
6	1.74	-1.441	13.04	.37	9	.95	-10.53
7	1.40	-.803	12.40	.38	9	1.05	-10.65
8	1.81	-1.217	14.92	.26	9	1.24	-10.66
9	-3.21	-1.984	-15.73	.05	7	2.24	-10.73

Continued....

Table 2.2.14 (Cont'd)

Fleet : FLT17: SINGLE TRAWLE

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	-.32	-.94	-.37	.05	1.44	-1.02	99.99	.53	.45
3	99.99	.27	.78	.07	.30	.64	-.04	-2.67	.20	.61
4	99.99	-.10	.51	.23	-.27	.09	-.67	-.43	.08	.61
5	99.99	-.08	.44	.11	-.20	-.11	-.90	.14	.29	.34
6	99.99	.28	.15	-.43	.03	-.03	-.50	.37	.29	-.13
7	99.99	-.01	.02	-.62	.03	.17	-.49	.39	.56	-.10
8	99.99	.05	-.13	-.27	.03	.17	-.06	.14	.11	-.06
9	99.99	-.58	.00	-.19	-.13	.30	-.09	.76	1.01	.35

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-13.5167	-11.5565	-10.5781	-10.6503	-10.5471	-10.4746	-10.5469	-10.5469
S.E(Log q)	.8315	1.0677	.4291	.4056	.3149	.3818	.1419	.5326

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
2	.87	.319	12.91	.53	8	.78	-13.52
3	.63	1.432	10.52	.70	9	.63	-11.56
4	1.00	-.016	10.58	.82	9	.46	-10.58
5	1.01	-.029	10.67	.81	9	.44	-10.65
6	1.09	-.458	10.85	.80	9	.36	-10.55
7	1.12	-.579	10.99	.77	9	.45	-10.47
8	.98	.222	10.46	.96	9	.15	-10.55
9	2.95	-1.589	22.01	.09	9	1.34	-10.37

Fleet : FLT18: SINGLE TRAWLE

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	.18	-1.79	-.11	.56	-.54	1.53	99.99	.65	-.65
3	99.99	.66	.65	-.46	.42	-.25	.68	-.55	-.01	-.97
4	99.99	.64	.50	-.02	-.12	.00	.11	-.42	-.25	-.27
5	99.99	.54	.23	.12	-.12	.33	.02	-.17	-.34	-.48
6	99.99	.62	-.03	.31	.09	.36	-.18	.02	-.38	-.67
7	99.99	.21	-.07	.12	.32	.36	-.17	.02	-.39	-.32
8	99.99	.42	-.43	.09	.18	.52	.17	.27	-.52	-.65
9	99.99	.64	.10	.32	.56	.38	-.04	-.21	-.32	-.24

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-15.1140	-12.8748	-11.8875	-11.5920	-11.4070	-11.2710	-11.2607	-11.2607
S.E(Log q)	1.0013	.6142	.3456	.3236	.3915	.2736	.4324	.3805

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
2	1.80	-.845	20.17	.17	8	1.84	-15.11
3	.68	2.437	11.55	.90	9	.33	-12.87
4	.79	2.666	11.14	.96	9	.20	-11.89
5	.80	2.208	10.83	.95	9	.21	-11.59
6	.76	1.712	10.37	.88	9	.26	-11.41
7	.76	5.076	10.07	.99	9	.10	-11.27
8	.70	2.401	9.48	.91	9	.24	-11.26
9	.66	1.765	8.85	.81	9	.21	-11.14

Continued..

Table 2.2.14 (Cont'd)

Fleet : FLT19: PAIR TRAWLERS

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	.56	-.16	.69	.94	.64	-1.71	99.99	-1.22	.44
3	99.99	.10	.94	.72	1.08	.05	-.91	-1.26	-.78	.27
4	99.99	-.32	.73	.45	.82	.16	-.73	-1.10	-.36	.46
5	99.99	-.30	.60	.26	.41	.04	-.51	-.75	.01	.29
6	99.99	-.06	.51	.12	.53	-.02	-.62	-.61	.11	.13
7	99.99	.22	.22	-.21	.17	-.04	-.44	-.64	.25	.51
8	99.99	.30	.00	.04	.06	.20	-.26	-.30	-.23	.24
9	99.99	.27	.33	.39	-.43	.02	-.47	-.29	-.03	.37

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-14.5654	-12.1110	-11.0519	-10.8044	-10.6223	-10.5393	-10.5189	-10.5189
S.E(Log q)	.9983	.8518	.6799	.4494	.4144	.3777	.2273	.3467

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
2	.56	1.753	12.03	.74	8	.49	-14.57
3	.67	1.528	11.01	.77	9	.53	-12.11
4	.85	.604	10.66	.72	9	.61	-11.05
5	.86	.802	10.39	.84	9	.40	-10.80
6	.71	2.246	9.62	.90	9	.24	-10.62
7	1.05	-.250	10.75	.79	9	.42	-10.54
8	.99	.113	10.44	.90	9	.24	-10.52
9	.85	.537	9.58	.65	9	.31	-10.51

Fleet : FLT20: PAIR TRAWLERS

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	.59	1.03	-.13	.18	.06	-.32	-1.13	-.76	.71
3	99.99	.22	.52	-.02	.51	-.20	-.24	-.67	-.35	.34
4	99.99	-.15	.43	-.02	.17	-.06	-.23	-.67	-.07	.63
5	99.99	-.30	.51	-.12	-.02	.05	-.30	-.38	.17	.39
6	99.99	-.28	.55	.09	.12	-.01	-.48	-.29	.24	.08
7	99.99	-.10	.48	-.20	.10	-.07	-.60	-.29	.35	.36
8	99.99	-.03	.13	-.28	.24	.12	-.29	-.05	.00	.16
9	99.99	.17	.14	-.42	.06	-.01	-.46	-.19	.02	.24

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-15.6011	-12.5282	-11.4159	-11.0521	-10.8151	-10.6818	-10.6423	-10.6423
S.E(Log q)	.7034	.4180	.3841	.3121	.3092	.3564	.1887	.2598

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
2	.73	1.149	13.71	.73	9	.50	-15.60
3	.79	1.778	11.74	.92	9	.29	-12.53
4	1.03	-.194	11.52	.84	9	.42	-11.42
5	1.06	-.376	11.24	.87	9	.35	-11.05
6	.87	.908	10.33	.88	9	.27	-10.82
7	1.18	-.904	11.48	.79	9	.43	-10.68
8	1.04	-.332	10.84	.93	9	.21	-10.64
9	1.40	-1.273	13.20	.61	9	.34	-10.70

Continued...

Table 2.2.14 (Cont'd)

Fleet : FLT21: LONGLINERS >

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	-.39	-2.33	-1.62	.08	2.02	1.33	.36	.42	-.30
3	99.99	-.33	-.67	-1.66	.24	.80	.56	.04	.13	.66
4	99.99	-.60	-.66	-.72	-.06	.44	.13	.28	.05	.90
5	99.99	-.45	-.36	-.55	-.12	.34	.36	.11	-.01	.51
6	99.99	-.24	-.28	-.15	-.28	.41	.29	.01	-.19	.34
7	99.99	.01	-.36	.01	-.21	.26	.38	-.09	-.14	.11
8	99.99	-.10	-.80	.25	.01	.35	.47	.05	-.52	.22
9	99.99	-.32	-.83	.18	.31	.27	.35	.09	-.10	-.06

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-13.6540	-11.6341	-10.8020	-10.5617	-10.1651	-9.8991	-9.6351	-9.6351
S.E(Log q)	1.3353	.7704	.5474	.3781	.2855	.2327	.4137	.3687

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
2	1.57	-.543	16.47	.12	9	2.20	-13.65
3	1.32	-.763	12.57	.46	9	1.05	-11.63
4	1.82	-2.929	12.79	.66	9	.70	-10.80
5	1.66	-4.940	12.40	.89	9	.31	-10.56
6	1.20	-1.076	10.76	.82	9	.34	-10.17
7	.94	.552	9.68	.93	9	.23	-9.90
8	.98	.094	9.54	.74	9	.43	-9.64
9	1.07	-.192	10.03	.50	9	.42	-9.63

Terminal year survivor and F summaries :

Age 2 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	1246.	.736	.000	.00	1	.135	.079
FLT14: LONGLINERS <	1474.	.737	.000	.00	1	.135	.067
FLT15: TRAWLERS < 40	4677.	1.026	.000	.00	1	.069	.022
FLT17: SINGLE TRAWLE	2701.	.911	.000	.00	1	.088	.037
FLT18: SINGLE TRAWLE	906.	1.097	.000	.00	1	.061	.107
FLT19: PAIR TRAWLERS	2679.	1.093	.000	.00	1	.061	.037
FLT20: PAIR TRAWLERS	3513.	.765	.000	.00	1	.125	.029
FLT21: LONGLINERS >	1276.	1.452	.000	.00	1	.035	.077
F shrinkage mean	1196.	.50				.292	.082

Weighted prediction :

Survivors, at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1730.	.27	.18	9	.680	.057

Age 3 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
FLT12: R/V Magnus H	2130.	.388	.100	.26	2	.166	.271
FLT14: LONGLINERS <	1693.	.346	.054	.16	2	.207	.331
FLT15: TRAWLERS < 40	2459.	.332	.066	.20	2	.226	.239
FLT17: SINGLE TRAWLE	3552.	.816	.035	.04	2	.037	.171
FLT18: SINGLE TRAWLE	1172.	.644	.708	1.10	2	.060	.449
FLT19: PAIR TRAWLERS	1453.	.801	.732	.91	2	.039	.376
FLT20: PAIR TRAWLERS	2159.	.441	.480	1.09	2	.128	.268
FLT21: LONGLINERS >	3691.	.818	.099	.12	2	.037	.165
F shrinkage mean	1620.	.50				.100	.343

Weighted prediction :

Survivors, at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2022.	.16	.10	17	.620	.284

Continued...

Table 2.2.14 (Cont'd)

Age 4 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
FLT12: R/V Magnus H,	435.,	.434,	.402,	.93,	3,	.123,	.777
FLT14: LONGLINERS < ,	534.,	.328,	.051,	.16,	3,	.215,	.672
FLT15: TRAWLERS < 40,	452.,	.365,	.291,	.80,	3,	.174,	.756
FLT17: SINGLE TRAWLE,	957.,	.597,	.128,	.21,	2,	.065,	.428
FLT18: SINGLE TRAWLE,	434.,	.457,	.103,	.23,	2,	.111,	.778
FLT19: PAIR TRAWLERS,	575.,	.823,	.580,	.70,	2,	.034,	.636
FLT20: PAIR TRAWLERS,	596.,	.417,	.442,	1.06,	3,	.133,	.619
FLT21: LONGLINERS > ,	1054.,	.659,	.244,	.37,	3,	.053,	.395
F shrinkage mean ,	544.,	.50,,,,				.093,	.662

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
543.,	.15,	.10,	22,	.650,	.664

Age 5 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,	260.,	.496,	.158,	.32,	4,	.077,	.547
FLT14: LONGLINERS < ,	224.,	.316,	.147,	.46,	4,	.188,	.613
FLT15: TRAWLERS < 40,	227.,	.394,	.263,	.67,	4,	.122,	.606
FLT17: SINGLE TRAWLE,	243.,	.457,	.350,	.77,	4,	.090,	.576
FLT18: SINGLE TRAWLE,	154.,	.365,	.178,	.49,	4,	.141,	.801
FLT19: PAIR TRAWLERS,	215.,	.542,	.342,	.63,	4,	.064,	.631
FLT20: PAIR TRAWLERS,	251.,	.349,	.220,	.63,	4,	.154,	.561
FLT21: LONGLINERS > ,	335.,	.462,	.139,	.30,	4,	.088,	.447
F shrinkage mean ,	170.,	.50,,,,				.075,	.747

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
223.,	.14,	.08,	33,	.553,	.613

Age 6 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
FLT12: R/V Magnus H,	366.,	.606,	.206,	.34,	5,	.050,	.568
FLT14: LONGLINERS < ,	340.,	.315,	.106,	.34,	5,	.184,	.600
FLT15: TRAWLERS < 40,	475.,	.499,	.049,	.10,	5,	.074,	.462
FLT17: SINGLE TRAWLE,	300.,	.382,	.127,	.33,	5,	.126,	.659
FLT18: SINGLE TRAWLE,	195.,	.397,	.126,	.32,	5,	.116,	.889
FLT19: PAIR TRAWLERS,	321.,	.485,	.160,	.33,	5,	.078,	.626
FLT20: PAIR TRAWLERS,	323.,	.343,	.115,	.34,	5,	.155,	.623
FLT21: LONGLINERS > ,	419.,	.356,	.091,	.25,	5,	.144,	.511
F shrinkage mean ,	201.,	.50,,,,				.073,	.873

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
316.,	.14,	.06,	41,	.411,	.634

Continued...

Table 2.2.14 (Cont'd)

Age 7 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
FLT12: R/V Magnus H,	92.,	.797,	.209,	.26,	6,	.035,	.633
FLT14: LONGLINERS < ,	62.,	.436,	.068,	.16,	6,	.118,	.839
FLT15: TRAWLERS < 40,	121.,	.667,	.070,	.10,	6,	.050,	.514
FLT17: SINGLE TRAWLE,	75.,	.436,	.105,	.24,	6,	.118,	.737
FLT18: SINGLE TRAWLE,	55.,	.365,	.051,	.14,	6,	.169,	.909
FLT19: PAIR TRAWLERS,	98.,	.474,	.181,	.38,	6,	.100,	.606
FLT20: PAIR TRAWLERS,	89.,	.398,	.119,	.30,	6,	.141,	.651
FLT21: LONGLINERS > ,	76.,	.355,	.062,	.18,	6,	.178,	.725
F shrinkage mean ,	53.,	.50,,,,				.090,	.934

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
73.,	.15,	.05,	49,	.315,	.747

Age 8 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
FLT12: R/V Magnus H,	35.,	1.034,	.172,	.17,	7,	.022,	.594
FLT14: LONGLINERS < ,	25.,	.471,	.052,	.11,	7,	.105,	.760
FLT15: TRAWLERS < 40,	45.,	.779,	.140,	.18,	7,	.038,	.482
FLT17: SINGLE TRAWLE,	26.,	.373,	.114,	.31,	7,	.167,	.724
FLT18: SINGLE TRAWLE,	16.,	.450,	.100,	.22,	7,	.115,	1.004
FLT19: PAIR TRAWLERS,	30.,	.382,	.092,	.24,	7,	.159,	.658
FLT20: PAIR TRAWLERS,	29.,	.364,	.074,	.20,	7,	.176,	.684
FLT21: LONGLINERS > ,	27.,	.431,	.075,	.17,	7,	.125,	.713
F shrinkage mean ,	15.,	.50,,,,				.093,	1.040

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
25.,	.15,	.05,	57,	.304,	.750

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT12: R/V Magnus H,	15.,	.887,	.162,	.18,	8,	.029,	.823
FLT14: LONGLINERS < ,	13.,	.494,	.078,	.16,	8,	.094,	.893
FLT15: TRAWLERS < 40,	29.,	.830,	.146,	.18,	8,	.033,	.511
FLT17: SINGLE TRAWLE,	19.,	.444,	.092,	.21,	8,	.117,	.686
FLT18: SINGLE TRAWLE,	13.,	.424,	.076,	.18,	8,	.129,	.890
FLT19: PAIR TRAWLERS,	17.,	.382,	.141,	.37,	8,	.158,	.752
FLT20: PAIR TRAWLERS,	18.,	.333,	.078,	.23,	8,	.208,	.717
FLT21: LONGLINERS > ,	15.,	.409,	.092,	.22,	8,	.138,	.833
F shrinkage mean ,	18.,	.50,,,,				.092,	.717

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
16.,	.15,	.04,	65,	.253,	.766

Table 2.2.15

Run title : Cod in the Faroe Plateau (Fishing Area Vb1) (run name: CODR40)

At 5-May-94 16:41

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
2,	.1076,	.0663,	.0252,	.0293,	.0681,	.2052,	.1102,	.0792,	.0561,	.0574,	.0642,
3,	.3726,	.3559,	.3579,	.2258,	.3568,	.4521,	.4375,	.3028,	.2828,	.2836,	.2897,
4,	.5811,	.5106,	.6271,	.4825,	.5830,	.7760,	.6553,	.6954,	.6179,	.6636,	.6590,
5,	.6655,	.6173,	.7110,	.4912,	.5629,	.8143,	.8164,	.6339,	.7696,	.6135,	.6723,
6,	.4690,	.9381,	.8367,	.5675,	.7926,	1.0166,	.8066,	.7829,	1.0017,	.6336,	.8061,
7,	.4757,	1.2002,	.8726,	.5021,	.8330,	1.1272,	.9604,	.7522,	1.0580,	.7467,	.8523,
8,	.4916,	1.3172,	.6498,	.6738,	.9100,	1.2382,	1.3625,	.9583,	.7645,	.7497,	.8241,
9,	.4824,	.9536,	.7087,	.7438,	.8441,	1.0738,	1.1393,	1.0057,	1.0220,	.7664,	.9314,
+gp,	.4824,	.9536,	.7087,	.7438,	.8441,	1.0738,	1.1393,	1.0057,	1.0220,	.7664,	
FBAR 3- 7,	.5128,	.7244,	.6811,	.4538,	.6257,	.8372,	.7352,	.6334,	.7460,	.5882,	

Table 2.2.16

Run title : Cod in the Faroe Plateau (Fishing Area Vb1) (run name: CODR40)

At 5-May-94 16:41

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	GMST
AGE												
2,	47608,	17191,	9330,	9829,	8546,	13326,	2573,	2758,	4238,	2238,	0,	93
3,	18596,	35000,	13172,	7448,	7815,	6536,	8886,	1887,	2086,	3280,	1730,	92
4,	8745,	10489,	20074,	7539,	4866,	4478,	3405,	4698,	1141,	1287,	2022,	68
5,	3322,	4004,	5154,	8779,	3810,	2224,	1687,	1448,	1919,	504,	543,	32
6,	2692,	1398,	1768,	2072,	4398,	1777,	806,	611,	629,	728,	223,	16
7,	917,	1379,	448,	627,	962,	1630,	526,	295,	229,	189,	316,	7
8,	233,	466,	340,	153,	311,	342,	432,	165,	114,	65,	73,	2
9,	98,	117,	102,	145,	64,	102,	81,	91,	52,	43,	25,	
+gp,	189,	141,	82,	54,	48,	15,	41,	41,	59,	49,	35,	
TOTAL,	82400,	70187,	50470,	36648,	30819,	30430,	18440,	11993,	10466,	8383,	4968,	

Table 2.2.17

Run title : Cod in the Faroe Plateau (Fishing Area Vb1) (run name: CODR40)

At 5-May-94 16:41

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,
1984,	47608,	151580,	115153,	36979,	.3211,	.5128,
1985,	17191,	130336,	84117,	39484,	.4694,	.7244,
1986,	9330,	98280,	73236,	34595,	.4724,	.6811,
1987,	9829,	76871,	60934,	21391,	.3511,	.4538,
1988,	8546,	64897,	51095,	23182,	.4537,	.6257,
1989,	13326,	54920,	37135,	22068,	.5943,	.8372,
1990,	2573,	32975,	25982,	13487,	.5191,	.7352,
1991,	2758,	20534,	16682,	8660,	.5191,	.6334,
1992,	4238,	18414,	12597,	6542,	.5193,	.7460,
1993,	2238,	17716,	13414,	5735,	.4276,	.5882,
Arith. Mean ,	11764,	66652,	49035,	21212,	.4647,	.6538,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.2.18

Cod in the Faroe Plateau (Fishing Area Vb1)

Cod in the Faroe Plateau (Fishing Area Vb1)

Prediction with management option table: Input data

Year: 1994

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	6748.000	0.2000	0.7200	0.0000	0.0000	1.155	0.0570	1.343
3	2656.000	0.2000	0.8900	0.0000	0.0000	1.805	0.2830	1.921
4	2720.000	0.2000	0.9800	0.0000	0.0000	2.487	0.6640	2.847
5	542.000	0.2000	0.9900	0.0000	0.0000	3.469	0.6100	3.436
6	225.000	0.2000	1.0000	0.0000	0.0000	4.314	0.6310	3.992
7	318.000	0.2000	0.9800	0.0000	0.0000	5.151	0.7440	5.414
8	74.000	0.2000	1.0000	0.0000	0.0000	6.872	0.7470	6.411
9	25.000	0.2000	1.0000	0.0000	0.0000	7.138	0.7620	8.435
10+	35.000	0.2000	1.0000	0.0000	0.0000	10.093	0.7620	10.307
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1995

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	7226.000	0.2000	0.3400	0.0000	0.0000	1.155	0.0570	1.343
3	.	0.2000	0.7100	0.0000	0.0000	1.805	0.2830	1.921
4	.	0.2000	0.8600	0.0000	0.0000	2.455	0.6640	2.847
5	.	0.2000	0.9600	0.0000	0.0000	3.269	0.6100	3.436
6	.	0.2000	1.0000	0.0000	C.0000	4.516	0.6310	3.992
7	.	0.2000	1.0000	0.0000	0.0000	5.496	0.7440	5.414
8	.	0.2000	1.0000	0.0000	0.0000	6.578	0.7470	6.411
9	.	0.2000	1.0000	0.0000	0.0000	8.773	0.7620	8.435
10+	.	0.2000	1.0000	0.0000	0.0000	8.117	0.7620	10.307
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	7800.000	0.2000	0.3400	0.0000	0.0000	1.155	0.0570	1.343
3	.	0.2000	0.7100	0.0000	0.0000	1.805	0.2830	1.921
4	.	0.2000	0.8600	0.0000	0.0000	2.455	0.6640	2.847
5	.	0.2000	0.9600	0.0000	0.0000	3.238	0.6100	3.436
6	.	0.2000	1.0000	0.0000	0.0000	4.317	0.6310	3.992
7	.	0.2000	1.0000	0.0000	0.0000	5.698	0.7440	5.414
8	.	0.2000	1.0000	0.0000	0.0000	6.924	0.7470	6.411
9	.	0.2000	1.0000	0.0000	0.0000	8.479	0.7620	8.435
10+	.	0.2000	1.0000	0.0000	0.0000	9.752	0.7620	10.307
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PRED1
Date and time: 09MAY94:22:08

Table 2.2.19 Input for the prediction using the RCT3-program

```
Faroe Plateau cod: Groundfish surveys and 0-group surveys data
4 11 2
'Yclass'  'VPA'   'GFAGE2'  'GFAGE3'  'GFAGE4'  '0-GROUP'
1983      17192   396       2780      4680      17100
1984      9330    84        2038      2531      3900
1985      9829    128       1414      1065      4300
1986      8547    198       616       1663      2200
1987      13330   446       845       1232      28900
1988      2577    136       355       474       19200
1989      2757    255       210       243       400
1990      -11     148       478       978       2600
1991      -11     44        254       -11       100
1992      -11     441       -11       -11       600
1993      -11     -11       -11       -11       6000
```

Table 2.2.20 Output from predictions or recruitment using the RCTS-program.

```
Analysis by RCT3 ver3.1 of data from file :

rct3inp.nr7

Faroe Plateau cod: Groundfish surveys and 0-group surveys data

Data for    4 surveys over   11 years :  1983 - 1993

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

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

Forecast/Hindcast variance correction used.
```

Yearclass = 1986

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	.43	7.16	.09	.965	3	5.29	9.45	.185	.413
GFAGE3	1.26	-.19	.36	.636	3	6.42	7.88	1.711	.006
GFAGE4	.59	4.75	.40	.586	3	7.42	9.16	.837	.024
0-GROU	.41	5.76	.01	1.000	3	7.70	8.91	.022	.413
					VPA Mean =		9.36	.339	.144

Yearclass = 1987

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------	Regression	----------I			I-----------	Prediction	---------	
GFAGE2	.62	6.09	.32	.598	4	6.10	9.88	.631	.058
GFAGE3	.66	4.46	.36	.542	4	6.74	8.91	.619	.060
GFAGE4	.65	4.30	.32	.599	4	7.12	8.93	.552	.076
0-GROU	.37	6.14	.07	.970	4	10.27	9.93	.157	.576
					VPA Mean =		9.28	.316	.230

Yearclass = 1988

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	.52	6.55	.27	.610	5	4.92	9.11	.393	.196
GFAGE3	.94	2.53	.59	.247	5	5.87	8.08	1.161	.022
GFAGE4	.92	2.37	.54	.277	5	6.16	8.04	1.122	.024
0-GROU	.30	6.65	.18	.777	5	9.86	9.63	.276	.397
					VPA Mean =		9.33	.290	.361

Continued...

Table 2.2.20 (Cont'd)

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	1.87	-.75	1.16	.286	6	5.55	9.60	1.572	.086
GFAGE3	1.09	1.48	.59	.611	6	5.35	7.32	1.036	.198
GFAGE4	1.04	1.49	.53	.660	6	5.50	7.19	.980	.222
0-GROU	-16.82	161.01	19.91	.001	6	5.99	60.21	41.321	.000
					VPA Mean =		9.08	.657	.493

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	3.81	-11.34	2.42	.103	7	5.00	7.75	3.135	.013
GFAGE3	.92	2.69	.48	.745	7	6.17	8.40	.624	.326
GFAGE4	.85	2.90	.44	.777	7	6.89	8.77	.559	.407
0-GROU	1.14	-.87	1.70	.187	7	7.86	8.08	2.205	.026
					VPA Mean =		8.90	.745	.229

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	3.86	-11.57	2.45	.102	7	3.81	3.11	4.346	.013
GFAGE3	.93	2.67	.48	.745	7	5.54	7.81	.686	.523
GFAGE4									
0-GROU	1.14	-.89	1.72	.186	7	4.62	4.37	3.146	.025
					VPA Mean =		8.90	.748	.439

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	3.91	-11.88	2.49	.100	7	6.09	11.95	3.601	.039
GFAGE3									
GFAGE4									
0-GROU	1.14	-.90	1.75	.184	7	6.40	6.40	2.587	.075
					VPA Mean =		8.88	.752	.886

Continued.....

Table 2.2.20 (Cont'd)

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I----------Regression---------I					I----------Prediction---------I			
GFAGE2									
GFAGE3									
GFAGE4									
0-GROU	1.14	-.91	1.78	.182	7	8.70	9.02	2.328	.096
					VPA Mean =		8.87	.758	.904

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1986	9881	9.20	.13	.14	1.11	8547	9.05
1987	15409	9.64	.15	.20	1.65	13331	9.50
1988	11431	9.34	.17	.17	.98	2578	7.85
1989	4273	8.36	.46	.56	1.46	2758	7.92
1990	5695	8.65	.36	.12	.12		
1991	3434	8.14	.50	.57	1.34		
1992	6748	8.82	.71	.64	.82		
1993	7226	8.89	.72	.04	.00		

Table 2.2.21

Cod in the Faroe Plateau (Fishing Area Vb1)

Cod in the Faroe Plateau (Fishing Area Vb1)

Prediction with management option table

Year: 1994					Year: 1995					Year: 1996	
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	0.5864	24882	21985	7545	0.0000	0.0000	28415	19462	0	41525	30840
.	.	.	.	.	0.2000	0.1173	.	19462	1870	39433	28886
.	.	.	.	.	0.4000	0.2346	.	19462	3560	37547	27129
.	.	.	.	.	0.6000	0.3518	.	19462	5091	35842	25547
.	.	.	.	.	0.8000	0.4691	.	19462	6481	34299	24121
.	.	.	.	.	1.0000	0.5864	.	19462	7744	32900	22833
.	.	.	.	.	1.2000	0.7037	.	19462	8894	31628	21666
.	.	.	.	.	1.4000	0.8210	.	19462	9945	30471	20609
.	.	.	.	.	1.6000	0.9382	.	19462	10905	29415	19649
.	.	.	.	.	1.8000	1.0555	.	19462	11785	28450	18775
.	.	.	.	.	2.0000	1.1728	.	19462	12592	27567	17978
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED1
Date and time : 09MAY94:22:08
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1994 : F factors

Table 2.2.22

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	0.1808	0.0000	0.0000	1.054	0.0950	1.054
3	.	0.2000	0.6667	0.0000	0.0000	1.552	0.2960	1.552
4	.	0.2000	0.9108	0.0000	0.0000	2.208	0.4560	2.208
5	.	0.2000	0.9758	0.0000	0.0000	2.990	0.5340	2.990
6	.	0.2000	0.9958	0.0000	0.0000	3.720	0.6120	3.720
7	.	0.2000	0.9967	0.0000	0.0000	4.737	0.7140	4.737
8	.	0.2000	1.0000	0.0000	0.0000	5.699	0.7200	5.699
9	.	0.2000	1.0000	0.0000	0.0000	7.318	0.6960	7.318
10+	.	0.2000	1.0000	0.0000	0.0000	9.620	0.6960	9.620
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YR94WG
Date and time: 09MAY94:14:14

Table 2.2.23

Cod in the Faroe Plateau (Fishing Area Vb1)

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	23096.258	4.348	21624.710	4.348	21624.710
0.0500	0.0261	0.102	510.889	5.006	19052.527	3.841	17588.201	3.841	17588.201
0.1000	0.0522	0.179	831.385	4.623	16160.130	3.461	14702.818	3.461	14702.818
0.1500	0.0784	0.240	1037.272	4.323	14009.530	3.165	12559.031	3.165	12559.031
0.2000	0.1045	0.288	1171.308	4.082	12361.316	2.926	10917.440	2.926	10917.440
0.2500	0.1306	0.329	1258.947	3.882	11066.756	2.729	9629.323	2.729	9629.323
0.3000	0.1567	0.363	1315.966	3.713	10028.976	2.564	8597.815	2.564	8597.815
0.3500	0.1828	0.392	1352.447	3.569	9182.437	2.422	7757.386	2.422	7757.386
0.4000	0.2090	0.417	1374.994	3.444	8481.407	2.300	7062.309	2.300	7062.309
0.4500	0.2351	0.440	1388.012	3.333	7893.130	2.192	6479.838	2.192	6479.838
0.5000	0.2612	0.460	1394.487	3.236	7393.629	2.097	5986.001	2.097	5986.001
0.5500	0.2873	0.477	1396.466	3.148	6965.012	2.012	5562.913	2.012	5562.913
0.6000	0.3134	0.493	1395.367	3.069	6593.707	1.936	5197.008	1.936	5197.008
0.6500	0.3396	0.508	1392.176	2.997	6269.267	1.866	4877.844	1.866	4877.844
0.7000	0.3657	0.521	1387.586	2.932	5983.544	1.803	4597.279	1.803	4597.279
0.7500	0.3918	0.534	1382.084	2.871	5730.111	1.746	4348.890	1.746	4348.890
0.8000	0.4179	0.545	1376.011	2.816	5503.839	1.692	4127.553	1.692	4127.553
0.8500	0.4440	0.556	1369.608	2.764	5300.601	1.643	3929.145	1.643	3929.145
0.9000	0.4702	0.565	1363.044	2.716	5117.039	1.598	3750.313	1.598	3750.313
0.9500	0.4963	0.575	1356.437	2.672	4950.405	1.555	3588.312	1.555	3588.312
1.0000	0.5224	0.583	1349.868	2.630	4798.426	1.516	3440.875	1.516	3440.875
1.0500	0.5485	0.591	1343.391	2.591	4659.216	1.479	3306.115	1.479	3306.115
1.1000	0.5746	0.599	1337.042	2.554	4531.190	1.444	3182.453	1.444	3182.453
1.1500	0.6008	0.606	1330.846	2.519	4413.014	1.411	3068.560	1.411	3068.560
1.2000	0.6269	0.613	1324.815	2.486	4303.559	1.380	2963.306	1.380	2963.306
1.2500	0.6530	0.619	1318.957	2.454	4201.858	1.351	2865.729	1.351	2865.729
1.3000	0.6791	0.625	1313.274	2.425	4107.085	1.324	2775.004	1.324	2775.004
1.3500	0.7052	0.631	1307.766	2.396	4018.524	1.297	2690.420	1.297	2690.420
1.4000	0.7314	0.637	1302.429	2.370	3935.559	1.272	2611.362	1.272	2611.362
1.4500	0.7575	0.642	1297.259	2.344	3857.651	1.249	2537.293	1.249	2537.293
1.5000	0.7836	0.647	1292.251	2.319	3784.329	1.226	2467.745	1.226	2467.745
1.5500	0.8097	0.652	1287.400	2.296	3715.181	1.205	2402.307	1.205	2402.307
1.6000	0.8358	0.657	1282.699	2.273	3649.842	1.184	2340.617	1.184	2340.617
1.6500	0.8620	0.661	1278.142	2.252	3587.989	1.164	2282.354	1.164	2282.354
1.7000	0.8881	0.666	1273.723	2.231	3529.337	1.145	2227.233	1.145	2227.233
1.7500	0.9142	0.670	1269.437	2.211	3473.631	1.127	2175.002	1.127	2175.002
1.8000	0.9403	0.674	1265.277	2.192	3420.641	1.110	2125.434	1.110	2125.434
1.8500	0.9664	0.678	1261.238	2.173	3370.164	1.093	2078.325	1.093	2078.325
1.9000	0.9926	0.681	1257.315	2.155	3322.015	1.077	2033.493	1.077	2033.493
1.9500	1.0187	0.685	1253.504	2.138	3276.028	1.062	1990.772	1.062	1990.772
2.0000	1.0448	0.689	1249.798	2.121	3232.052	1.047	1950.015	1.047	1950.015
2.0500	1.0709	0.692	1246.195	2.105	3189.951	1.032	1911.085	1.032	1911.085
2.1000	1.0970	0.695	1242.689	2.090	3149.601	1.018	1873.861	1.018	1873.861
2.1500	1.1232	0.698	1239.277	2.075	3110.889	1.005	1838.229	1.005	1838.229
2.2000	1.1493	0.701	1235.954	2.060	3073.711	0.992	1804.088	0.992	1804.088
2.2500	1.1754	0.704	1232.718	2.046	3037.973	0.980	1771.344	0.980	1771.344
2.3000	1.2015	0.707	1229.564	2.032	3003.587	0.967	1739.911	0.967	1739.911
2.3500	1.2276	0.710	1226.490	2.019	2970.475	0.956	1709.711	0.956	1709.711
2.4000	1.2538	0.713	1223.493	2.006	2938.561	0.944	1680.671	0.944	1680.671
2.4500	1.2799	0.716	1220.569	1.993	2907.779	0.933	1652.724	0.933	1652.724
2.5000	1.3060	0.718	1217.716	1.981	2878.066	0.923	1625.808	0.923	1625.808
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YR94WG
Date and time : 10MAY94:12:47
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.2599
F-max factor : 0.5541
F-0.1 reference F : 0.1358
F-max reference F : 0.2895
Recruitment : Single recruit

Table 2.3.1	Faroe Bank cod (Subdivision Vb2). Nominal catches (t) by countries 1983-1993, as officially reported to ICES.									
Nation/Year	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**[1]
Faroe Islands	2,189	2,913	1,836	3,409	2,960	1,270	289	297	122	266
France[2]										
Norway	11	23	6	23	94	128	72	38	32[1]	61
UK (Engl.& Wales)										1
UK Scotland[3]	16	25	63	47	37	14	207	90	172	55
Total	**2,216**	**2,961**	**1,905**	**3,479**	**3,091**	**1,412**	**568**	**425**	**326**	**383**

1) Preliminary
2) Catches included in Sub-division Vb1
3) Sub-division Vb1 included

Table 2.4.1 Faroe Plateau (Sub-Division Vb1) HADDOCK. Nominal catches (tonnes) by countries, 1980-1993, as officially reported to ICES.

Country	1980	1981	1982	1983	1984	1985	1986
Denmark	-	-	-	-	-	-	1
Faroe Islands	13,633	10,891	10,319	11,898	11,418	13,597	13,359
France[1]	31	113	2	2	20	23	8
Germany	4	+	1	+	+	+	1
Norway	9	20	12	12	10	21	22
UK (Engl. & Wales)	6	-	-	-	-	-	-
UK (Scotland)	434	85	1	-[3]	-[3]	-[3]	-[3]
Others	6	-	-	-	-	-	-
Total	14,123	11,109	10,335	11,912	11,448	13,641	13,391
Total used in the assessment[4,5]	15,016	12,233	11,937	12,894	12,378	15,143	14,477

Country	1987	1988	1989	1990	1991	1992	1993[2]
Denmark	8	4	-	-	-	-	-
Faroe Islands	13,954	10,867	13,506	11,106	8,074	4,655	3,464
France[1]	22	14	-	-	-	-	-
Germany	1	-	-	-	+	-	-
Norway	13	54	111	94[2]	125[2]	71	31
UK (Engl. & Wales)	2	-	-	7	-	71	78
UK (Scotland)	-[3]	-[3]	-[3]	-[3]	-[3]	-[3]	-[3]
Total	14,000	10,939	13,617	11,207	8,199	4,961	3,573
Total used in the assessment[4,5]	14,882	12,178	14,325	11,726	8,429	5,473	3,814

[1]Including catches from Sub-division Vb2.
[2]Preliminary.
[3]Catches included in Sub-division Vb2.
[4]Includes catches from Sub-division Vb2 and Division IIa[4] in Faroese waters.
[5]Includes French catches from Division Vb, as reported to the Faroese coastal guard service.

Table 2.4.2 Faroe Bank (Sub-Division Vb2) HADDOCK. Nominal catches (tonnes) by countries, 1980-1993 as officially reported to ICES.

Country	1980	1981	1982	1983	1984	1985	1986
Faroe Islands	690	1,103	1,553	967	925	1,474	1,050
France[1]	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-
Norway	8	7	1	2	5	3	10
UK (Engl. & Wales)	152	-	-	-	-	-	-
UK (Scotland)	43	14	48	13[3]	+[3]	25[3]	26[3]
Total	893	1,124	1,602	982	930	1,502	1,086

Country	1987	1988	1989	1990	1991	1992	1993[2]
Faroe Islands	832	1,160	659	325	217	338	186
France[1]	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-
Norway	5	43	16	97[2]	4[1]	23	8
UK (Engl. & Wales)	-	-	-	-	-	17	-
UK (Scotland)	45[3]	15[3]	30[3]	725[3]	287	869	47
Total	882	1,218	705	1,147	508	1,247	241

[1]Catches included in Sub-division Vb1.
[2]Preliminary.
[3]Includes catches taken in Sub-division Vb1.

Table 2.4.3 Haddock in ICES Division Vb. Catch at age 1993 by fleet category.

Age	Open Boats	LLiners <100 GRT	LLiners >100 GRT	S.trawl <400 HP	S.trawl >400 HP	P.trawl <1000 HP	P.trawl >1000 HP	Others	Foreign trawlers	Foreign liners	Total
1	1	19	10	5	8	0	0	3	5	0	51
2	1	31	29	12	13	2	5	5	8	1	107
3	3	92	61	31	31	9	20	14	18	3	282
4	2	80	55	30	20	14	33	12	12	2	260
5	4	152	124	43	31	44	82	22	18	5	525
6	3	112	134	32	18	67	111	16	11	6	510
7	2	64	125	27	15	71	122	9	9	5	449
8	1	22	20	10	5	21	38	3	3	1	124
9	1	46	43	13	8	24	42	6	5	2	190
10+	1	46	32	16	10	20	36	7	6	1	175
Total	19	664	633	219	159	272	489	97	95	26	2,673
Catch. t	23	791	827	262	190	374	707	114	113	35	3,436
Effort, days	1,423	7,497	1,754	261	191	3,153	6,245				

Notes: Numbers in '000.
Gutted weight in tonnes.
Others includes netters, jiggers, industry trawlers and other small categories.
Liner = Longliner; S.trawl = single (otterboard) trawlers; P.trawl = Pair trawlers.

Table 2.4.4

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: HS1)

At 4-Aug-94 10:46:45

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

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

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
2,	2284,	1368,	1081,	1425,	5881,	2384,	1728,	717,	750,	3300,
3,	7457,	4286,	3304,	2405,	4097,	7539,	4855,	4393,	3744,	8388,
4,	3899,	5133,	4804,	2599,	2812,	4567,	6581,	4727,	4179,	1236,
5,	2360,	1443,	2710,	1785,	1524,	1565,	1624,	3267,	2706,	2786,
6,	1120,	1209,	1112,	1426,	1526,	1485,	1383,	1292,	1171,	916,
7,	728,	673,	740,	631,	923,	1224,	1099,	864,	696,	1051,
8,	198,	1345,	180,	197,	230,	378,	326,	222,	180,	150,
9,	49,	43,	54,	52,	68,	114,	68,	147,	113,	68,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	11,
TOTALNUM,	18095,	15500,	13985,	10520,	17061,	19256,	17664,	15629,	13539,	17906,
TONSLAND,	19490,	18479,	18766,	13381,	17852,	23272,	21361,	19393,	16485,	17969,
SOPCOF %,	101,	94,	109,	102,	103,	108,	103,	99,	98,	98,

Continued..

Table 2.4.4 (Cont'd)

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: HS1)

At 4-Aug-94 10:46:45

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
2,	5633,	7337,	4396,	255,	32,	1,	143,	74,	539,	441,
3,	2899,	7952,	7858,	4039,	1022,	1161,	58,	455,	934,	1969,
4,	3970,	2097,	6798,	5168,	4248,	1754,	3724,	202,	784,	383,
5,	451,	1371,	1251,	4918,	4054,	3341,	2583,	2586,	298,	422,
6,	976,	247,	1189,	2128,	1841,	1850,	2496,	1354,	2182,	93,
7,	466,	352,	298,	946,	717,	772,	1568,	1559,	973,	1444,
8,	535,	237,	720,	443,	635,	212,	660,	608,	1166,	740,
9,	68,	419,	258,	731,	243,	155,	99,	177,	1283,	947,
+gp,	147,	187,	318,	855,	312,	74,	86,	36,	214,	795,
TOTALNUM,	15145,	20199,	23086,	19483,	13104,	9320,	11417,	7051,	8373,	7234,
TONSLAND,	14763,	20715,	26211,	25553,	19200,	12424,	15016,	12233,	11937,	12894,
SOPCOF %,	97,	117,	107,	98,	99,	104,	100,	109,	92,	106,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
2,	1195,	985,	230,	283,	655,	63,	105,	77,	40,	107,
3,	1561,	4553,	2549,	1718,	444,	1518,	1275,	1044,	155,	282,
4,	2462,	2196,	4452,	3565,	2463,	658,	1921,	1774,	780,	260,
5,	147,	1242,	1522,	2972,	3036,	2787,	768,	1248,	1126,	525,
6,	234,	169,	738,	1114,	2140,	2554,	1737,	651,	964,	510,
7,	42,	91,	39,	529,	475,	1976,	1909,	1101,	337,	449,
8,	861,	61,	130,	83,	151,	541,	885,	698,	375,	124,
9,	388,	503,	71,	48,	18,	133,	270,	317,	403,	190,
+gp,	968,	973,	712,	334,	128,	81,	108,	32,	163,	175,
TOTALNUM,	7858,	10773,	10443,	10646,	9510,	10311,	8978,	6942,	4343,	2622,
TONSLAND,	12378,	15143,	14477,	14882,	12178,	14325,	11726,	8429,	5473,	3814,
SOPCOF %,	106,	106,	101,	102,	97,	100,	102,	106,	105,	104,

Table 2.4.5

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: HS1)

At 4-Aug-94 10:46:45

Table 2 Catch weights at age (kg)

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

Table 2 Catch weights at age (kg)

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
2,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,	.4700,
3,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,	.7300,
4,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,	1.1300,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,	1.9700,
7,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,	2.4100,
8,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,	2.7600,
9,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,	3.0700,
+gp,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,	3.5500,
SOPCOFAC,	1.0131,	.9401,	1.0920,	1.0166,	1.0278,	1.0835,	1.0274,	.9874,	.9795,	.9772,

Continued..

Table 2.4.5 (Cont'd)

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: HS1)

At 4-Aug-94 10:46:45

Table 2 Catch weights at age (kg)

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
2,	.4700,	.4700,	.4700,	.3110,	.3570,	.3570,	.6430,	.4520,	.7000,	.4700,
3,	.7300,	.7300,	.7300,	.6330,	.7900,	.6720,	.7130,	.7250,	.8960,	.7400,
4,	1.1300,	1.1300,	1.1300,	1.0440,	1.0350,	.8940,	.9410,	.9570,	1.1500,	1.0100,
5,	1.5500,	1.5500,	1.5500,	1.4260,	1.3980,	1.1560,	1.1570,	1.2370,	1.4440,	1.3200,
6,	1.9700,	1.9700,	1.9700,	1.8520,	1.8700,	1.5900,	1.4930,	1.6510,	1.4980,	1.6600,
7,	2.4100,	2.4100,	2.4100,	2.2410,	2.3500,	2.0700,	1.7390,	2.0530,	1.8290,	2.0500,
8,	2.7600,	2.7600,	2.7600,	2.2050,	2.5970,	2.5250,	2.0950,	2.4060,	1.8870,	2.2600,
9,	3.0700,	3.0700,	3.0700,	2.5700,	3.0140,	2.6960,	2.4650,	2.7250,	1.9610,	2.5400,
+gp,	3.5500,	3.5500,	3.5500,	2.5910,	2.9200,	3.5190,	3.3100,	3.2500,	2.8560,	3.0400,
SOPCOFAC,	.9711,	1.1712,	1.0746,	.9762,	.9947,	1.0385,	1.0017,	1.0870,	.9238,	1.0554,

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
2,	.6810,	.5280,	.6080,	.6050,	.5010,	.5800,	.4380,	.5470,	.5250,	.7550,
3,	1.0110,	.8590,	.8870,	.8310,	.7810,	.7790,	.6990,	.6930,	.7240,	.9820,
4,	1.2550,	1.3910,	1.1750,	1.1260,	.9740,	.9230,	.9390,	.8840,	.8170,	1.0270,
5,	1.8120,	1.7770,	1.6310,	1.4620,	1.3630,	1.2070,	1.2040,	1.0860,	1.0380,	1.1920,
6,	2.0610,	2.3260,	1.9840,	1.9410,	1.6800,	1.5640,	1.3840,	1.2760,	1.2490,	1.3780,
7,	2.0590,	2.4400,	2.5190,	2.1730,	1.9750,	1.7460,	1.5640,	1.4770,	1.4300,	1.6430,
8,	2.1370,	2.4010,	2.5830,	2.3470,	2.3440,	2.0860,	1.8180,	1.5740,	1.5640,	1.7960,
9,	2.3680,	2.5320,	2.5700,	3.1180,	2.2480,	2.4240,	2.1680,	1.9300,	1.6330,	1.9710,
+gp,	2.6860,	2.6860,	2.9220,	2.9330,	3.2950,	2.5140,	2.3350,	2.1530,	2.1260,	2.2400,
SOPCOFAC,	1.0602,	1.0559,	1.0141,	1.0197,	.9695,	1.0025,	1.0195,	1.0635,	1.0492,	1.0364,

Table 2.4.6

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: HS1)

At 4-Aug-94 10:46:45

Table 5 Proportion mature at age

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

Table 5 Proportion mature at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
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 Grounds (Fishing Area Vb) (run name: HS1)

At 4-Aug-94 10:46:45

Table 5 Proportion mature at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
2,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0000,	.1500,
3,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.4800,	.3000,	.7900,
4,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.7300,	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,

Table 5 Proportion mature at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
2,	.1000,	.0000,	.0000,	.0900,	.0500,	.0000,	.0000,	.2500,	.2200,	.0800,
3,	.7800,	.7200,	.3500,	.2200,	.3800,	.1200,	.1600,	.8200,	.7500,	.3900,
4,	.9500,	1.0000,	.9200,	.9300,	.8900,	.8600,	.8700,	.9800,	.9300,	.8100,
5,	1.0000,	1.0000,	1.0000,	.9600,	.9900,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	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

10:42 Thursday, August 4, 1994 2

Haddock in the Faroe Grounds (Fishing Area Vb)

magnus heinason revised93 (code: MH93C) (Catch: Number) (Effort: trawlhours)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1983	100	25.1	17.3	2.3	1.7	0.0	6.2	2.3	2.4	1.1
1984	100	114	24.8	9.8	0.5	0.6	0.2	2.1	0.7	2.6
1985	100	68.1	33.8	7.2	2.1	0.0	0.3	0.2	1.0	0.6
1986	100	115	47.9	22.7	4.1	0.8	0.1	0.1	0.3	1.6
1987	100	14.1	24.3	17.8	9.1	1.4	0.0	0.0	0.1	0.2
1988	100	88.2	14.9	21.9	12.9	4.6	1.3	0.2	0.1	0.1
1989	100	148	113	10.5	26.8	33.0	19.8	2.5	0.0	0.0
1990	100	46.7	65.1	24.0	2.8	8.4	8.5	4.0	0.9	0.1
1991	100	17.1	14.3	9.9	3.9	1.6	1.1	0.3	0.2	0.1
1992	100	26.4	10.0	15.4	6.8	6.2	1.6	1.1	0.5	0.2
1993	100	9.1	10.0	6.2	6.9	5.2	2.9	0.8	0.5	0.8
1994	100	8.5	2.1	3.0	1.5	2.8	3.5	2.5	0.3	0.8

Table 2.4.8

10:42 Thursday, August 4, 1994 10

Haddock in the Faroe Grounds (Fishing Area Vb)

lline<100GRT (code: LL94A) (Catch: Thousands) (Effort: 1)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1985	7558	613	2542	787	306	65	23	30	120	295
1986	6692	167	1435	1747	530	256	12	51	15	203
1987	6728	200	1027	1819	1118	331	155	20	12	96
1988	8753	599	311	1557	1405	768	138	40	5	31
1989	12804	48	1042	433	1676	1361	1015	313	74	54
1990	14543	94	993	1141	428	955	1005	457	155	72
1991	14801	53	733	1165	615	281	560	385	170	13
1992	10599	35	103	419	480	282	65	154	181	84
1993	7497	31	92	80	152	112	64	22	46	46

Table 2.4.9

10:42 Thursday, August 4, 1994 11

Haddock in the Faroe Grounds (Fishing Area Vb)

Longliners > 100 GRT (code: LL94B) (Catch: Thousands) (Effort: 1)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1985	2973	89	348	300	188	40	8	7	68	190
1986	2176	7	137	584	203	124	5	26	5	84
1987	2915	1	17	168	323	220	146	26	27	137
1988	3203	16	34	200	470	504	105	42	1	45
1989	3369	3	81	79	421	492	440	99	22	12
1990	3521	2	126	316	146	312	380	187	46	15
1991	3573	3	90	260	223	127	223	133	71	6
1992	2892	4	28	92	216	188	95	71	61	31
1993	2046	29	61	55	124	134	125	20	43	32

Table 2.4.10

10:42 Thursday, August 4, 1994 7

Haddock in the Faroe Grounds (Fishing Area `

Single trawlers < 400 HP (code: ST94A) (Catch: Thousands) ('fort: 1)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catt age 8	Catch, age 9	Catch, age 10
1985	2171	7	60	36	23	2	2	1	7	15
1986	1509	0	61	95	21	7	1	1		18
1987	1297	0	31	109	87	26	4	0	[illegible]	3
1988	1261	1	7	41	36	34	15	1	2	1
1989	1445	0	24	5	29	40	20	2	2	0
1990	1159	0	4	36	10	14	11	2	1	0
1991	1141	1	20	32	17	8	15	11	5	0
1992	1150	1	3	14	16	9	2	5	6	3
1993	2045	12	31	30	43	32	27	10	13	16

Table 2.4.11

Haddock in the Faroe Grounds (Fishing Area Vb)

Single trawlers 400-999 HP (code: ST94B) (Catch: Thousands) (Effort: 1)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1985	2077	19	269	128	91	5	8	3	32	43
1986	1221	1	53	147	44	15	2	1	3	20
1987	1531	1	49	216	164	53	25	4	0	6
1988	2204	2	10	81	118	86	19	5	1	3
1989	1993	1	72	23	91	92	56	14	4	1
1990	1853	0	9	116	25	52	48	16	6	3
1991	1038	4	24	27	15	10	12	7	3	0
1992	495	0	1	11	8	4	2	3	2	1
1993	1008	10	24	16	24	14	12	4	6	8

Table 2.4.12

Haddock in the Faroe Grounds (Fishing Area Vb)

Single trawlers > 1000 HP (code: ST94C) (Catch: Thousands) (Effort: 1)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1985	5565	0	149	184	193	9	18	3	75	84
1986	5402	1	62	228	92	39	1	5	4	42
1987	4389	0	0	9	71	90	36	14	2	7
1988	4964	0	3	25	62	61	16	5	0	3
1989	4939	0	9	9	42	40	33	10	3	2
1990	4020	3	23	34	14	32	34	17	5	1
1991	4005	5	33	37	21	14	17	10	4	0
1992	4174	0	0	5	8	10	4	4	4	1
1993	3577	3	7	4	7	4	3	1	2	2

Table 2.4.13

Haddock in the Faroe Grounds (Fishing Area Vb)

Pair trawlers < 1000 HP (code: PT94A) (Catch: Thousands) (Effort: 1)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1985	5389	23	431	490	293	26	22	12	132	214
1986	6573	6	268	777	314	158	10	21	29	211
1987	6314	8	161	667	569	206	102	15	7	57
1988	6026	3	30	248	353	227	62	18	4	12
1989	5175	0	41	34	158	185	144	45	11	7
1990	5444	0	22	74	40	102	123	56	14	4
1991	5828	0	25	55	108	69	87	46	20	4
1992	3985	0	15	118	132	90	21	24	28	8
1993	2851	2	9	14	44	67	71	21	24	20

Table 2.4.14

Haddock in the Faroe Grounds (Fishing Area Vb)

Pair trawlers > 1000 HP (code: PT94B) (Catch: Thousands) (Effort: 1)

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1985	3193	11	153	160	97	11	7	4	43	70
1986	4433	1	154	422	190	76	5	12	10	89
1987	5546	1	36	332	358	133	52	7	2	29
1988	6034	1	7	88	251	194	55	19	3	17
1989	5127	5	10	108	162	156	39	9	1	5
1990	7491	0	10	79	57	156	184	92	24	6
1991	7875	0	45	88	181	104	131	75	33	7
1992	7243	0	1	38	107	150	52	41	50	15
1993	6335	5	20	33	82	111	122	38	42	36

Table 2.4.15 Final Run.

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VPA Version 3.1 (MSDOS)

   6-May-94  18:31

Extended Survivors Analysis

Haddock in the Faroe Grounds (Fishing Area Vb) (run name: JAKVPAFINAL)

CPUE data from file /users/ifad/ifapwork/wg_109/had_farp/FLEET.FI1


Data for    8 fleets over   33 years
Age range from    2 to    9


     Fleet,              Alpha,    Beta
LL94A: lline<100GRT    ,  .000   , 1.000
LL94B: Longliners >    ,  .000   , 1.000
MH93: magnus heinaso   ,  .200   ,  .300
PT94A: Pair trawlers   ,  .000   , 1.000
PT94B: Pair trawlers   ,  .000   , 1.000
ST94A: Single trawle   ,  .000   , 1.000
ST94B: Single trawle   ,  .000   , 1.000
ST94C: Single trawle   ,  .000   , 1.000


Time series weights :

     Tapered time weighting applied
     Power =    3 over  10 years


Catchability analysis :

     Catchability independent of stock size for all ages

     Catchability independent of age for ages >=    8


Terminal population estimation :

     Survivor estimates shrunk towards the mean F
     of the final   3 years or the   3 oldest ages.

     S.E. of the mean to which the estimates  are shrunk =    .300

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

     Prior weighting not applied


Tuning converged after   44 iterations




Terminal year survivor and F summaries :

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

Year class = 1991

Fleet,                 Estimated,   Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,   s.e,       s.e,   Ratio,    , Weights,    F
LL94A: lline<100GRT ,    2968.,     .952,      .000,    .00,   1,  .065,     .032
LL94B: Longliners > ,   43276.,    1.472,      .000,    .00,   1,  .027,     .002
MH93: magnus heinaso,    1450.,     .829,      .000,    .00,   1,  .086,     .065
PT94A: Pair trawlers,    6919.,     .982,      .000,    .00,   1,  .061,     .014
PT94B: Pair trawlers,   13929.,    1.411,      .000,    .00,   1,  .030,     .007
ST94A: Single trawle,   15935.,    1.271,      .000,    .00,   1,  .037,     .006
ST94B: Single trawle,   29960.,    2.137,      .000,    .00,   1,  .013,     .003
ST94C: Single trawle,    4734.,    1.592,      .000,    .00,   1,  .023,     .020

  F shrinkage mean  ,    4559.,      .30,,,,                         .657,     .021

Weighted prediction :

Survivors,         Int,      Ext,    N,    Var,      F
at end of year,    s.e,      s.e,     ,   Ratio,
   4863.,          .24,      .23,    9,   .948,   .020
```


Continued.....

Table 2.4.15 Cont'd)

Age 3 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
LL94A: lline<100GRT ,	1404.,	.304,	.064,	.21,	2,	.334,	.167
LL94B: Longliners > ,	5097.,	.900,	.358,	.40,	2,	.038,	.049
MH93: magnus heinaso,	2361.,	.588,	.232,	.39,	2,	.090,	.103
PT94A: Pair trawlers,	2411.,	.607,	.000,	.00,	1,	.084,	.101
PT94B: Pair trawlers,	7281.,	1.320,	.000,	.00,	1,	.018,	.034
ST94A: Single trawle,	4288.,	.813,	.692,	.85,	2,	.047,	.058
ST94B: Single trawle,	8756.,	1.186,	.000,	.00,	1,	.022,	.029
ST94C: Single trawle,	3086.,	1.167,	.000,	.00,	1,	.023,	.079
F shrinkage mean ,	1571.,	.30,,,,				.344,	.151

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1933.,	.18,	.15,	13,	.827,	.124

Age 4 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
LL94A: lline<100GRT ,	731.,	.237,	.083,	.35,	3,	.362,	.279
LL94B: Longliners > ,	1786.,	.587,	.140,	.24,	3,	.059,	.124
MH93: magnus heinaso,	1524.,	.470,	.113,	.24,	3,	.092,	.144
PT94A: Pair trawlers,	1520.,	.504,	.273,	.54,	2,	.080,	.144
PT94B: Pair trawlers,	1056.,	.654,	.808,	1.24,	2,	.047,	.201
ST94A: Single trawle,	1605.,	.650,	.406,	.62,	3,	.048,	.137
ST94B: Single trawle,	1598.,	.566,	.430,	.76,	3,	.063,	.137
ST94C: Single trawle,	1593.,	.953,	.449,	.47,	2,	.022,	.138
F shrinkage mean ,	671.,	.30,,,,				.225,	.300

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
969.,	.14,	.11,	22,	.769,	.217

Age 5 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
LL94A: lline<100GRT ,	1576.,	.213,	.150,	.70,	4,	.269,	.264
LL94B: Longliners > ,	2290.,	.308,	.161,	.52,	4,	.129,	.188
MH93: magnus heinaso,	2487.,	.431,	.227,	.53,	4,	.066,	.175
PT94A: Pair trawlers,	2138.,	.406,	.290,	.71,	3,	.074,	.201
PT94B: Pair trawlers,	1902.,	.311,	.213,	.68,	3,	.126,	.223
ST94A: Single trawle,	3208.,	.449,	.241,	.54,	3,	.060,	.138
ST94B: Single trawle,	2629.,	.361,	.158,	.44,	3,	.094,	.166
ST94C: Single trawle,	1387.,	.517,	.290,	.56,	4,	.046,	.295
F shrinkage mean ,	1066.,	.30,,,,				.136,	.369

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1843.,	.11,	.08,	29,	.742,	.229

Continued.....

Table 2.4.15 (Cont'd)

Age 6 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
LL94A: lline<100GRT ,	1123.,	.220,	.174,	.79,	5,	.228,	.344
LL94B: Longliners > ,	1680.,	.263,	.069,	.26,	5,	.160,	.243
MH93: magnus heinaso,	1683.,	.506,	.206,	.41,	5,	.043,	.242
PT94A: Pair trawlers,	1609.,	.378,	.302,	.80,	4,	.077,	.252
PT94B: Pair trawlers,	1393.,	.303,	.100,	.33,	5,	.121,	.286
ST94A: Single trawle,	1790.,	.388,	.265,	.68,	4,	.074,	.229
ST94B: Single trawle,	1274.,	.284,	.134,	.47,	5,	.137,	.309
ST94C: Single trawle,	726.,	.543,	.336,	.62,	4,	.038,	.492
F shrinkage mean ,	678.,	.30,,,,				.123,	.519

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1252.,	.11,	.07,	38,	.704,	.314

Age 7 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
LL94A: lline<100GRT ,	582.,	.285,	.111,	.39,	6,	.191,	.529
LL94B: Longliners > ,	751.,	.337,	.096,	.28,	6,	.137,	.432
MH93: magnus heinaso,	837.,	.632,	.199,	.32,	6,	.039,	.396
PT94A: Pair trawlers,	884.,	.428,	.231,	.54,	6,	.085,	.378
PT94B: Pair trawlers,	881.,	.390,	.157,	.40,	6,	.102,	.379
ST94A: Single trawle,	796.,	.454,	.247,	.54,	6,	.075,	.412
ST94B: Single trawle,	576.,	.319,	.202,	.63,	6,	.153,	.534
ST94C: Single trawle,	441.,	.590,	.249,	.42,	5,	.045,	.653
F shrinkage mean ,	454.,	.30,,,,				.173,	.639

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
639.,	.12,	.06,	48,	.511,	.492

Age 8 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
LL94A: lline<100GRT ,	139.,	.324,	.097,	.30,	7,	.190,	.591
LL94B: Longliners > ,	184.,	.358,	.080,	.22,	7,	.156,	.476
MH93: magnus heinaso,	200.,	.772,	.235,	.30,	7,	.033,	.445
PT94A: Pair trawlers,	220.,	.493,	.253,	.51,	7,	.082,	.412
PT94B: Pair trawlers,	227.,	.492,	.231,	.47,	7,	.082,	.401
ST94A: Single trawle,	186.,	.589,	.342,	.58,	6,	.057,	.471
ST94B: Single trawle,	196.,	.385,	.160,	.42,	7,	.135,	.453
ST94C: Single trawle,	139.,	.690,	.213,	.31,	6,	.042,	.593
F shrinkage mean ,	145.,	.30,,,,				.222,	.572

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
171.,	.14,	.06,	55,	.413,	.504

Continued......

Table 2.4.15 Cont'd)

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
LL94A: lline<100GRT ,	308.,	.316,	.091,	.29,	8,	.185,	.443
LL94B: Longliners > ,	282.,	.402,	.093,	.23,	8,	.114,	.476
MH93: magnus heinaso,	291.,	.654,	.172,	.26,	8,	.043,	.464
PT94A: Pair trawlers,	368.,	.424,	.187,	.44,	8,	.102,	.383
PT94B: Pair trawlers,	303.,	.547,	.139,	.25,	8,	.062,	.450
ST94A: Single trawle,	371.,	.650,	.257,	.39,	7,	.044,	.380
ST94B: Single trawle,	401.,	.320,	.132,	.41,	8,	.180,	.356
ST94C: Single trawle,	204.,	.531,	.136,	.26,	7,	.065,	.612
F shrinkage mean ,	311.,	.30,,,,				.205,	.440

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
319.,	.14,	.05,	63,	.343,	.431

Fleet : ST94C: Single trawle

Age ,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
2 ,	99.99,	99.99,	-2.90,	99.99,	99.99,	99.99,	-.42,	1.27,	99.99,	-.03
3 ,	99.99,	.69,	-.11,	99.99,	-1.49,	-1.01,	.29,	1.06,	99.99,	.47
4 ,	99.99,	1.70,	1.25,	-1.79,	-.52,	-.36,	.65,	.91,	-.77,	.24
5 ,	99.99,	2.15,	1.00,	.25,	-.05,	-.02,	.22,	.19,	-.62,	-.38
6 ,	99.99,	.86,	.79,	1.32,	.11,	-.34,	.15,	.47,	-.36,	-.99
7 ,	99.99,	1.40,	-.90,	1.49,	-.12,	.07,	.30,	.13,	-.16,	-.83
8 ,	99.99,	-.23,	.67,	2.47,	-.02,	-.07,	.41,	-.23,	-.71,	-.72
9 ,	99.99,	1.25,	.58,	.74,	99.99,	.12,	.25,	-.14,	-.41,	-.61

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-15.6580,	-14.4373,	-14.1242,	-13.6013,	-13.2051,	-13.0771,	-12.9789,	-12.9789,
S.E(Log q),	1.3750,	.9979,	.9188,	.5254,	.6968,	.6690,	.9028,	.5050,

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
2,	-1.38,	-6.538,	-1.07,	.86,	4,	.42,	-15.66,
3,	1.39,	-.351,	16.63,	.22,	7,	1.59,	-14.44,
4,	1.16,	-.274,	15.01,	.40,	9,	1.18,	-14.12,
5,	.85,	.434,	12.86,	.67,	9,	.49,	-13.60,
6,	1.02,	-.045,	13.32,	.48,	9,	.79,	-13.21,
7,	.82,	.569,	12.10,	.71,	9,	.59,	-13.08,
8,	1.61,	-.806,	16.79,	.29,	9,	1.50,	-12.98,
9,	1.66,	-1.151,	17.47,	.46,	8,	.81,	-13.01,

Continued.....

Table 2.4.15 (Cont'd)

Fleet : ST94B: Single trawle

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	-.01	-2.04	-1.08	-1.42	-1.83	99.99	1.77	99.99	1.82
3	99.99	.81	-.23	-.17	-.93	.52	-1.33	.64	-.67	1.51
4	99.99	.14	.12	.26	-.72	-.70	.47	-.24	-.03	.71
5	99.99	.73	.09	.49	-.25	.00	-.08	-.45	-.14	.47
6	99.99	-.10	-.04	.49	-.10	.04	.05	.12	-.51	.17
7	99.99	.15	-.14	.76	-.56	.08	.00	-.29	-.15	.40
8	99.99	-.47	-.68	1.04	-.43	-.05	-.10	-.46	-.09	.71
9	99.99	.16	.55	99.99	.04	.09	-.02	-.30	-.20	.53

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-15.0326	-12.9815	-11.9422	-11.9471	-11.8434	-11.6561	-11.7553	-11.7553
S.E(Log q)	1.9076	1.0354	.5408	.3561	.2846	.3803	.5404	.3263

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
2	-1.22	-1.996	1.45	.26	7	1.70	-15.03
3	1.23	-.330	13.96	.32	9	1.40	-12.98
4	1.30	-.824	12.93	.63	9	.73	-11.94
5	1.05	-.176	12.12	.74	9	.41	-11.95
6	.99	.040	11.81	.86	9	.31	-11.84
7	1.06	-.256	11.90	.81	9	.44	-11.66
8	1.65	-1.671	15.00	.61	9	.77	-11.76
9	1.09	-.438	12.19	.87	8	.38	-11.70

Fleet : ST94A: Single trawle

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	-1.16	99.99	99.99	-1.66	99.99	99.99	.18	-.12	1.19
3	99.99	-.48	-.05	-.20	-.46	.00	-1.41	.62	-.15	1.32
4	99.99	-.71	-.07	.21	-.38	-1.44	.23	.30	-.17	1.09
5	99.99	-.30	-.47	.41	-.50	-.43	-.14	-.04	.10	.73
6	99.99	-.69	-.65	.31	-.10	-.10	-.43	.17	-.17	.66
7	99.99	-.78	-.55	-.41	.26	-.13	-.51	.34	-.49	1.00
8	99.99	-.93	-.20	99.99	-.79	-.99	-1.02	.59	.27	1.61
9	99.99	-.71	.63	99.99	1.98	.41	-.65	.81	.75	1.29

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-14.9264	-13.2407	-12.4061	-12.3319	-12.2132	-12.1552	-12.4448	-12.4448
S.E(Log q)	1.1185	.8886	.7828	.4424	.4114	.5990	1.0520	1.1360

Continued.....

Table 2.4.15 Cont'd)

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
2,	3.18,	-.772,	28.87,	.07,	5,	3.85,	-14.93,
3,	1.70,	-.917,	16.42,	.28,	9,	1.54,	-13.24,
4,	1.42,	-.714,	13.97,	.40,	9,	1.17,	-12.41,
5,	1.58,	-1.256,	14.50,	.53,	9,	.66,	-12.33,
6,	1.21,	-.638,	13.09,	.68,	9,	.53,	-12.21,
7,	.95,	.142,	11.94,	.68,	9,	.63,	-12.16,
8,	2.62,	-.958,	21.47,	.09,	8,	2.78,	-12.44,
9,	2.07,	-1.229,	17.77,	.26,	8,	1.67,	-11.76,

Fleet : PT94B: Pair trawlers

Age	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
2	99.99,	.78,	-1.57,	-.60,	-1.35,	.60,	99.99,	99.99,	99.99,	1.05
3	99.99,	1.65,	1.38,	.07,	-.45,	-.56,	-.78,	1.08,	-1.51,	1.33
4	99.99,	.84,	.78,	.31,	-.74,	.81,	-.41,	-.18,	-.57,	.49
5	99.99,	.60,	.50,	.22,	-.27,	-.13,	-.41,	.25,	.01,	.09
6	99.99,	.15,	.18,	.01,	-.40,	-.48,	-.36,	.33,	.32,	.29
7	99.99,	-.39,	-.50,	.22,	-.49,	-1.21,	-.04,	.09,	.45,	.90
8	99.99,	-.62,	.51,	.31,	-.11,	-1.45,	.24,	-.13,	-.17,	1.11
9	99.99,	.02,	.46,	-.72,	.12,	-2.25,	-.04,	.06,	.33,	.63

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-16.7980,	-14.8176,	-12.8436,	-12.1836,	-11.7330,	-11.6741,	-11.7456,	-11.7456,
S.E(Log q),	1.2269,	1.1521,	.6105,	.2834,	.3709,	.6864,	.7837,	.9718,

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
2,	-4.88,	-.807,	-27.64,	.01,	6,	6.48,	-16.80,
3,	.80,	.409,	13.58,	.48,	9,	1.00,	-14.82,
4,	1.24,	-.587,	13.84,	.58,	9,	.81,	-12.84,
5,	.99,	.025,	12.16,	.83,	9,	.31,	-12.18,
6,	1.93,	-4.191,	15.09,	.83,	9,	.35,	-11.73,
7,	1.57,	-1.018,	14.04,	.43,	9,	1.07,	-11.67,
8,	1.85,	-1.222,	16.03,	.32,	9,	1.39,	-11.75,
9,	.79,	.530,	10.70,	.61,	9,	.82,	-11.90,

Continued......

Table 2.4.15 (Cont'd)

Fleet : PT94A: Pair trawlers

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99,	.41,	-.75,	.77,	-.83,	99.99,	99.99,	99.99,	99.99,	.35
3	99.99,	1.06,	.43,	.33,	-.10,	-.27,	-.78,	-.32,	.69,	.22
4	99.99,	1.13,	.70,	.58,	.00,	-.66,	-.46,	-.65,	.86,	.14
5	99.99,	.99,	.42,	.36,	-.12,	-.35,	-.64,	-.16,	.63,	.08
6	99.99,	.37,	.41,	.21,	-.36,	-.43,	-.58,	.11,	.30,	.47
7	99.99,	.02,	-.41,	.55,	-.58,	-.12,	-.33,	-.23,	-.08,	.94
8	99.99,	-.31,	.41,	.68,	-.42,	-.11,	-.20,	-.57,	-.36,	1.06
9	99.99,	.36,	.87,	.14,	.15,	-.12,	-.52,	-.40,	.09,	.61

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-16.2162,	-13.7123,	-12.5437,	-11.9922,	-11.6217,	-11.4618,	-11.4877,	-11.4877,
S.E(Log q),	.8239,	.5299,	.6404,	.4645,	.4254,	.5298,	.6200,	.4459,

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
2,	4.85,	-.691,	43.20,	.06,	5,	4.90,	-16.22,
3,	1.27,	-.771,	15.05,	.66,	9,	.70,	-13.71,
4,	.95,	.141,	12.36,	.67,	9,	.68,	-12.54,
5,	.98,	.047,	11.94,	.66,	9,	.51,	-11.99,
6,	1.95,	-2.650,	14.93,	.65,	9,	.57,	-11.62,
7,	1.22,	-.606,	12.32,	.65,	9,	.69,	-11.46,
8,	2.24,	-2.524,	17.40,	.49,	9,	.98,	-11.49,
9,	1.11,	-.423,	12.04,	.78,	9,	.54,	-11.46,

Fleet : MH93: magnus heinaso

Age	1983
2	99.99
3	99.99
4	99.99
5	99.99
6	99.99
7	99.99
8	99.99
9	99.99

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	-.52,	-.94,	-.04,	-.95,	.21,	.92,	.15,	.31,	.46,	-1.21
3	-.78,	-1.20,	-.78,	-1.09,	-.38,	1.00,	.61,	-.51,	.29,	-.01
4	-.56,	-1.17,	-.71,	-.95,	-.38,	.07,	.34,	-.38,	.45,	.62
5	-.75,	-.98,	-.74,	-.63,	-.33,	.80,	-.31,	-.43,	.32,	.59
6	-.69,	99.99,	-1.45,	-1.39,	-.90,	1.04,	.16,	-.37,	.53,	.53
7	-1.31,	-.84,	-1.36,	99.99,	-.90,	1.21,	.37,	-1.16,	.41,	.50
8	-.42,	-.51,	-.93,	99.99,	-.95,	.78,	.97,	-1.69,	.10,	.99
9	-.88,	-.65,	.35,	-.12,	.44,	99.99,	.56,	-1.12,	-.43,	-.05

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-9.8409,	-10.1038,	-10.5882,	-11.1051,	-11.0069,	-11.0184,	-11.4898,	-11.4898,
S.E(Log q),	.7621,	.6907,	.5641,	.5805,	.8430,	.9376,	1.1203,	.5566,

Continued.....

Table 2.4.15 (Cont'd)

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
2,	1.08,	-.142,	9.92,	.46,	10,	.91,	-9.84,
3,	1.24,	-.514,	10.43,	.53,	10,	.92,	-10.10,
4,	2.15,	-2.936,	12.78,	.60,	10,	.78,	-10.59,
5,	1.18,	-.359,	11.57,	.47,	10,	.75,	-11.11,
6,	.90,	.176,	10.72,	.42,	9,	.84,	-11.01,
7,	.77,	.551,	10.23,	.61,	9,	.78,	-11.02,
8,	1.30,	-.310,	12.89,	.22,	9,	1.62,	-11.49,
9,	1.46,	-1.047,	14.18,	.60,	9,	.92,	-11.64,

Fleet : LL94B: Longliners >

Age	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
2	99.99,	1.19,	-.66,	-1.71,	.30,	-1.24,	-1.31,	.26,	.46,	2.19
3	99.99,	.19,	-.38,	-2.39,	-.59,	-.40,	.16,	.21,	.39,	1.22
4	99.99,	.15,	.44,	-1.11,	-.67,	-.47,	.35,	.31,	-.15,	.75
5	99.99,	.02,	-.03,	-.55,	-.32,	-.07,	-.03,	-.07,	.32,	.32
6	99.99,	.21,	.08,	-.15,	-.12,	-.22,	-.22,	.01,	.16,	.30
7	99.99,	-1.71,	-1.31,	.37,	-.73,	.11,	-.08,	-.11,	.44,	.53
8	99.99,	-1.48,	.50,	.77,	-.18,	-.12,	.21,	-.25,	-.19,	.11
9	99.99,	-.94,	-1.01,	1.03,	-1.84,	-.23,	-.12,	.13,	-.04,	.30

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

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-15.0436,	-12.4677,	-11.4618,	-10.8694,	-10.4306,	-10.1505,	-10.2560,	-10.2560,
S.E(Log q),	1.3539,	.9611,	.6049,	.2862,	.2081,	.5771,	.3897,	.7949,

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
2,	2.06,	-.607,	21.67,	.07,	9,	2.98,	-15.04,
3,	3.91,	-1.894,	23.33,	.09,	9,	3.08,	-12.47,
4,	1.72,	-1.541,	13.47,	.52,	9,	.93,	-11.46,
5,	1.56,	-2.675,	12.17,	.84,	9,	.30,	-10.87,
6,	1.29,	-2.355,	11.11,	.94,	9,	.20,	-10.43,
7,	.93,	.212,	9.98,	.71,	9,	.60,	-10.15,
8,	1.25,	-1.006,	11.12,	.80,	9,	.48,	-10.26,
9,	.72,	1.098,	9.18,	.78,	9,	.54,	-10.42,

Continued......

Table 2.4.15 Cont'd)

Log catchability residuals.

Fleet : LL94A: lline<100GRT

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	99.99	.74	-.06	1.30	1.47	-1.25	-.32	.26	-.12	-.49
3	99.99	.57	.18	.20	-.06	.15	.13	.21	-.28	-.34
4	99.99	.03	.25	.28	.22	-.26	.06	.23	-.09	-.33
5	99.99	-.09	.14	.19	.11	.32	-.04	-.14	.15	-.43
6	99.99	.44	.36	.11	-.02	.15	.17	.07	-.05	-.49
7	99.99	-.65	-.62	.53	-.52	.55	.41	.33	-.30	-.50
8	99.99	-.32	.69	.31	-.59	.33	.33	.03	-.07	-.45
9	99.99	-.66	-.40	.03	-.59	.29	.31	.22	.39	-.30

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

Age	2	3	4	5	6	7	8	9
Mean Log q	-13.5959	-11.7937	-11.3041	-11.2064	-11.1136	-11.0874	-10.8964	-10.8964
S.E(Log q)	.8752	.2542	.2444	.2558	.2605	.5017	.3967	.3835

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
2	.94	.110	13.31	.45	9	.91	-13.60
3	.80	3.858	11.17	.99	9	.11	-11.79
4	.80	3.861	10.78	.99	9	.10	-11.30
5	.79	1.841	10.64	.95	9	.17	-11.21
6	.91	.529	10.86	.90	9	.26	-11.11
7	.70	2.086	10.02	.92	9	.28	-11.09
8	.88	.626	10.41	.87	9	.37	-10.90
9	.81	1.345	9.97	.93	9	.29	-10.85

XSA population numbers

YEAR	AGE 2	3	4	5	6	7	8	9
1984	3.82E+04	1.43E+04	7.96E+03	7.81E+02	8.35E+02	4.86E+02	3.54E+03	1.85E+03
1985	3.49E+04	3.02E+04	1.03E+04	4.29E+03	5.07E+02	4.72E+02	3.60E+02	2.12E+03
1986	2.36E+04	2.77E+04	2.06E+04	6.45E+03	2.39E+03	2.62E+02	3.04E+02	2.39E+02
1987	7.31E+03	1.91E+04	2.03E+04	1.29E+04	3.90E+03	1.29E+03	1.79E+02	1.31E+02
1988	1.43E+04	5.73E+03	1.41E+04	1.34E+04	7.83E+03	2.19E+03	5.76E+02	7.16E+01
1989	1.16E+04	1.11E+04	4.29E+03	9.33E+03	8.25E+03	4.48E+03	1.36E+03	3.35E+02
1990	7.97E+03	9.47E+03	7.72E+03	2.91E+03	5.12E+03	4.44E+03	1.88E+03	6.24E+02
1991	2.49E+03	6.43E+03	6.60E+03	4.59E+03	1.69E+03	2.62E+03	1.91E+03	7.37E+02
1992	3.31E+03	1.97E+03	4.32E+03	3.80E+03	2.63E+03	7.95E+02	1.15E+03	9.31E+02
1993	6.06E+03	2.67E+03	1.47E+03	2.83E+03	2.09E+03	1.28E+03	3.46E+02	6.00E+02

Estimated population abundance at 1st Jan 1994

, .00E+00, 4.86E+03, 1.93E+03, 9.69E+02, 1.84E+03, 1.25E+03, 6.39E+02, 1.71E+02,

Taper weighted geometric mean of the VPA populations:

, 6.67E+03, 6.23E+03, 5.90E+03, 5.18E+03, 3.38E+03, 1.81E+03, 8.41E+02, 4.33E+02,

Standard error of the weighted Log(VPA populations) :

, .7480, .8725, .8611, .6391, .6942, .8398, .8689, .9159,

Continued......

Table 2.4.15 (Cont'd)

Regression weights

.020	.116	.284	.482	.670	.820	.921	.976	.997	1.000

Fishing mortalities

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
2	.035	.032	.011	.044	.052	.006	.015	.035	.013	.020
3	.128	.182	.107	.104	.090	.164	.161	.198	.091	.124
4	.418	.269	.273	.215	.214	.186	.321	.352	.223	.217
5	.233	.386	.302	.295	.288	.401	.344	.358	.397	.229
6	.371	.460	.418	.379	.359	.419	.470	.554	.521	.314
7	.100	.240	.180	.605	.275	.669	.644	.625	.632	.492
8	.313	.208	.639	.717	.342	.579	.736	.518	.448	.504
9	.263	.304	.398	.517	.326	.578	.651	.646	.651	.431

Table 2.4.16

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: JAKVPAFINAL)

At 6-May-94 18:32

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1961,	1962,	1963,
AGE			
2,	.1881,	.3249,	.3812,
3,	.4184,	.5893,	.5685,
4,	.4226,	.6033,	.7326,
5,	.4416,	.3501,	.5680,
6,	.5941,	.6783,	.4061,
7,	.9729,	1.0762,	1.2893,
8,	.9701,	1.0429,	1.2015,
9,	.8546,	.9427,	.9765,
+gp,	.8546,	.9427,	.9765,
FBAR 3- 7,	.5699,	.6594,	.7129,

Table 8 Fishing mortality (F) at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
2,	.0880,	.0688,	.0604,	.0633,	.1177,	.0859,	.0572,	.0555,	.0256,	.1669,
3,	.3737,	.2369,	.2359,	.1853,	.2609,	.2176,	.2523,	.2020,	.4521,	.4374,
4,	.5266,	.4796,	.4557,	.2952,	.3435,	.5207,	.3000,	.4175,	.3012,	.2620,
5,	.5460,	.3759,	.5056,	.3037,	.2823,	.3266,	.3520,	.2384,	.4499,	.3372,
6,	.6285,	.6060,	.5612,	.5497,	.4630,	.4914,	.5393,	.5276,	.1254,	.2678,
7,	.3417,	1.0274,	.9749,	.7377,	.8657,	.8601,	.8523,	.7885,	.6109,	.1584,
8,	1.3457,	2.5144,	.8819,	.7697,	.6650,	1.1667,	.5861,	.4032,	.3643,	.2506,
9,	.7797,	1.4005,	.8143,	.6921,	.6707,	.8482,	.6653,	.5780,	.3693,	.2267,
+gp,	.7797,	1.4005,	.8143,	.6921,	.6707,	.8482,	.6653,	.5780,	.3693,	.2267,
FBAR 3- 7,	.4833,	.5452,	.5467,	.4143,	.4431,	.4833,	.4592,	.4348,	.3879,	.2925,

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: JAKVPAFINAL)

At 6-May-94 18:32

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
2,	.1262,	.1180,	.0882,	.0108,	.0010,	.0004,	.0337,	.0244,	.0402,	.0275,
3,	.2168,	.2637,	.1790,	.1092,	.0546,	.0467,	.0311,	.1428,	.4784,	.2019,
4,	.3815,	.2407,	.3785,	.1713,	.1605,	.1252,	.2072,	.1441,	.3902,	.3671,
5,	.1433,	.2180,	.2210,	.5218,	.1973,	.1830,	.2743,	.2172,	.3275,	.3765,
6,	.1882,	.1088,	.2985,	.7212,	.3758,	.1296,	.2024,	.2257,	.2877,	.1598,
7,	.2117,	.0957,	.1855,	.4125,	.5709,	.2661,	.1546,	.1877,	.2514,	.3140,
8,	.1128,	.1583,	.2887,	.4622,	.5424,	.3258,	.3832,	.0825,	.2090,	.3085,
9,	.1716,	.1213,	.2589,	.5363,	.5002,	.2417,	.2480,	.1660,	.2506,	.2621,
+gp,	.1716,	.1213,	.2589,	.5363,	.5002,	.2417,	.2480,	.1660,	.2506,	.2621,
FBAR 3- 7,	.2283,	.1854,	.2525,	.3872,	.2718,	.1501,	.1739,	.1835,	.3470,	.2839,

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
2,	.0352,	.0317,	.0108,	.0438,	.0520,	.0060,	.0147,	.0348,	.0135,	.0197,	.0227,
3,	.1285,	.1822,	.1074,	.1045,	.0896,	.1637,	.1610,	.1978,	.0911,	.1240,	.1376,
4,	.4182,	.2687,	.2726,	.2153,	.2142,	.1859,	.3214,	.3523,	.2226,	.2174,	.2641,
5,	.2331,	.3855,	.3023,	.2951,	.2875,	.4006,	.3443,	.3578,	.3967,	.2293,	.3279,
6,	.3706,	.4598,	.4176,	.3792,	.3594,	.4189,	.4702,	.5544,	.5206,	.3138,	.4629,
7,	.1005,	.2396,	.1798,	.6048,	.2746,	.6690,	.6444,	.6250,	.6319,	.4920,	.5830,
8,	.3128,	.2076,	.6394,	.7173,	.3420,	.5792,	.7359,	.5177,	.4482,	.5042,	.4900,
9,	.2632,	.3039,	.3976,	.5172,	.3255,	.5775,	.6506,	.6456,	.6506,	.4307,	.5756,
+gp,	.2632,	.3039,	.3976,	.5172,	.3255,	.5775,	.6506,	.6456,	.6506,	.4307,	
FBAR 3- 7,	.2502,	.3071,	.2560,	.3198,	.2451,	.3676,	.3883,	.4175,	.3726,	.2753,	

Table 2.4.17

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: JAKVPAFINAL)

At 6-May-94 18:32

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1961,	1962,	1963,
AGE			
2,	51134,	38369,	47258,
3,	23695,	34688,	22700,
4,	16464,	12767,	15753,
5,	5997,	8834,	5718,
6,	3220,	3157,	5096,
7,	1489,	1455,	1312,
8,	420,	461,	406,
9,	113,	130,	133,
+gp,	0,	0,	0,
TOTAL,	102532,	99862,	98376,

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
2,	29952,	22735,	20389,	25657,	58539,	32022,	34332,	14687,	32790,	23723,
3,	26429,	22456,	17376,	15715,	19717,	42607,	24060,	26545,	11376,	26167,
4,	10526,	14891,	14507,	11236,	10690,	12436,	28062,	15306,	17759,	5926,
5,	6199,	5090,	7547,	7531,	6848,	6208,	6049,	17020,	8254,	10758,
6,	2653,	2940,	2861,	3727,	4551,	4228,	3667,	3483,	10979,	4310,
7,	2780,	1158,	1313,	1337,	1761,	2345,	2118,	1751,	1683,	7929,
8,	296,	1617,	339,	406,	523,	607,	812,	739,	651,	748,
9,	100,	63,	107,	115,	154,	220,	155,	370,	404,	371,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	60,
TOTAL,	78935,	70950,	64440,	65723,	102783,	100672,	99255,	79902,	83896,	79992,

R itle : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: JAKVPAFINAL)

At -May-94 18:32

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
2,	52527,	72828,	57548,	26237,	34416,	2561,	4773,	3398,	15131,	17962,
3,	16437,	37908,	52988,	43139,	21250,	28149,	2096,	3779,	2715,	11900,
4,	13834,	10834,	23842,	36273,	31664,	16474,	21996,	1664,	2682,	1378,
5,	3734,	7734,	6973,	13369,	25021,	22081,	11900,	14639,	1179,	1486,
6,	6287,	2649,	5092,	4577,	6495,	16817,	15055,	7406,	9645,	696,
7,	2700,	4264,	1945,	3093,	1822,	3652,	12095,	10068,	4838,	5923,
8,	5541,	1789,	3173,	1323,	1676,	843,	2292,	8484,	6832,	3081,
9,	477,	4052,	1250,	1946,	682,	798,	498,	1279,	6396,	4539,
+gp,	1026,	1802,	1531,	2253,	867,	379,	430,	259,	1061,	3787,
TOTAL,	102561,	143861,	154342,	132209,	123896,	91753,	71136,	50975,	50479,	50752,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	GMST
AGE												
2,	38225,	34875,	23635,	7306,	14295,	11641,	7970,	2488,	3308,	6058,	0,	[illegible]
3,	14307,	30215,	27662,	19143,	5726,	11111,	9473,	6430,	1968,	2672,	4863,	[illegible]
4,	7962,	10301,	20618,	20341,	14118,	4286,	7724,	6603,	4320,	1471,	1933,	[illegible]
5,	781,	4291,	6447,	12852,	13428,	9331,	2914,	4585,	3801,	2831,	969,	[illegible]
6,	835,	507,	2389,	3901,	7834,	8247,	5117,	1691,	2625,	2093,	1843,	[illegible]
7,	486,	472,	262,	1288,	2186,	4477,	4441,	2618,	795,	1277,	1252,	[illegible]
8,	3542,	360,	304,	179,	576,	1360,	1878,	1909,	1147,	346,	639,	[illegible]
9,	1853,	2121,	239,	131,	72,	335,	624,	737,	931,	600,	171,	[illegible]
+gp,	4595,	4076,	2379,	905,	506,	202,	246,	73,	372,	548,	611,	
TOTAL,	72586,	87218,	83936,	66048,	58741,	50990,	40388,	27134,	19267,	17896,	12281,	

Table 2.4.18

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: JAKVPAFINAL)

At 6-May-94 18:32

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,	51134,	80669,	47409,	20831,	.4394,	.5699,
1962,	38369,	82875,	51457,	27151,	.5276,	.6594,
1963,	47258,	80176,	49079,	27571,	.5618,	.7129,
1964,	29952,	67922,	43587,	19490,	.4472,	.4833,
1965,	22735,	65035,	44952,	18479,	.4111,	.5452,
1966,	20389,	60426,	43347,	18766,	.4329,	.5467,
1967,	25657,	59936,	41493,	13381,	.3225,	.4143,
1968,	58539,	79726,	45292,	17852,	.3942,	.4431,
1969,	32022,	86158,	54573,	23272,	.4264,	.4833,
1970,	34332,	89830,	62674,	21361,	.3408,	.4592,
1971,	14687,	84216,	66094,	19393,	.2934,	.4348,
1972,	32790,	85301,	64690,	16485,	.2548,	.3879,
1973,	23723,	84636,	63620,	17969,	.2824,	.2925,
1974,	52527,	97395,	66542,	14763,	.2219,	.2283,
1975,	72828,	125403,	77735,	20715,	.2665,	.1854,
1976,	57548,	136227,	88263,	26211,	.2970,	.2525,
1977,	26237,	121562,	96284,	25553,	.2654,	.3872,
1978,	34416,	122197,	98968,	19200,	.1940,	.2718,
1979,	2561,	99995,	87974,	12424,	.1412,	.1501,
1980,	4773,	89994,	84469,	15016,	.1778,	.1739,
1981,	3398,	81611,	78600,	12233,	.1556,	.1835,
1982,	15131,	69573,	56446,	11937,	.2115,	.3470,
1983,	17962,	63903,	54878,	12894,	.2350,	.2839,
1984,	38225,	78924,	51814,	12378,	.2389,	.2502,
1985,	34875,	85835,	60154,	15143,	.2517,	.3071,
1986,	23635,	87399,	55142,	14477,	.2625,	.2560,
1987,	7306,	75878,	57093,	14882,	.2607,	.3198,
1988,	14295,	64343,	52808,	12178,	.2306,	.2451,
1989,	11641,	55497,	40575,	14325,	.3531,	.3676,
1990,	7970,	40244,	30248,	11726,	.3877,	.3883,
1991,	2488,	27242,	25302,	8429,	.3331,	.4175,
1992,	3308,	19158,	17200,	5473,	.3182,	.3726,
1993,	6058,	20096,	14001,	3814,	.2724,	.2753,
Arith. Mean ,	26326,	77860,	56750,	16539,	.3094,	.3665,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.4.19

Haddock in the Faroe Grounds (Fishing Area Vb)

Haddock in the Faroe Grounds (Fishing Area Vb)

Prediction with management option table: Input data

Year: 1994								
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	7299.000	0.2000	0.4700	0.0000	0.0000	0.585	0.0200	0.585
3	2690.000	0.2000	0.9500	0.0000	0.0000	1.255	0.1240	1.255
4	1933.000	0.2000	1.0000	0.0000	0.0000	1.769	0.2170	1.769
5	969.000	0.2000	1.0000	0.0000	0.0000	1.581	0.2300	1.581
6	1843.000	0.2000	1.0000	0.0000	0.0000	1.764	0.3140	1.764
7	1252.000	0.2000	1.0000	0.0000	0.0000	1.832	0.4920	1.832
8	639.000	0.2000	1.0000	0.0000	0.0000	2.127	0.5040	2.127
9	171.000	0.2000	1.0000	0.0000	0.0000	2.253	0.4310	2.253
10+	611.000	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1995								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	10853.000	0.2000	0.2600	0.0000	0.0000	0.579	0.0200	0.579
3	.	0.2000	0.7000	0.0000	0.0000	0.948	0.1240	0.948
4	.	0.2000	0.9100	0.0000	0.0000	1.709	0.2170	1.709
5	.	0.2000	1.0000	0.0000	0.0000	2.334	0.2300	2.334
6	.	0.2000	1.0000	0.0000	0.0000	1.966	0.3140	1.966
7	.	0.2000	1.0000	0.0000	0.0000	2.056	0.4920	2.056
8	.	0.2000	1.0000	0.0000	0.0000	2.023	0.5040	2.023
9	.	0.2000	1.0000	0.0000	0.0000	2.433	0.4310	2.433
10+	.	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
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	8768.000	0.2000	0.2600	0.0000	0.0000	0.579	0.0200	0.579
3	.	0.2000	0.7000	0.0000	0.0000	0.938	0.1240	0.938
4	.	0.2000	0.9100	0.0000	0.0000	1.291	0.2170	1.291
5	.	0.2000	1.0000	0.0000	0.0000	2.256	0.2300	2.256
6	.	0.2000	1.0000	0.0000	0.0000	2.903	0.3140	2.903
7	.	0.2000	1.0000	0.0000	0.0000	2.291	0.4920	2.291
8	.	0.2000	1.0000	0.0000	0.0000	2.270	0.5040	2.270
9	.	0.2000	1.0000	0.0000	0.0000	2.314	0.4310	2.314
10+	.	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : JR94A
Date and time: 09MAY94:23:04

Table 2.4.20

Faroe Haddock: Input data for RCT3 - VPA and groundfish survey data

4 10 2

'Yearclass'	'VPAage2'	'Survage1'	'Survage2'	'Survage3'	'Survage4'
1984	23635	188.7	115.0	24.3	21.9
1985	7306	23.1	14.1	14.9	10.5
1986	14295	41.2	88.2	113.0	24.0
1987	11641	38.9	148.0	65.1	9.9
1988	7970	42.5	46.7	14.3	15.4
1989	2488	4.1	17.1	10.0	6.2
1990	3308	3.7	26.4	10.0	3.0
1991	-11	6.0	9.1	2.1	-11
1992	-11	27.9	8.5	-11	-11
1993	-11	46.0	-11	-11	-11

Table 2.4.21

Analysis by RCT3 ver3.1 of data from file :

hs1rct3.dat

Faroe Haddock: Input data for RCT3 - VPA and groundfish survey data

Data for 4 surveys over 10 years : 1984 - 1993

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1987

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction				--------I
Survag	.59	7.14	.30	.888	3	3.69	9.29	.605	.314
Survag	.56	7.28	.28	.900	3	5.00	10.08	.640	.281
Survag	1.87	2.82	2.60	.093	3	4.19	10.66	5.533	.004
Survag	1.62	4.77	.50	.732	3	2.39	8.63	1.282	.070
					VPA Mean =		9.51	.589	.331

Yearclass = 1988

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			---------I	I-----------Prediction				--------I
Survag	.58	7.18	.21	.889	4	3.77	9.36	.336	.553
Survag	.63	6.80	.54	.550	4	3.86	9.24	.869	.083
Survag	2.33	.77	2.49	.054	4	2.73	7.13	4.562	.003
Survag	1.45	5.42	.51	.578	4	2.80	9.48	.807	.096
					VPA Mean =		9.47	.486	.265

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
Survag	.70	6.64	.30	.775	5	1.63	7.78	.707	.229
Survag	.71	6.42	.51	.534	5	2.90	8.47	.860	.155
Survag	1.28	4.86	1.21	.170	5	2.40	7.92	1.981	.029
Survag	1.85	4.21	.61	.450	5	1.97	7.86	1.205	.079
					VPA Mean =		9.37	.474	.509

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
Survag	.68	6.69	.25	.921	6	1.55	7.75	.410	.587
Survag	1.00	5.16	.67	.622	6	3.31	8.47	.921	.116
Survag	1.33	4.66	1.09	.382	6	2.40	7.85	1.574	.040
Survag	1.88	4.12	.53	.720	6	1.39	6.72	1.058	.088
					VPA Mean =		9.11	.765	.169

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

Continued..

Table 2.4.21 (Cont'd)

Survag	.63	6.91	.24	.930	7	1.95	8.14	.328	.758
Survag	1.09	4.75	.67	.632	7	2.31	7.27	1.013	.079
Survag	1.25	4.95	.92	.476	7	1.13	6.37	1.546	.034
Survag									
					VPA Mean =		8.96	.795	.129

Yearclass = 1992

	I-----------Regression---------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Survag	.63	6.91	.24	.929	7	3.36	9.04	.310	.805
Survag	1.09	4.74	.67	.634	7	2.25	7.20	1.032	.073
Survag									
Survag									
					VPA Mean =		8.95	.796	.122

Yearclass = 1993

	I-----------Regression---------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Survag	.63	6.91	.24	.929	7	3.85	9.35	.321	.861
Survag									
Survag									
Survag									
					VPA Mean =		8.94	.798	.139

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1987	13992	9.55	.34	.20	.36	11641	9.36
1988	11924	9.39	.25	.07	.08	7971	8.98
1989	6051	8.71	.34	.36	1.11	2489	7.82
1990	2913	7.98	.31	.32	1.05	3309	8.10
1991	3351	8.12	.29	.29	1.03		
1992	7299	8.90	.28	.34	1.46		
1993	10853	9.29	.30	.14	.23		

Table 2.4.22

Haddock in the Faroe Grounds (Fishing Area Vb)

Haddock in the Faroe Grounds (Fishing Area Vb)

Prediction with management option table

Year: 1994					Year: 1995					Year: 1996	
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
1.6829	0.4635	21552	19120	6200	0.0000	0.0000	22565	15996	0	30136	23329
.	.	.	.	.	0.0500	0.0138	.	15996	195	29922	23121
.	.	.	.	.	0.1000	0.0275	.	15996	388	29711	22916
.	.	.	.	.	0.1500	0.0413	.	15996	577	29503	22714
.	.	.	.	.	0.2000	0.0551	.	15996	764	29299	22515
.	.	.	.	.	0.2500	0.0689	.	15996	948	29097	22320
.	.	.	.	.	0.3000	0.0826	.	15996	1128	28899	22127
.	.	.	.	.	0.3500	0.0964	.	15996	1307	28704	21938
.	.	.	.	.	0.4000	0.1102	.	15996	1482	28511	21751
.	.	.	.	.	0.4500	0.1239	.	15996	1655	28322	21567
.	.	.	.	.	0.5000	0.1377	.	15996	1825	28135	21386
.	.	.	.	.	0.5500	0.1515	.	15996	1993	27951	21208
.	.	.	.	.	0.6000	0.1652	.	15996	2158	27769	21032
.	.	.	.	.	0.6500	0.1790	.	15996	2321	27591	20859
.	.	.	.	.	0.7000	0.1928	.	15996	2481	27415	20688
.	.	.	.	.	0.7500	0.2066	.	15996	2639	27241	20520
.	.	.	.	.	0.8000	0.2203	.	15996	2795	27070	20355
.	.	.	.	.	0.8500	0.2341	.	15996	2949	26901	20192
.	.	.	.	.	0.9000	0.2479	.	15996	3100	26735	20031
.	.	.	.	.	0.9500	0.2616	.	15996	3249	26571	19873
.	.	.	.	.	1.0000	0.2754	.	15996	3396	26410	19716
.	.	.	.	.	1.0500	0.2892	.	15996	3541	26250	19563
.	.	.	.	.	1.1000	0.3029	.	15996	3684	26093	19411
.	.	.	.	.	1.1500	0.3167	.	15996	3824	25939	19262
.	.	.	.	.	1.2000	0.3305	.	15996	3963	25786	19114
.	.	.	.	.	1.2500	0.3443	.	15996	4100	25636	18969
.	.	.	.	.	1.3000	0.3580	.	15996	4235	25487	18826
.	.	.	.	.	1.3500	0.3718	.	15996	4368	25341	18685
.	.	.	.	.	1.4000	0.3856	.	15996	4499	25196	18546
.	.	.	.	.	1.4500	0.3993	.	15996	4628	25054	18409
.	.	.	.	.	1.5000	0.4131	.	15996	4756	24913	18274
.	.	.	.	.	1.5500	0.4269	.	15996	4881	24775	18140
.	.	.	.	.	1.6000	0.4406	.	15996	5005	24638	18009
.	.	.	.	.	1.6500	0.4544	.	15996	5128	24503	17879
.	.	.	.	.	1.7000	0.4682	.	15996	5248	24370	17752
.	.	.	.	.	1.7500	0.4820	.	15996	5367	24239	17625
.	.	.	.	.	1.8000	0.4957	.	15996	5485	24110	17501
.	.	.	.	.	1.8500	0.5095	.	15996	5601	23982	17378
.	.	.	.	.	1.9000	0.5233	.	15996	5715	23856	17257
.	.	.	.	.	1.9500	0.5370	.	15996	5828	23731	17138
.	.	.	.	.	2.0000	0.5508	.	15996	5939	23608	17020
.	.	.	.	.	2.0500	0.5646	.	15996	6049	23487	16904
.	.	.	.	.	2.1000	0.5783	.	15996	6157	23367	16789
.	.	.	.	.	2.1500	0.5921	.	15996	6264	23249	16676
.	.	.	.	.	2.2000	0.6059	.	15996	6370	23133	16565
.	.	.	.	.	2.2500	0.6197	.	15996	6474	23017	16454
.	.	.	.	.	2.3000	0.6334	.	15996	6577	22904	16346
.	.	.	.	.	2.3500	0.6472	.	15996	6678	22792	16239
.	.	.	.	.	2.4000	0.6610	.	15996	6779	22681	16133
.	.	.	.	.	2.4500	0.6747	.	15996	6878	22571	16028
.	.	.	.	.	2.5000	0.6885	.	15996	6975	22463	15925
.	.	.	.	.	2.5500	0.7023	.	15996	7072	22357	15823
.	.	.	.	.	2.6000	0.7160	.	15996	7167	22251	15723
.	.	.	.	.	2.6500	0.7298	.	15996	7261	22147	15623
.	.	.	.	.	2.7000	0.7436	.	15996	7354	22045	15526
.	.	.	.	.	2.7500	0.7573	.	15996	7446	21943	15429
.	.	.	.	.	2.8000	0.7711	.	15996	7536	21843	15333
.	.	.	.	.	2.8500	0.7849	.	15996	7626	21744	15239
.	.	.	.	.	2.9000	0.7987	.	15996	7714	21646	15146
.	.	.	.	.	2.9500	0.8124	.	15996	7801	21549	15054
.	.	.	.	.	3.0000	0.8262	.	15996	7888	21454	14963
.	.	.	.	.	3.0500	0.8400	.	15996	7973	21359	14873
.	.	.	.	.	3.1000	0.8537	.	15996	8057	21266	14785
.	.	.	.	.	3.1500	0.8675	.	15996	8140	21174	14697
.	.	.	.	.	3.2000	0.8813	.	15996	8222	21083	14611
.	.	.	.	.	3.2500	0.8950	.	15996	8303	20993	14526
.	.	.	.	.	3.3000	0.9088	.	15996	8384	20904	14441
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Continued.....

Table 2.4.22 (Cont'd)

Haddock in the Faroe Grounds (Fishing Area Vb)

Haddock in the Faroe Grounds (Fishing Area Vb)

Prediction with management option table

(cont.)

Year: 1994					Year: 1995					Year: 1996	
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
.	.	.	.	.	3.3500	0.9226	.	15996	8463	20816	14358
.	.	.	.	.	3.4000	0.9364	.	15996	8541	20729	14276
.	.	.	.	.	3.4500	0.9501	.	15996	8618	20643	14194
.	.	.	.	.	3.5000	0.9639	.	15996	8695	20558	14114
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : JR94A
Date and time : 09MAY94:23:04
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1994 : TAC constraints

Table 2.4.23

Haddock in the Faroe Grounds (Fishing Area Vb)

Single option prediction: Input data

Year: 1994

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	7299.000	0.2000	0.4700	0.0000	0.0000	0.585	0.0200	0.585
3	2690.000	0.2000	0.9500	0.0000	0.0000	1.255	0.1240	1.255
4	1933.000	0.2000	1.0000	0.0000	0.0000	1.769	0.2170	1.769
5	969.000	0.2000	1.0000	0.0000	0.0000	1.581	0.2300	1.581
6	1843.000	0.2000	1.0000	0.0000	0.0000	1.764	0.3140	1.764
7	1252.000	0.2000	1.0000	0.0000	0.0000	1.832	0.4920	1.832
8	639.000	0.2000	1.0000	0.0000	0.0000	2.127	0.5040	2.127
9	171.000	0.2000	1.0000	0.0000	0.0000	2.253	0.4310	2.253
10+	611.000	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1995

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	10853.000	0.2000	0.2600	0.0000	0.0000	0.579	0.0200	0.579
3	.	0.2000	0.7000	0.0000	0.0000	0.948	0.1240	0.948
4	.	0.2000	0.9100	0.0000	0.0000	1.709	0.2170	1.709
5	.	0.2000	1.0000	0.0000	0.0000	2.334	0.2300	2.334
6	.	0.2000	1.0000	0.0000	0.0000	1.966	0.3140	1.966
7	.	0.2000	1.0000	0.0000	0.0000	2.056	0.4920	2.056
8	.	0.2000	1.0000	0.0000	0.0000	2.023	0.5040	2.023
9	.	0.2000	1.0000	0.0000	0.0000	2.433	0.4310	2.433
10+	.	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
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	8768.000	0.2000	0.2600	0.0000	0.0000	0.579	0.0200	0.579
3	.	0.2000	0.7000	0.0000	0.0000	0.938	0.1240	0.938
4	.	0.2000	0.9100	0.0000	0.0000	1.291	0.2170	1.291
5	.	0.2000	1.0000	0.0000	0.0000	2.256	0.2300	2.256
6	.	0.2000	1.0000	0.0000	0.0000	2.903	0.3140	2.903
7	.	0.2000	1.0000	0.0000	0.0000	2.291	0.4920	2.291
8	.	0.2000	1.0000	0.0000	0.0000	2.270	0.5040	2.270
9	.	0.2000	1.0000	0.0000	0.0000	2.314	0.4310	2.314
10+	.	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
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	12900.000	0.2000	0.2600	0.0000	0.0000	0.579	0.0200	0.579
3	.	0.2000	0.7000	0.0000	0.0000	0.938	0.1240	0.938
4	.	0.2000	0.9100	0.0000	0.0000	1.277	0.2170	1.277
5	.	0.2000	1.0000	0.0000	0.0000	1.703	0.2300	1.703
6	.	0.2000	1.0000	0.0000	0.0000	2.803	0.3140	2.803
7	.	0.2000	1.0000	0.0000	0.0000	3.383	0.4920	3.383
8	.	0.2000	1.0000	0.0000	0.0000	2.530	0.5040	2.530
9	.	0.2000	1.0000	0.0000	0.0000	2.596	0.4310	2.596
10+	.	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Continued.....

Table 2.4.23 (Cont'd)

Single option prediction: Input data

(cont.)

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	12900.000	0.2000	0.2600	0.0000	0.0000	0.579	0.0200	0.579
3	.	0.2000	0.7000	0.0000	0.0000	0.938	0.1240	0.938
4	.	0.2000	0.9100	0.0000	0.0000	1.277	0.2170	1.277
5	.	0.2000	1.0000	0.0000	0.0000	1.685	0.2300	1.685
6	.	0.2000	1.0000	0.0000	0.0000	2.118	0.3140	2.118
7	.	0.2000	1.0000	0.0000	0.0000	3.269	0.4920	3.269
8	.	0.2000	1.0000	0.0000	0.0000	3.735	0.5040	3.735
9	.	0.2000	1.0000	0.0000	0.0000	2.894	0.4310	2.894
10+	.	0.2000	1.0000	0.0000	0.0000	2.726	0.4310	2.726
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : JR94D
Date and time: 09MAY94:23:43

Table 2.4.24

Haddock in the Faroe Grounds (Fishing Area Vb)

Single option prediction: Summary table

Year	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
1994	1.6829	0.4635	3548	6200	17407	21552	13404	19120	13404	19120
1995	2.1199	0.5838	3950	6200	21927	22565	12002	15996	12002	15996
1996	2.2168	0.6105	4538	6200	23183	23320	13812	16744	13812	16744
1997	2.0450	0.5632	4687	6200	27811	26441	15728	18372	15728	18372
1998	1.7201	0.4737	4769	6200	31463	30329	18482	21448	18482	21448
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : JR94D
Date and time : 09MAY94:23:43
Computation of ref. F: Simple mean, age 3 - 7
Prediction basis : TAC constraints

Table 2.4.25

Haddock in the Faroe Grounds (Fishing Area Vb)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	1.000	0.2000	0.1085	0.0000	0.0000	0.502	0.0732	0.502
3	.	0.2000	0.5177	0.0000	0.0000	0.760	0.2274	0.760
4	.	0.2000	0.9131	0.0000	0.0000	1.079	0.3308	1.079
5	.	0.2000	0.9962	0.0000	0.0000	1.446	0.3330	1.446
6	.	0.2000	0.9985	0.0000	0.0000	1.817	0.4061	1.817
7	.	0.2000	1.0000	0.0000	0.0000	2.179	0.5354	2.179
8	.	0.2000	1.0000	0.0000	0.0000	2.448	0.6073	2.448
9	.	0.2000	1.0000	0.0000	0.0000	2.729	0.5254	2.729
10+	.	0.2000	1.0000	0.0000	0.0000	3.157	0.5254	3.157
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : JR94B
Date and time: 09MAY94:13:19

Table 2.4.26

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	9186.724	4.169	8371.355	4.169	8371.355
0.0500	0.0183	0.078	157.943	5.127	8098.733	3.782	7285.554	3.782	7285.554
0.1000	0.0367	0.141	273.321	4.816	7248.401	3.473	6437.387	3.473	6437.387
0.1500	0.0550	0.192	359.319	4.560	6567.189	3.219	5758.318	3.219	5758.318
0.2000	0.0733	0.235	424.431	4.345	6010.325	3.007	5203.573	3.007	5203.573
0.2500	0.0916	0.272	474.336	4.162	5547.363	2.826	4742.707	2.826	4742.707
0.3000	0.1100	0.304	512.956	4.004	5156.905	2.670	4354.325	2.670	4354.325
0.3500	0.1283	0.332	543.062	3.865	4823.497	2.534	4022.970	2.534	4022.970
0.4000	0.1466	0.357	566.657	3.743	4535.713	2.414	3737.218	2.414	3737.218
0.4500	0.1649	0.379	585.214	3.633	4284.932	2.307	3488.449	2.307	3488.449
0.5000	0.1833	0.399	599.833	3.535	4064.542	2.210	3270.049	2.210	3270.049
0.5500	0.2016	0.417	611.348	3.446	3869.387	2.123	3076.865	2.123	3076.865
0.6000	0.2199	0.433	620.397	3.364	3695.397	2.044	2904.826	2.044	2904.826
0.6500	0.2383	0.449	627.472	3.290	3539.317	1.972	2750.677	1.972	2750.677
0.7000	0.2566	0.463	632.960	3.221	3398.517	1.905	2611.789	1.905	2611.789
0.7500	0.2749	0.475	637.163	3.157	3270.851	1.844	2486.017	1.844	2486.017
0.8000	0.2932	0.487	640.323	3.098	3154.551	1.787	2371.592	1.787	2371.592
0.8500	0.3116	0.499	642.633	3.043	3048.151	1.734	2267.049	1.734	2267.049
0.9000	0.3299	0.509	644.245	2.991	2950.424	1.684	2171.160	1.684	2171.160
0.9500	0.3482	0.519	645.287	2.943	2860.334	1.638	2082.892	1.638	2082.892
1.0000	0.3665	0.528	645.858	2.897	2777.006	1.594	2001.369	1.594	2001.369
1.0500	0.3849	0.537	646.042	2.854	2699.693	1.553	1925.843	1.553	1925.843
1.1000	0.4032	0.545	645.906	2.814	2627.753	1.515	1855.673	1.515	1855.673
1.1500	0.4215	0.553	645.507	2.775	2560.632	1.478	1790.307	1.478	1790.307
1.2000	0.4398	0.561	644.891	2.739	2497.852	1.444	1729.265	1.444	1729.265
1.2500	0.4582	0.568	644.097	2.704	2438.996	1.411	1672.130	1.411	1672.130
1.3000	0.4765	0.575	643.155	2.671	2383.697	1.380	1618.538	1.380	1618.538
1.3500	0.4948	0.581	642.093	2.639	2331.636	1.350	1568.168	1.350	1568.168
1.4000	0.5132	0.587	640.933	2.609	2282.530	1.322	1520.737	1.322	1520.737
1.4500	0.5315	0.593	639.694	2.580	2236.127	1.295	1475.995	1.295	1475.995
1.5000	0.5498	0.599	638.391	2.553	2192.207	1.269	1433.721	1.269	1433.721
1.5500	0.5681	0.604	637.037	2.526	2150.570	1.245	1393.715	1.245	1393.715
1.6000	0.5865	0.610	635.645	2.501	2111.039	1.221	1355.801	1.221	1355.801
1.6500	0.6048	0.615	634.222	2.476	2073.454	1.198	1319.819	1.198	1319.819
1.7000	0.6231	0.619	632.778	2.453	2037.673	1.177	1285.628	1.177	1285.628
1.7500	0.6414	0.624	631.318	2.430	2003.567	1.156	1253.097	1.156	1253.097
1.8000	0.6598	0.629	629.849	2.408	1971.018	1.136	1222.109	1.136	1222.109
1.8500	0.6781	0.633	628.375	2.387	1939.920	1.116	1192.560	1.116	1192.560
1.9000	0.6964	0.637	626.901	2.367	1910.176	1.098	1164.352	1.098	1164.352
1.9500	0.7148	0.641	625.429	2.347	1881.699	1.080	1137.398	1.080	1137.398
2.0000	0.7331	0.645	623.964	2.328	1854.408	1.063	1111.617	1.063	1111.617
2.0500	0.7514	0.649	622.506	2.309	1828.230	1.046	1086.935	1.046	1086.935
2.1000	0.7697	0.653	621.059	2.292	1803.096	1.030	1063.287	1.030	1063.287
2.1500	0.7881	0.656	619.624	2.274	1778.945	1.014	1040.609	1.014	1040.609
2.2000	0.8064	0.660	618.203	2.258	1755.719	0.999	1018.844	0.999	1018.844
2.2500	0.8247	0.663	616.796	2.241	1733.366	0.985	997.940	0.985	997.940
2.3000	0.8430	0.667	615.404	2.225	1711.837	0.970	977.848	0.970	977.848
2.3500	0.8614	0.670	614.029	2.210	1691.086	0.957	958.523	0.957	958.523
2.4000	0.8797	0.673	612.671	2.195	1671.072	0.944	939.923	0.944	939.923
2.4500	0.8980	0.676	611.331	2.181	1651.756	0.931	922.009	0.931	922.009
2.5000	0.9163	0.679	610.008	2.167	1633.101	0.918	904.746	0.918	904.746
2.5500	0.9347	0.682	608.704	2.153	1615.073	0.906	888.099	0.906	888.099
2.6000	0.9530	0.685	607.417	2.140	1597.641	0.894	872.038	0.894	872.038
2.6500	0.9713	0.687	606.150	2.127	1580.776	0.883	856.532	0.883	856.532
2.7000	0.9897	0.690	604.900	2.114	1564.451	0.872	841.556	0.872	841.556
2.7500	1.0080	0.693	603.670	2.101	1548.638	0.861	827.082	0.861	827.082
2.8000	1.0263	0.695	602.457	2.089	1533.315	0.851	813.087	0.851	813.087
2.8500	1.0446	0.698	601.263	2.078	1518.459	0.840	799.549	0.840	799.549
2.9000	1.0630	0.700	600.087	2.066	1504.047	0.831	786.446	0.831	786.446
2.9500	1.0813	0.702	598.929	2.055	1490.061	0.821	773.758	0.821	773.758
3.0000	1.0996	0.705	597.789	2.044	1476.482	0.811	761.468	0.811	761.468
3.0500	1.1179	0.707	596.667	2.033	1463.291	0.802	749.556	0.802	749.556
3.1000	1.1363	0.709	595.562	2.023	1450.472	0.793	738.007	0.793	738.007
3.1500	1.1546	0.711	594.474	2.013	1438.010	0.785	726.804	0.785	726.804
3.2000	1.1729	0.713	593.403	2.003	1425.888	0.776	715.934	0.776	715.934
3.2500	1.1913	0.715	592.348	1.993	1414.094	0.768	705.381	0.768	705.381
3.3000	1.2096	0.717	591.310	1.983	1402.614	0.760	695.134	0.760	695.134
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Continued.....

Table 2.4.26 (Cont'd)

Haddock in the Faroe Grounds (Fishing Area Vb)

Yield per recruit: Summary table

(cont.)

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
3.3500	1.2279	0.719	590.289	1.974	1391.435	0.752	685.178	0.752	685.178
3.4000	1.2462	0.721	589.283	1.965	1380.545	0.744	675.504	0.744	675.504
3.4500	1.2646	0.723	588.292	1.956	1369.933	0.736	666.098	0.736	666.098
3.5000	1.2829	0.725	587.317	1.947	1359.588	0.729	656.951	0.729	656.951
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : JR94B
Date and time : 09MAY94:13:19
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.4247
F-max factor : 1.0522
F-0.1 reference F : 0.1557
F-max reference F : 0.3857
Recruitment : Single recruit

Table 2.5.1 Nominal catch (t) of SAITHE in Division Vb, 1979-1993, as reported to ICES.

Country	1979	1980	1981	1982	1983	1984	1985
Denmark	-	-	-	-	-	-	-
Faroe Islands	22003	23810	29682	30808	38963	54344	42874
France	2974	1110	258	130	180	243	839
German Dem.Rep.	-	-	-	-	-	-	31
Germany Fed.Rep	581	197	20	19	28	73	227
Netherlands	-	-	-	-	-	-	-
Norway	1137	62	134	15	5	5	-
UK (Eng. & W.)	190	13	-	-	-	-	4
UK (Scotland)	361	38	9	1	-	-	630
USSR	-	-	-	-	-	-	-
Total	27246	25230	30103	30973	39176	54665	44605

Country	1986	1987	1988	1989	1990	1991	1992	1993 [1]
Denmark	21	255	94	-	2	-	-	-
Faroe Islands	40139	39301	44402	43624	59821	53321	35979	32443
France	87	153	313	-	-	-	1999	-
German Dem.Rep.	-	-	-	9	-			
Germany Fed.Rep	105	49	74	20	15	32	5	2
Netherlands	-	-	-	22	67	65	-	-
Norway	24	14	52	51	46	103	34 [1]	38
UK (Eng. & W.)	-	108	-	-	-	5	74	83
UK (Scotland)	1340	140	92	9	33	79	98	53
USSR/Russia [2]	-	-	-	-	30	-	12	-
Total	41716	40020	45027	43735	60014	53605	38201	32619

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

Table 2.5.2 Nominal catch (t) of SAITHE in Division Vb, 1979-1993, as used in the assessment.

Country	1979	1980	1981	1982	1983	1984	1985
Belgia	-	-	-	-	-	-	-
Denmark	-	-	-	-	-	-	-
Faroe Islands							
Vb	22003	23810	29682	30808	38963	54344	42874
IIa$_4$	-	-	-	-	-	-	-
France	2974	1110	258	130	180	243	839
German Dem.Rep.	-	-	-	-	-	-	31
Germany Fed.Rep	581	197	20	19	28	73	227
Netherlands	-	-	-	-	-	-	-
Norway	1137	62	134	15	5	5	-
UK (Eng. & W.)	190	13	-	-	-	-	4
UK (Scotland)	361	38	9	1	-	-	630
USSR	-	-	-	-	-	-	-
Total	27246	25230	30103	30973	39176	54665	44605

Country	1986	1987	1988	1989	1990	1991	1992	1993 [1]
Belgia	-	-	-	-	-	5	-	-
Denmark	21	255	94	-	2	-	-	-
Faroe Islands								
Vb	40139	39301	44402	43624	59821	53321	35979	32443
IIa$_4$	-	-	258	269	988	963	165	
France	87	153	313	473	626	283	1999	9
German Dem.Rep.	-	-	-	9	-			
Germany Fed.Rep	105	49	74	20	15	32	5	2
Netherlands	-	-	-	22	67	65 [1]	-	-
Norway	24	14	52	51	46	103	34	38
UK (Eng. & W.)	-	108	-	-	-	5	74	83
UK (Scotland)	1340	140	92	9	33	79	98	53
USSR/Russia [2]	-	-	-	-	30	7	12	11
Total	41716	40020	45285	44477	61628	54863	38366	32639

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

Table 2.5.3 Age distribution in catches of SAITHE in Division Vb, 1960-1993.

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

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

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

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
3,	684,	996,	488,	595,	614,	1191,	1445,	2857,	2714,	2515,
4,	1908,	850,	1540,	796,	1689,	2086,	6277,	3316,	1774,	6253,
5,	1506,	1708,	1201,	1364,	1116,	2294,	1558,	5585,	2588,	7075,
6,	617,	965,	1686,	792,	1095,	1414,	1478,	1005,	2742,	3478,
7,	572,	510,	806,	1192,	548,	1118,	899,	828,	1529,	1634,
8,	424,	407,	377,	473,	655,	589,	730,	469,	1305,	693,
9,	179,	306,	294,	217,	254,	580,	316,	326,	1017,	550,
10,	150,	201,	205,	190,	128,	239,	241,	164,	743,	403,
11,	100,	156,	156,	97,	89,	115,	86,	100,	330,	215,
12,	83,	120,	94,	75,	59,	100,	48,	54,	133,	103,
+gp,	91,	165,	131,	65,	128,	90,	84,	46,	77,	83,
TOTALNUM,	6314,	6384,	6978,	5856,	6375,	9816,	13162,	14750,	14952,	23002,
TONSLAND,	21893,	22181,	25563,	21319,	20387,	27437,	29110,	32706,	42186,	57574,
SOPCOF %,	99,	92,	98,	104,	102,	97,	98,	109,	99,	120,

Continued

Table 2.5.3 Continued

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	3504,	2062,	3178,	1609,	611,	287,	996,	411,	387,	2483,
4,	4126,	3361,	3217,	2937,	1743,	933,	877,	1804,	4076,	1103,
5,	4011,	3801,	1720,	2034,	1736,	1341,	720,	769,	994,	5052,
6,	2784,	1939,	1250,	1288,	548,	1033,	673,	932,	1114,	1343,
7,	1401,	1045,	877,	767,	373,	584,	726,	908,	380,	575,
8,	640,	714,	641,	708,	479,	414,	284,	734,	417,	339,
9,	368,	302,	468,	498,	466,	247,	212,	343,	296,	273,
10,	340,	192,	223,	338,	473,	473,	171,	192,	105,	98,
11,	197,	193,	141,	272,	407,	368,	196,	92,	88,	98,
12,	124,	126,	96,	129,	211,	206,	156,	128,	56,	99,
+gp,	141,	172,	191,	201,	324,	485,	630,	893,	846,	441,
TOTALNUM,	17636,	13907,	12002,	10781,	7371,	6371,	5641,	7206,	8759,	11904,
TONSLAND,	47188,	41578,	33067,	34835,	28135,	27246,	25230,	30103,	30973,	39176,
SOPCOF %,	113,	116,	107,	104,	100,	102,	99,	96,	96,	100,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
3,	368,	1224,	1167,	1581,	866,	451,	294,	1030,	548,	1281,
4,	11067,	3990,	1997,	5793,	2950,	5981,	3833,	5125,	4281,	2540,
5,	2359,	5583,	4473,	3827,	9555,	5300,	10120,	7452,	3860,	4562,
6,	4093,	1182,	3730,	2785,	2784,	7136,	9219,	5544,	2820,	1620,
7,	875,	1898,	953,	990,	1300,	793,	5070,	3487,	1445,	834,
8,	273,	273,	1077,	532,	621,	546,	477,	1630,	941,	479,
9,	161,	103,	245,	333,	363,	185,	123,	405,	645,	436,
10,	52,	38,	104,	81,	159,	83,	61,	238,	129,	239,
11,	65,	26,	67,	43,	27,	55,	60,	128,	66,	53,
12,	59,	72,	33,	5,	43,	10,	18,	77,	39,	33,
+gp,	194,	203,	125,	92,	17,	29,	61,	41,	75,	18,
TOTALNUM,	19566,	14592,	13971,	16062,	18685,	20569,	29336,	25157,	14849,	12095,
TONSLAND,	54665,	44605,	41716,	40020,	45285,	44477,	61561,	54863,	38366,	32639,
SOPCOF %,	100,	94,	95,	96,	99,	97,	98,	99,	105,	102,

Table 2.5.4 Mean weight at age in catches of SAITHE in Division Vb, 1960-1993.

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

Table 2 Catch weights at age (kg)

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

Table 2 Catch weights at age (kg)

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
3,	1.1750,	1.1810,	1.3610,	1.2730,	1.3020,	1.1880,	1.2440,	1.1010,	1.0430,	1.0880,
4,	2.0550,	2.1250,	2.0260,	1.7800,	1.7370,	1.6670,	1.4450,	1.3160,	1.4850,	1.4610,
5,	3.2660,	2.9410,	3.0550,	2.5340,	2.0360,	2.3020,	2.2490,	1.8180,	2.0550,	1.5820,
6,	4.2550,	4.0960,	3.6580,	3.5720,	3.1200,	2.8530,	2.8530,	2.9780,	2.8290,	2.2490,
7,	5.0380,	4.8780,	4.5850,	4.3680,	4.0490,	3.6730,	3.5150,	3.7020,	3.7910,	3.6870,
8,	5.6940,	5.9320,	5.5200,	5.3130,	5.1830,	5.0020,	4.4180,	4.2710,	4.1750,	4.3850,
9,	6.6620,	6.3210,	6.8370,	5.8120,	6.2380,	5.7140,	5.4440,	5.3880,	4.8080,	5.1280,
10,	6.8370,	7.2880,	7.2650,	6.5540,	7.5200,	6.4050,	5.7330,	5.9720,	5.2940,	5.2760,
11,	7.6860,	8.0740,	7.6620,	7.8060,	8.0490,	6.5540,	6.6620,	6.4900,	6.9480,	6.7270,
12,	8.3480,	7.8780,	8.1230,	7.5910,	8.6540,	7.5910,	7.3100,	7.1730,	6.7270,	7.3110,
+gp,	8.7520,	9.6490,	10.0130,	8.7940,	9.2950,	8.6380,	9.3130,	8.9810,	8.8750,	8.9240,
SOPCOFAC,	.9933,	.9220,	.9769,	1.0357,	1.0194,	.9663,	.9774,	1.0935,	.9931,	1.2036,

Continued

Table 2.5.4 Continued

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

Table 2 Catch weights at age (kg)

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	1.4300,	1.1140,	1.0880,	1.2230,	1.4930,	1.2200,	1.2300,	1.3100,	1.3370,	1.2080,
4,	1.5250,	1.6580,	1.6760,	1.6410,	2.3240,	1.8800,	2.2100,	2.1300,	1.8510,	2.0290,
5,	2.2070,	2.2600,	2.8780,	2.6600,	3.0680,	2.6200,	3.3200,	3.0000,	2.9510,	2.9650,
6,	2.5000,	3.1200,	3.0810,	3.7900,	3.7460,	3.4000,	4.2800,	3.8100,	3.5770,	4.1430,
7,	3.1200,	3.5570,	4.2870,	4.2390,	4.9130,	4.1800,	5.1600,	4.7500,	4.9270,	4.7240,
8,	4.6010,	4.0960,	4.3520,	5.5970,	4.3680,	4.9500,	6.4200,	5.2500,	6.2430,	5.9010,
9,	5.5590,	5.1280,	4.7900,	5.3500,	5.2760,	5.6900,	6.8700,	5.9500,	7.2320,	6.8110,
10,	5.7140,	6.0940,	5.9120,	5.9120,	5.8320,	6.3800,	7.0900,	6.4300,	7.2390,	7.0510,
11,	6.2590,	7.1960,	6.6190,	6.8370,	6.0530,	7.0200,	7.9300,	7.0000,	8.3460,	7.2480,
12,	6.8810,	7.7820,	6.6190,	6.7270,	6.7060,	7.6200,	8.0700,	7.4700,	8.3450,	8.2920,
+gp,	9.0040,	9.1960,	8.5350,	8.3380,	8.1420,	9.2060,	9.4990,	9.1760,	10.1530,	10.4500,
SOPCOFAC,	1.1296,	1.1607,	1.0681,	1.0442,	1.0048,	1.0219,	.9906,	.9564,	.9635,	.9997,

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
3,	1.4310,	1.4010,	1.7180,	1.6090,	1.5000,	1.3090,	1.2230,	1.2400,	1.2640,	1.4080,
4,	1.9530,	2.0320,	1.9860,	1.8350,	1.9750,	1.7350,	1.6330,	1.5860,	1.6020,	1.8060,
5,	2.4700,	2.9650,	2.6180,	2.3950,	1.9780,	1.9070,	1.8300,	1.8640,	2.0690,	2.3230,
6,	3.8500,	3.5960,	3.2770,	3.1820,	2.9370,	2.3730,	2.0520,	2.2110,	2.5540,	3.1310,
7,	5.1770,	5.3360,	4.1860,	4.0670,	3.7980,	3.8100,	2.8660,	2.6480,	3.0570,	3.7300,
8,	6.3470,	7.2020,	5.2890,	5.1490,	4.4190,	4.5670,	4.4740,	3.3800,	4.0780,	4.3940,
9,	7.8250,	6.9660,	6.0500,	5.5010,	5.1150,	5.5090,	5.4240,	4.8160,	5.0120,	5.2090,
10,	6.7460,	9.8620,	6.1500,	6.6260,	6.7120,	5.9720,	6.4690,	5.5160,	6.7680,	6.5400,
11,	8.6360,	10.6700,	9.5360,	6.3430,	8.0400,	6.9390,	6.3430,	6.4070,	7.7540,	8.4030,
12,	8.4670,	10.4610,	9.8230,	10.2450,	9.3640,	8.5430,	8.4180,	7.3950,	8.3030,	7.2750,
+gp,	10.5930,	12.4790,	10.3220,	10.2440,	8.0660,	10.4170,	8.2480,	8.3550,	8.2110,	9.5140,
SOPCOFAC,	.9991,	.9415,	.9488,	.9620,	.9939,	.9710,	.9800,	.9922,	1.0496,	1.0210,

Table 2.5.5 Proportion mature at age of SAITHE in Division Vb, 1960-1993. Values for 1983-1993 are observations made during the Faroese bottom trawl surveys. Please note that the 1988 values are averages of the observations in 1987 and 1989. In the period 1960-1982 the values are mean of the period 1983-1992.

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

Table 5 Proportion mature at age

YEAR,	1960,	1961,	1962,	1963,
AGE				
3,	.0400,	.0400,	.0400,	.0400,
4,	.2400,	.2400,	.2400,	.2400,
5,	.5500,	.5500,	.5500,	.5500,
6,	.8100,	.8100,	.8100,	.8100,
7,	.9200,	.9200,	.9200,	.9200,
8,	.9800,	.9800,	.9800,	.9800,
9,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
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,

Continued

Table 2.5.5 Continued

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

Table 5 Proportion mature at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0400,	.0000,
4,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.2400,	.1300,
5,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.4200,
6,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	1.0000,
7,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	.9200,	1.0000,
8,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	.9800,	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 5 Proportion mature at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
3,	.0000,	.0900,	.0400,	.2000,	.1000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.4300,	.1900,	.5000,	.2500,	.2200,	.1800,	.2000,	.2100,	.0600,	.2300,
5,	.8400,	.4100,	.8800,	.3600,	.5200,	.6700,	.5300,	.4600,	.3300,	.6200,
6,	.9700,	.8500,	.9400,	.7900,	.7500,	.7100,	.5600,	.7700,	.7700,	.8200,
7,	1.0000,	.9300,	1.0000,	1.0000,	.9100,	.8200,	.7500,	.8200,	.9200,	.9200,
8,	1.0000,	1.0000,	1.0000,	1.0000,	.9200,	.8300,	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 2.5.6 SAITHE in Division Vb. Effort (days fishing) and catch at age in numbers ('000) for eight Faroese pair trawlers in the category 'greater than 1000 HP' fishing in Division Vb for the period 1982-1993.

14:50 Tuesday, May 3, 1994 14

Saithe in the Faroes Grounds (Fishing Area Vb)

CUBATRAWLERS (code: FLT02)

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

Table 2.5.7 SAITHE in Division Vb. Fishing mortalities and statistics from the XSA tuning of the effort data series in Table 2.5.6.

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VPA Version 3.1 (MSDOS)

   7-May-94  19:12

Extended Survivors Analysis

Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

CPUE data from file /users/ifad/ifapwork/wg_109/sai_faro/FLEET.021


Data for    1 fleets over   34 years
Age range from    3 to   12


     Fleet,                 Alpha,    Beta
FLT02: CUBATRAWLERS     ,  .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   21 iterations
```

Regression weights

.193	.348	.515	.670	.798	.893	.954	.986	.998	1.000

Fishing mortalities

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	.016	.063	.021	.037	.022	.018	.016	.044	.040	.027
4	.497	.236	.139	.138	.090	.207	.205	.423	.260	.262
5	.350	.505	.452	.430	.355	.231	.645	.780	.663	.490
6	.574	.297	.768	.571	.649	.492	.803	.930	.789	.657
7	.631	.578	.416	.469	.578	.382	.801	.843	.671	.569
8	.405	.408	.782	.433	.614	.514	.418	.658	.573	.490
9	.668	.262	.804	.593	.600	.369	.204	.774	.598	.575
10	.372	.320	.460	.690	.640	.261	.198	.767	.606	.463
11	.189	.322	1.672	.350	.519	.476	.306	.824	.496	.541
12	.395	.330	.890	.501	.716	.367	.279	.822	.646	.497

$\overline{F}_{4-8} = 0.494$

Continued

Table 2.5.7 Continued

XSA population numbers

YEAR	AGE 3,	4,	5,	6,	7,	8,	9,	10,		
1984 ,	2.61E+04,	3.12E+04,	8.82E+03,	1.04E+04,	2.07E+03,	9.06E+02,	3.65E+02,	1.85E+02,	4.17E+02,	2.00E+02,
1985 ,	2.21E+04,	2.10E+04,	1.56E+04,	5.09E+03,	4.78E+03,	9.00E+02,	4.94E+02,	1.53E+02,	1.04E+02,	2.83E+02,
1986 ,	6.19E+04,	1.70E+04,	1.36E+04,	7.69E+03,	3.10E+03,	2.19E+03,	4.90E+02,	3.12E+02,	9.12E+01,	6.19E+01,
1987 ,	4.81E+04,	4.96E+04,	1.21E+04,	7.07E+03,	2.92E+03,	1.67E+03,	8.22E+02,	1.80E+02,	1.61E+02,	1.40E+01,
1988 ,	4.42E+04,	3.79E+04,	3.54E+04,	6.45E+03,	3.27E+03,	1.50E+03,	8.89E+02,	3.72E+02,	7.37E+01,	9.29E+01,
1989 ,	2.84E+04,	3.54E+04,	2.84E+04,	2.03E+04,	2.76E+03,	1.50E+03,	6.63E+02,	3.99E+02,	1.61E+02,	3.59E+01,
1990 ,	2.04E+04,	2.28E+04,	2.35E+04,	1.85E+04,	1.02E+04,	1.54E+03,	7.36E+02,	3.75E+02,	2.52E+02,	8.17E+01,
1991 ,	2.63E+04,	1.64E+04,	1.52E+04,	1.01E+04,	6.77E+03,	3.74E+03,	8.31E+02,	4.91E+02,	2.52E+02,	1.52E+02,
1992 ,	1.55E+04,	2.06E+04,	8.80E+03,	5.71E+03,	3.27E+03,	2.39E+03,	1.58E+03,	3.14E+02,	1.87E+02,	9.06E+01,
1993 ,	5.31E+04,	1.22E+04,	1.30E+04,	3.72E+03,	2.13E+03,	1.37E+03,	1.10E+03,	7.13E+02,	1.40E+02,	9.31E+01,

Estimated population abundance at 1st Jan 1994

,	.00E+00,	4.23E+04,	7.68E+03,	6.53E+03,	1.58E+03,	9.85E+02,	6.86E+02,	5.07E+02,	3.68E+02,	6.68E+01,

Taper weighted geometric mean of the VPA populations:

,	3.10E+04,	2.31E+04,	1.66E+04,	8.34E+03,	3.79E+03,	1.77E+03,	8.32E+02,	3.64E+02,	1.62E+02,	7.75E+01,

Standard error of the weighted Log(VPA populations) :

,	.4832,	.4642,	.4789,	.6053,	.5483,	.4112,	.3825,	.4476,	.4632,	.7831,

Log catchability residuals.

Fleet : FLT02: CUBATRAWLERS

Age ,	1982,	1983
3 ,	99.99,	.69
4 ,	.27,	-.41
5 ,	-.42,	-.10
6 ,	.53,	-.14
7 ,	-.10,	-.17
8 ,	-.43,	.50
9 ,	-.57,	1.05
10 ,	-.03,	-.98
11 ,	-.73,	.39
12 ,	-.27,	.64

Age ,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3 ,	.08,	.80,	.26,	.59,	.08,	.37,	-.29,	-.13,	-.90,	.04
4 ,	.90,	.28,	-.11,	-.39,	-.67,	.31,	-.30,	.26,	-.26,	.61
5 ,	-.51,	.63,	.35,	.07,	-.24,	-.54,	.06,	.14,	-.09,	.22
6 ,	-.10,	-.30,	.34,	.06,	.17,	-.23,	-.04,	.02,	-.15,	.15
7 ,	.23,	.25,	-.05,	.05,	.05,	-.33,	.09,	.06,	-.20,	.17
8 ,	-.20,	-.03,	.67,	.11,	.13,	-.03,	-.41,	.01,	-.32,	.21
9 ,	.04,	-.28,	.91,	.40,	.39,	-.22,	-.93,	-.40,	.12,	.33
10 ,	-1.26,	-.76,	.24,	.49,	-.16,	-.32,	-1.12,	.06,	.10,	.20
11 ,	-1.17,	.32,	1.32,	.05,	-.67,	.29,	-.68,	.43,	-.13,	.34
12 ,	.41,	.02,	1.00,	.25,	-.82,	.12,	-.54,	.29,	-.25,	.37

Continued

Table 2.5.7 Continued

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,	-13.2478,	-10.8821,	-9.9696,	-9.5900,	-9.7237,	-9.8792,	-10.0383,	-10.0383,	-10.0383,	-10.0383,
S.E(Log q),	.4931,	.4575,	.3146,	.1829,	.1830,	.3024,	.5448,	.5761,	.6095,	.5190,

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,	.61,	1.879,	12.11,	.81,	11,	.25,	-13.25,
4,	2.07,	-1.434,	11.77,	.25,	12,	.88,	-10.88,
5,	1.36,	-1.021,	10.06,	.60,	12,	.43,	-9.97,
6,	1.13,	-.975,	9.66,	.91,	12,	.21,	-9.59,
7,	.93,	.498,	9.63,	.91,	12,	.18,	-9.72,
8,	1.02,	-.066,	9.93,	.64,	12,	.34,	-9.88,
9,	.90,	.180,	9.71,	.38,	12,	.53,	-10.04,
10,	.88,	.268,	9.68,	.47,	12,	.52,	-10.21,
11,	1.39,	-.507,	11.89,	.24,	12,	.90,	-10.00,
12,	1.07,	-.245,	10.44,	.67,	12,	.60,	-10.02,

Terminal year survivor and F summaries :

Age 3 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
FLT02: CUBATRAWLERS ,	44094.,	.532,	.000,	.00,	1,	.469,	.026
F shrinkage mean ,	40795.,	.50,,,,				.531,	.028

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
42310.,	.36,	.06,	2,	.156,	.027

Continued

Table 2.5.7 Continued

Age 4 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
FLT02: CUBATRAWLERS ,	7141.,	.411,	.756,	1.84,	2,	.597,	.279
F shrinkage mean ,	8540.,	.50,,,,				.403,	.238

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7675.,	.32,	.42,	3,	1.325,	.262

Age 5 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
FLT02: CUBATRAWLERS ,	6896.,	.332,	.149,	.45,	3,	.694,	.469
F shrinkage mean ,	5781.,	.50,,,,				.306,	.539

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6534.,	.28,	.12,	4,	.418,	.490

Age 6 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
FLT02: CUBATRAWLERS ,	1689.,	.325,	.084,	.26,	4,	.703,	.625
F shrinkage mean ,	1338.,	.50,,,,				.297,	.740

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1576.,	.27,	.09,	5,	.322,	.657

Age 7 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
FLT02: CUBATRAWLERS ,	1061.,	.303,	.081,	.27,	5,	.731,	.537
F shrinkage mean ,	805.,	.50,,,,				.269,	.661

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
985.,	.26,	.09,	6,	.344,	.569

Continued

Table 2.5.7 Continued

Age 8 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
FLT02: CUBATRAWLERS ,	728.,	.293,	.081,	.28,	6,	.744,	.467
F shrinkage mean ,	577.,	.50,,,,				.256,	.560

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
686.,	.25,	.08,	7,	.315,	.490

Age 9 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
FLT02: CUBATRAWLERS ,	469.,	.365,	.121,	.33,	7,	.652,	.611
F shrinkage mean ,	588.,	.50,,,,				.348,	.513

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
507.,	.29,	.10,	8,	.352,	.575

Age 10 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
FLT02: CUBATRAWLERS ,	391.,	.404,	.054,	.13,	8,	.605,	.440
F shrinkage mean ,	335.,	.50,,,,				.395,	.498

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
368.,	.31,	.05,	9,	.166,	.463

Age 11 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
FLT02: CUBATRAWLERS ,	65.,	.461,	.112,	.24,	9,	.540,	.553
F shrinkage mean ,	69.,	.50,,,,				.460,	.528

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
67.,	.34,	.08,	10,	.233,	.541

Continued

Table 2.5.7 Continued

Age 12 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
FLT02: CUBATRAWLERS ,	49.,	.440,	.116,	.26,	10,	.563,	.472
F shrinkage mean ,	43.,	.50,,,,				.437,	.531

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
46.,	.33,	.09,	11,	.267,	.497

Table 2.5.8 Fishing mortality at age for SAITHE in Division Vb, 1960-1993.

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,
AGE				
3,	.1727,	.0234,	.0458,	.0335,
4,	.0577,	.0544,	.0896,	.0352,
5,	.1054,	.0959,	.1179,	.0746,
6,	.1494,	.1272,	.1347,	.1085,
7,	.1046,	.1009,	.1251,	.1560,
8,	.1163,	.0742,	.0819,	.1221,
9,	.0634,	.0869,	.0988,	.1491,
10,	.1304,	.0424,	.1143,	.1688,
11,	.0630,	.1005,	.0469,	.1313,
12,	.0859,	.0768,	.0869,	.1503,
+gp,	.0859,	.0768,	.0869,	.1503,
FBAR 4- 8,	.1067,	.0905,	.1098,	.0993,

Table 8 Fishing mortality (F) at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
3,	.0504,	.0500,	.0250,	.0272,	.0324,	.0341,	.0499,	.0881,	.0923,	.1222,
4,	.1383,	.0816,	.1018,	.0517,	.1006,	.1470,	.2530,	.1546,	.0724,	.3177,
5,	.2155,	.1769,	.1587,	.1233,	.0952,	.1931,	.1560,	.3751,	.1737,	.4554,
6,	.1882,	.2085,	.2657,	.1491,	.1377,	.1679,	.1835,	.1427,	.3188,	.3730,
7,	.2143,	.2346,	.2698,	.3049,	.1461,	.2034,	.1531,	.1483,	.3355,	.3192,
8,	.2425,	.2328,	.2727,	.2511,	.2735,	.2313,	.1984,	.1114,	.3678,	.2494,
9,	.1515,	.2769,	.2630,	.2490,	.2073,	.4158,	.1870,	.1275,	.3743,	.2599,
10,	.1854,	.2540,	.3025,	.2711,	.2278,	.3075,	.3034,	.1396,	.4755,	.2481,
11,	.1534,	.2995,	.3204,	.2283,	.1962,	.3296,	.1722,	.1980,	.4594,	.2423,
12,	.1641,	.2783,	.2970,	.2508,	.2114,	.3532,	.2219,	.1556,	.4395,	.2514,
+gp,	.1641,	.2783,	.2970,	.2508,	.2114,	.3532,	.2219,	.1556,	.4395,	.2514,
FBAR 4- 8,	.1997,	.1869,	.2138,	.1760,	.1506,	.1886,	.1888,	.1864,	.2536,	.3429,

Continued

Table 2.5.8 Continued

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

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Table 8 Fishing mortality (F) at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	.2164,	.1454,	.1931,	.1479,	.0863,	.0363,	.0923,	.0138,	.0288,	.0695,
4,	.3018,	.3328,	.3541,	.2750,	.2368,	.1841,	.1486,	.2408,	.1842,	.1072,
5,	.3467,	.5047,	.2834,	.3977,	.2594,	.2892,	.2114,	.1883,	.2024,	.3655,
6,	.3246,	.2806,	.3061,	.3562,	.1752,	.2424,	.2301,	.4655,	.4566,	.4625,
7,	.2516,	.1934,	.1972,	.3126,	.1641,	.2867,	.2685,	.5558,	.3499,	.4539,
8,	.1983,	.1961,	.1741,	.2420,	.3284,	.2768,	.2196,	.4787,	.5395,	.6097,
9,	.2030,	.1351,	.1905,	.1991,	.2486,	.2808,	.2224,	.4499,	.3601,	.8484,
10,	.2537,	.1548,	.1398,	.2047,	.2951,	.4306,	.3203,	.3224,	.2388,	.1927,
11,	.1841,	.2234,	.1627,	.2531,	.4065,	.3948,	.3180,	.2852,	.2394,	.3675,
12,	.2146,	.1718,	.1650,	.2200,	.3186,	.3711,	.2885,	.3547,	.2815,	.4648,
+gp,	.2146,	.1718,	.1650,	.2200,	.3186,	.3711,	.2885,	.3547,	.2815,	.4648,
FBAR 4- 8,	.2846,	.3015,	.2630,	.3167,	.2328,	.2558,	.2157,	.3858,	.3465,	.3997,

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
3,	.0157,	.0631,	.0211,	.0370,	.0219,	.0177,	.0161,	.0442,	.0399,	.0270,	.0370,
4,	.4968,	.2357,	.1391,	.1382,	.0898,	.2069,	.2054,	.4231,	.2604,	.2619,	.3152,
5,	.3502,	.5049,	.4525,	.4299,	.3547,	.2310,	.6445,	.7795,	.6627,	.4897,	.6440,
6,	.5739,	.2966,	.7680,	.5712,	.6486,	.4917,	.8032,	.9304,	.7888,	.6575,	.7922,
7,	.6309,	.5780,	.4156,	.4693,	.5784,	.3821,	.8010,	.8428,	.6711,	.5687,	.6942,
8,	.4052,	.4081,	.7817,	.4328,	.6140,	.5138,	.4184,	.6581,	.5727,	.4897,	.5735,
9,	.6678,	.2616,	.8040,	.5934,	.6003,	.3688,	.2043,	.7738,	.5979,	.5753,	.6490,
10,	.3722,	.3200,	.4602,	.6901,	.6396,	.2610,	.1980,	.7672,	.6059,	.4626,	.6119,
11,	.1890,	.3222,	1.6720,	.3497,	.5186,	.4755,	.3056,	.8238,	.4956,	.5412,	.6202,
12,	.3953,	.3305,	.8898,	.5009,	.7161,	.3674,	.2789,	.8217,	.6462,	.4971,	.6550,
+gp,	.3953,	.3305,	.8898,	.5009,	.7161,	.3674,	.2789,	.8217,	.6462,	.4971,	
FBAR 4- 8,	.4914,	.4047,	.5114,	.4083,	.4571,	.3651,	.5745,	.7268,	.5911,	.4935,	

Table 2.5.9

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

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

YEAR,	1960,	1961,	1962,	1963,
AGE				
3,	11479,	8736,	13889,	20621,
4,	7553,	7908,	6987,	10862,
5,	5060,	5837,	6131,	5230,
6,	3527,	3729,	4342,	4462,
7,	2703,	2487,	2688,	3107,
8,	2113,	1993,	1841,	1942,
9,	2841,	1540,	1515,	1389,
10,	723,	2183,	1156,	1124,
11,	525,	520,	1713,	844,
12,	376,	403,	385,	1338,
+gp,	1018,	819,	1006,	828,
TOTAL,	37919,	36156,	41653,	51747,

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
3,	15395,	22572,	21873,	24471,	21280,	39228,	32837,	37442,	34010,	24161,
4,	16327,	11985,	17579,	17467,	19497,	16867,	31039,	25577,	28070,	25389,
5,	8586,	11641,	9044,	12999,	13580,	14434,	11922,	19733,	17940,	21376,
6,	3974,	5667,	7986,	6318,	9409,	10109,	9742,	8351,	11103,	12347,
7,	3277,	2695,	3766,	5012,	4456,	6712,	6997,	6639,	5928,	6609,
8,	2176,	2166,	1745,	2354,	3025,	3152,	4484,	4915,	4686,	3470,
9,	1407,	1398,	1405,	1088,	1500,	1884,	2048,	3011,	3600,	2656,
10,	979,	990,	868,	884,	694,	998,	1018,	1391,	2170,	2027,
11,	777,	666,	629,	525,	552,	453,	601,	615,	990,	1104,
12,	606,	546,	404,	374,	342,	371,	267,	414,	413,	512,
+gp,	662,	746,	560,	322,	738,	332,	464,	351,	237,	410,
TOTAL,	54168,	61073,	65859,	71814,	75073,	94540,	101418,	108439,	109147,	100062,

Continued

Table 2.5.9 Continued

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	19901,	16842,	20002,	12935,	8164,	8888,	12479,	33162,	15080,	40900,
4,	17506,	13123,	11923,	13500,	9134,	6132,	7017,	9315,	26779,	11996,
5,	15129,	10599,	7703,	6851,	8396,	5901,	4176,	4952,	5995,	18236,
6,	11100,	8757,	5238,	4750,	3769,	5303,	3618,	2767,	3358,	4009,
7,	6961,	6569,	5415,	3158,	2724,	2590,	3407,	2353,	1422,	1742,
8,	3932,	4432,	4432,	3640,	1891,	1892,	1592,	2133,	1105,	821,
9,	2214,	2641,	2982,	3049,	2340,	1115,	1175,	1046,	1082,	528,
10,	1677,	1480,	1889,	2018,	2046,	1494,	689,	770,	546,	618,
11,	1295,	1065,	1038,	1345,	1347,	1247,	795,	410,	457,	352,
12,	710,	882,	697,	722,	855,	734,	688,	474,	252,	294,
+gp,	803,	1199,	1382,	1119,	1303,	1715,	2760,	3280,	3787,	1299,
TOTAL,	81227,	67587,	62702,	53087,	41968,	37012,	38396,	60662,	59862,	80794,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	GMST
AGE												
3,	26056,	22106,	61859,	48093,	44150,	28367,	20377,	26343,	15484,	53092,	0,	219
4,	31240,	21000,	16991,	49590,	37945,	35364,	22817,	16417,	20636,	12182,	42310,	162
5,	8823,	15563,	13583,	12104,	35359,	28397,	23542,	15213,	8804,	13022,	7675,	108
6,	10359,	5089,	7690,	7073,	6447,	20304,	18454,	10117,	5712,	3716,	6534,	65
7,	2067,	4778,	3097,	2921,	3271,	2760,	10167,	6767,	3267,	2125,	1576,	37
8,	906,	900,	2195,	1674,	1496,	1502,	1542,	3736,	2385,	1367,	985,	22
9,	365,	494,	490,	822,	889,	663,	736,	831,	1584,	1101,	686,	13
10,	185,	153,	312,	180,	372,	399,	375,	491,	314,	713,	507,	8
11,	417,	104,	91,	161,	74,	161,	252,	252,	187,	140,	368,	5
12,	200,	283,	62,	14,	93,	36,	82,	152,	91,	93,	67,	3
+gp,	651,	792,	231,	256,	36,	103,	275,	80,	172,	50,	71,	
TOTAL,	81269,	71263,	106601,	122888,	130132,	118056,	98618,	80399,	58636,	87602,	60779,	

Table 2.5.10

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

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

YEAR,	1960,	1961,	1962,	1963,
AGE				
3,	527,	500,	707,	1056,
4,	4593,	4369,	3429,	5728,
5,	9471,	10749,	11105,	9239,
6,	12249,	12948,	14740,	16509,
7,	12983,	11734,	12726,	14452,
8,	12705,	12025,	10202,	11290,
9,	18559,	10874,	9803,	8692,
10,	5806,	15859,	7752,	8992,
11,	4804,	3898,	12248,	6133,
12,	3323,	3308,	3042,	11444,
+gp,	10401,	8113,	9505,	7745,
TOTSPBIO,	95422,	94374,	95260,	101279,

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,
AGE										
3,	724,	1066,	1191,	1246,	1108,	1864,	1634,	1649,	1419,	1051,
4,	8053,	6112,	8548,	7462,	8128,	6748,	10764,	8078,	10004,	8903,
5,	15423,	18830,	15195,	18117,	15207,	18275,	14747,	19731,	20277,	18600,
6,	13697,	18801,	23661,	18279,	23777,	23361,	22513,	20145,	25442,	22492,
7,	15191,	12097,	15887,	20143,	16598,	22682,	22627,	22611,	20675,	22418,
8,	12145,	12590,	9442,	12258,	15366,	15452,	19414,	20573,	19174,	14911,
9,	9375,	8839,	9605,	6323,	9354,	10766,	11148,	16221,	17308,	13620,
10,	6697,	7217,	6306,	5795,	5221,	6392,	5835,	8305,	11488,	10695,
11,	5974,	5379,	4818,	4099,	4443,	2967,	4002,	3993,	6880,	7429,
12,	5060,	4301,	3284,	2837,	2961,	2820,	1949,	2970,	2780,	3744,
+gp,	5791,	7197,	5604,	2831,	6864,	2866,	4321,	3154,	2105,	3661,
TOTSPBIO,	98128,	102429,	103542,	99390,	109030,	114193,	118955,	127431,	137550,	127523,

Continued

Table 2.5.10 Continued

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	1138,	750,	870,	633,	488,	434,	614,	1738,	806,	0,
4,	6407,	5222,	4796,	5317,	5095,	2767,	3722,	4762,	11896,	3164,
5,	18364,	13175,	12193,	10023,	14167,	8504,	7625,	8170,	9729,	22710,
6,	22477,	22132,	13073,	14583,	11435,	14604,	12544,	8540,	9730,	16607,
7,	19982,	21496,	21359,	12315,	12311,	9958,	16174,	10284,	6448,	8227,
8,	17731,	17790,	18904,	19967,	8096,	9180,	10015,	10972,	6762,	4843,
9,	12307,	13541,	14286,	16312,	12345,	6345,	8071,	6225,	7824,	3593,
10,	9581,	9017,	11166,	11933,	11930,	9532,	4888,	4951,	3954,	4357,
11,	8105,	7665,	6868,	9192,	8151,	8753,	6306,	2868,	3812,	2553,
12,	4883,	6864,	4617,	4857,	5731,	5595,	5551,	3538,	2105,	2440,
+gp,	7227,	11022,	11792,	9330,	10611,	15791,	26218,	30096,	38446,	13573,
TOTSPBIO,	128204,	128672,	119924,	114461,	100360,	91463,	101727,	92147,	101513,	82067,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
3,	0,	2787,	4251,	15476,	6623,	0,	0,	0,	0,	0,
4,	26235,	8108,	16873,	22749,	16487,	11044,	7452,	5468,	1984,	5060,
5,	18307,	18919,	31293,	10436,	36369,	36283,	22833,	13044,	6011,	18755,
6,	38687,	15557,	23689,	17781,	14202,	34209,	21206,	17224,	11233,	9540,
7,	10699,	23711,	12966,	11881,	11306,	8622,	21853,	14694,	9188,	7292,
8,	5748,	6484,	11607,	8618,	6082,	5693,	6899,	12628,	9727,	6007,
9,	2858,	3444,	2965,	4523,	4547,	3652,	3990,	4001,	7939,	5737,
10,	1247,	1512,	1917,	1190,	2496,	2385,	2428,	2708,	2123,	4665,
11,	3603,	1113,	869,	1021,	593,	1115,	1597,	1615,	1447,	1178,
12,	1691,	2958,	608,	144,	870,	307,	688,	1123,	752,	677,
+gp,	6898,	9878,	2381,	2617,	292,	1077,	2270,	666,	1412,	478,
TOTSPBIO,	115974,	94472,	109418,	96437,	99867,	104386,	91216,	73171,	51817,	59390,

Table 2.5.11 Summary of population statistics for SAITHE in Division Vb, 1960-1990.

Run title : Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFRXSA021)

At 7-May-94 19:13

Table 16 Summary (without SOP correction)

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 8,
1960,	11479,	134629,	95422,	11845,	.1241,	.1067,
1961,	8736,	133298,	94374,	9592,	.1016,	.0905,
1962,	13889,	136950,	95260,	10454,	.1097,	.1098,
1963,	20621,	157674,	101279,	12693,	.1253,	.0993,
1964,	15395,	158394,	98129,	21893,	.2231,	.1997,
1965,	22572,	168502,	102429,	22181,	.2166,	.1869,
1966,	21873,	178745,	103542,	25563,	.2469,	.2138,
1967,	24471,	174037,	99390,	21319,	.2145,	.1760,
1968,	21280,	181142,	109030,	20387,	.1870,	.1506,
1969,	39228,	203020,	114193,	27437,	.2403,	.1886,
1970,	32837,	211968,	118955,	29110,	.2447,	.1888,
1971,	37442,	215841,	127431,	32706,	.2567,	.1864,
1972,	34010,	228031,	137551,	42186,	.3067,	.2536,
1973,	24161,	203697,	127523,	57574,	.4515,	.3429,
1974,	19901,	198210,	128204,	47188,	.3681,	.2846,
1975,	16842,	181422,	128672,	41578,	.3231,	.3015,
1976,	20002,	171287,	119924,	33067,	.2757,	.2630,
1977,	12935,	159584,	114461,	34835,	.3043,	.3167,
1978,	8164,	143704,	100360,	28135,	.2803,	.2328,
1979,	8888,	122071,	91463,	27246,	.2979,	.2558,
1980,	12479,	139040,	101727,	25230,	.2480,	.2157,
1981,	33162,	158737,	92146,	30103,	.3267,	.3858,
1982,	15080,	169481,	101513,	30973,	.3051,	.3465,
1983,	40900,	184012,	82068,	39176,	.4774,	.3997,
1984,	26056,	192720,	115974,	54665,	.4714,	.4914,
1985,	22106,	188975,	94472,	44605,	.4721,	.4047,
1986,	61859,	234093,	109418,	41716,	.3813,	.5114,
1987,	48093,	249871,	96437,	40020,	.4150,	.4083,
1988,	44150,	257876,	99867,	45285,	.4535,	.4571,
1989,	28367,	226732,	104386,	44477,	.4261,	.3651,
1990,	20377,	190139,	91216,	61561,	.6749,	.5745,
1991,	26343,	150090,	73171,	54863,	.7498,	.7268,
1992,	15484,	118824,	51817,	38366,	.7404,	.5911,
1993,	53092,	165307,	59390,	32639,	.5496,	.4935,
Arith. Mean ,	25361,	179062,	102388,	33549,	.3409,	.3094,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 2.5.12

Saithe in the Faroes Grounds (Fishing Area Vb)

Prediction with management option table: Input data

Year: 1994								
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	31000.000	0.2000	0.0000	0.0000	0.0000	1.304	0.0270	1.304
4	24705.000	0.2000	0.2300	0.0000	0.0000	1.797	0.2619	1.797
5	15366.000	0.2000	0.6200	0.0000	0.0000	2.207	0.4897	2.207
6	6534.000	0.2000	0.8200	0.0000	0.0000	2.908	0.6575	2.908
7	1576.000	0.2000	0.9200	0.0000	0.0000	4.007	0.5687	4.007
8	985.000	0.2000	1.0000	0.0000	0.0000	4.632	0.4893	4.632
9	686.000	0.2000	1.0000	0.0000	0.0000	5.265	0.5753	5.265
10	507.000	0.2000	1.0000	0.0000	0.0000	7.568	0.4626	7.568
11	368.000	0.2000	1.0000	0.0000	0.0000	7.521	0.5412	7.521
12	67.000	0.2000	1.0000	0.0000	0.0000	7.658	0.4971	7.658
13+	71.000	0.2000	1.0000	0.0000	0.0000	8.988	0.4971	8.988
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1995								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	31000.000	0.2000	0.0000	0.0000	0.0000	1.304	0.0270	1.304
4	.	0.2000	0.1700	0.0000	0.0000	1.740	0.2619	1.740
5	.	0.2000	0.4700	0.0000	0.0000	2.198	0.4897	2.198
6	.	0.2000	0.7900	0.0000	0.0000	2.785	0.6575	2.785
7	.	0.2000	0.8900	0.0000	0.0000	3.740	0.5687	3.740
8	.	0.2000	1.0000	0.0000	0.0000	4.887	0.4893	4.887
9	.	0.2000	1.0000	0.0000	0.0000	5.363	0.5753	5.363
10	.	0.2000	1.0000	0.0000	0.0000	7.371	0.4626	7.371
11	.	0.2000	1.0000	0.0000	0.0000	7.521	0.5412	7.521
12	.	0.2000	1.0000	0.0000	0.0000	7.658	0.4971	7.658
13+	.	0.2000	1.0000	0.0000	0.0000	8.988	0.4971	8.988
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	31000.000	0.2000	0.0000	0.0000	0.0000	1.304	0.0270	1.304
4	.	0.2000	0.1700	0.0000	0.0000	1.740	0.2619	1.740
5	.	0.2000	0.4700	0.0000	0.0000	2.137	0.4897	2.137
6	.	0.2000	0.7900	0.0000	0.0000	2.776	0.6575	2.776
7	.	0.2000	0.8900	0.0000	0.0000	3.594	0.5687	3.594
8	.	0.2000	1.0000	0.0000	0.0000	4.642	0.4893	4.642
9	.	0.2000	1.0000	0.0000	0.0000	5.469	0.5753	5.469
10	.	0.2000	1.0000	0.0000	0.0000	8.258	0.4626	8.258
11	.	0.2000	1.0000	0.0000	0.0000	7.521	0.5412	7.521
12	.	0.2000	1.0000	0.0000	0.0000	7.658	0.4971	7.658
13+	.	0.2000	1.0000	0.0000	0.0000	8.988	0.4971	8.988
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SAIFR023
Date and time: 10MAY94:19:02

Table 2.5.13

18:22 Tuesday, May 10, 1994 4

Saithe in the Faroes Grounds (Fishing Area Vb)

Prediction with management option table

Year: 1994					Year: 1995					Year: 1996	
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
1.0988	0.5422	159978	68558	42000	0.0000	0.0000	158649	59607	0	205043	95499
.	.	.	.	.	0.1000	0.0493	.	59607	4754	199667	91310
.	.	.	.	.	0.2000	0.0987	.	59607	9290	194545	87333
.	.	.	.	.	0.3000	0.1480	.	59607	13621	189665	83558
.	.	.	.	.	0.4000	0.1974	.	59607	17757	185014	79974
.	.	.	.	.	0.5000	0.2467	.	59607	21707	180580	76570
.	.	.	.	.	0.6000	0.2961	.	59607	25480	176352	73338
.	.	.	.	.	0.7000	0.3454	.	59607	29087	172319	70267
.	.	.	.	.	0.8000	0.3947	.	59607	32534	168472	67349
.	.	.	.	.	0.9000	0.4441	.	59607	35831	164800	64576
.	.	.	.	.	1.0000	0.4934	.	59607	38983	161295	61941
.	.	.	.	.	1.1000	0.5428	.	59607	42000	157949	59436
.	.	.	.	.	1.2000	0.5921	.	59607	44887	154753	57055
.	.	.	.	.	1.3000	0.6414	.	59607	47650	151700	54790
.	.	.	.	.	1.4000	0.6908	.	59607	50296	148783	52635
.	.	.	.	.	1.5000	0.7401	.	59607	52831	145995	50586
.	.	.	.	.	1.6000	0.7895	.	59607	55260	143329	48636
.	.	.	.	.	1.7000	0.8388	.	59607	57587	140779	46780
.	.	.	.	.	1.8000	0.8882	.	59607	59819	138340	45014
.	.	.	.	.	1.9000	0.9375	.	59607	61959	136006	43332
.	.	.	.	.	2.0000	0.9868	.	59607	64012	133772	41731
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : SAIFR023
Date and time : 10MAY94:19:02
Computation of ref. F: Simple mean, age 4 - 8
Basis for 1994 : TAC constraints

Table 2.5.14

09:12 Tuesday, May 10, 1994 1

Saithe in the Faroes Grounds (Fishing Area Vb)

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	0.0626	0.0000	0.0000	1.290	0.0270	1.304
4	.	0.2000	0.2573	0.0000	0.0000	1.860	0.2619	1.797
5	.	0.2000	0.5597	0.0000	0.0000	2.572	0.4897	2.207
6	.	0.2000	0.8142	0.0000	0.0000	3.365	0.6575	2.908
7	.	0.2000	0.9201	0.0000	0.0000	4.246	0.5687	4.007
8	.	0.2000	0.9797	0.0000	0.0000	5.143	0.4893	4.632
9	.	0.2000	1.0000	0.0000	0.0000	5.905	0.5753	5.265
10	.	0.2000	1.0000	0.0000	0.0000	6.622	0.4626	7.568
11	.	0.2000	1.0000	0.0000	0.0000	7.450	0.5412	7.521
12	.	0.2000	1.0000	0.0000	0.0000	8.029	0.4971	7.658
13+	.	0.2000	1.0000	0.0000	0.0000	8.504	0.4971	8.988
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SAIFR024
Date and time: 10MAY94:09:21

Table 2.5.15

Saithe in the Faroes Grounds (Fishing Area Vb)

Saithe in the Faroes 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	22774.524	3.531	19141.784	3.531	19141.784
0.0250	0.0123	0.047	219.441	5.282	21097.244	3.302	17484.592	3.302	17484.592
0.0500	0.0247	0.089	402.260	5.073	19634.467	3.100	16041.456	3.100	16041.456
0.0750	0.0370	0.126	555.336	4.888	18350.516	2.920	14776.710	2.920	14776.710
0.1000	0.0493	0.160	684.072	4.721	17216.958	2.759	13661.938	2.759	13661.938
0.1250	0.0617	0.190	792.756	4.571	16210.885	2.615	12674.240	2.615	12674.240
0.1500	0.0740	0.217	884.818	4.436	15313.644	2.485	11794.981	2.485	11794.981
0.1750	0.0863	0.242	963.029	4.312	14509.916	2.367	11008.849	2.367	11008.849
0.2000	0.0987	0.265	1029.642	4.199	13787.007	2.259	10303.164	2.259	10303.164
0.2250	0.1110	0.286	1086.500	4.096	13134.327	2.161	9667.348	2.161	9667.348
0.2500	0.1234	0.305	1135.122	4.000	12542.974	2.071	9092.508	2.071	9092.508
0.2750	0.1357	0.323	1176.765	3.912	12005.422	1.988	8571.129	1.988	8571.129
0.3000	0.1480	0.339	1212.473	3.831	11515.267	1.912	8096.817	1.912	8096.817
0.3250	0.1604	0.354	1243.122	3.755	11067.035	1.841	7664.108	1.841	7664.108
0.3500	0.1727	0.369	1269.443	3.685	10656.020	1.775	7268.305	1.775	7268.305
0.3750	0.1850	0.382	1292.056	3.619	10278.159	1.715	6905.354	1.715	6905.354
0.4000	0.1974	0.394	1311.483	3.558	9929.927	1.658	6571.739	1.658	6571.739
0.4250	0.2097	0.406	1328.166	3.500	9608.257	1.605	6264.401	1.605	6264.401
0.4500	0.2220	0.417	1342.483	3.446	9310.468	1.556	5980.667	1.556	5980.667
0.4750	0.2344	0.427	1354.755	3.396	9034.207	1.509	5718.192	1.509	5718.192
0.5000	0.2467	0.437	1365.258	3.348	8777.403	1.466	5474.914	1.466	5474.914
0.5250	0.2590	0.446	1374.228	3.303	8538.230	1.425	5249.012	1.425	5249.012
0.5500	0.2714	0.455	1381.868	3.260	8315.068	1.386	5038.874	1.386	5038.874
0.5750	0.2837	0.463	1388.352	3.219	8106.479	1.350	4843.069	1.350	4843.069
0.6000	0.2961	0.471	1393.832	3.181	7911.184	1.316	4660.324	1.316	4660.324
0.6250	0.3084	0.478	1398.437	3.144	7728.040	1.283	4489.503	1.283	4489.503
0.6500	0.3207	0.485	1402.282	3.110	7556.022	1.253	4329.588	1.253	4329.588
0.6750	0.3331	0.492	1405.464	3.077	7394.214	1.223	4179.667	1.223	4179.667
0.7000	0.3454	0.499	1408.068	3.045	7241.791	1.196	4038.921	1.196	4038.921
0.7250	0.3577	0.505	1410.169	3.015	7098.008	1.169	3906.611	1.169	3906.611
0.7500	0.3701	0.511	1411.831	2.986	6962.194	1.144	3782.073	1.144	3782.073
0.7750	0.3824	0.516	1413.111	2.959	6833.742	1.121	3664.703	1.121	3664.703
0.8000	0.3947	0.522	1414.058	2.932	6712.101	1.098	3553.956	1.098	3553.956
0.8250	0.4071	0.527	1414.716	2.907	6596.771	1.076	3449.336	1.076	3449.336
0.8500	0.4194	0.532	1415.121	2.883	6487.297	1.056	3350.395	1.056	3350.395
0.8750	0.4317	0.537	1415.307	2.859	6383.265	1.036	3256.720	1.036	3256.720
0.9000	0.4441	0.541	1415.303	2.837	6284.295	1.017	3167.939	1.017	3167.939
0.9250	0.4564	0.546	1415.135	2.815	6190.044	0.999	3083.711	0.999	3083.711
0.9500	0.4687	0.550	1414.825	2.795	6100.192	0.981	3003.721	0.981	3003.721
0.9750	0.4811	0.554	1414.392	2.775	6014.452	0.965	2927.685	0.965	2927.685
1.0000	0.4934	0.558	1413.854	2.755	5932.554	0.949	2855.339	0.949	2855.339
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : SAIFRO24
Date and time : 10MAY94:09:21
Computation of ref. F: Simple mean, age 4 - 8
F-0.1 factor : 0.3522
F-max factor : 0.8868
F-0.1 reference F : 0.1738
F-max reference F : 0.4376
Recruitment : Single recruit

Table 3.2.1 Nominal catch (tonnes) of SAITHE in Division Va, 1979-1993 as officially reported to ICES.

Country	1979	1980	1981	1982	1983	1984	1985	1986
Belgium	980	980	532	201	224	269	158	218
Faroe Islands	5,457	4,930	3,545	3,582	2,138	2,044	1,778	783
France	-	-	-	23	-	-	-	-
Iceland	57,066	52,436	54,921	65,124	55,904	60,406	55,135	63,867
Norway	1	1	3	1	+	-	1	-
UK (Engl. & Wales)	-	-	-	-	-	-	29	-
Total	63,504	58,347	59,001	68,933	58,266	62,719	57,101	64,868
Total used in the assessment								66,376[2]

Country	1987	1988	1989	1990	1991	1992	1993[1]
Belgium	217	268	369	190	236	195	91
Faroe Islands	2,139	2,596	2,246	2,905	2,690	1,570	-
France	-	-	-	-	-	-	-
Iceland	78,175	74,383	79,796	95,032	99,390	77,832	67,025
Norway	-	-	-	-	-	-	-
UK (Engl. & Wales)	-	-	-	-	-	-	-
Total	80,531	77,247	82,411	98,127	102,316	79,597	67,116
Total used in the assessment	-	-	82,425[3]	-	102,737[3]		71,249[4]

[1]Preliminary.
[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 2,571 t and by Faroes 1,562 t included.

Table 3.2.2

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN12)

At 4-May-94 14:38

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	1269,	526,	329,	59,	548,	480,	275,	203,	508,	107,
4,	3404,	2997,	3234,	2099,	1145,	3764,	2540,	1325,	1092,	1750,
5,	2348,	2479,	3045,	2858,	2435,	1991,	5214,	3503,	2804,	1065,
6,	3164,	1829,	2530,	1801,	1556,	3616,	2596,	5404,	4845,	2455,
7,	3452,	3496,	2154,	1036,	1275,	1566,	2169,	1457,	4293,	4454,
8,	3384,	2994,	2367,	1068,	961,	718,	1341,	1415,	1215,	2311,
9,	1303,	1434,	1530,	1528,	537,	292,	387,	578,	975,	501,
10,	824,	710,	1064,	958,	575,	669,	262,	242,	306,	251,
11,	351,	325,	295,	538,	476,	589,	155,	61,	59,	38,
12,	141,	176,	191,	166,	279,	489,	112,	154,	35,	12,
13,	43,	100,	94,	71,	139,	150,	64,	135,	48,	2,
14,	13,	36,	68,	12,	91,	72,	33,	128,	46,	4,
+gp,	20,	61,	18,	49,	55,	0,	0,	0,	0,	0,
TOTALNUM,	19716,	17163,	16919,	12243,	10072,	14396,	15148,	14605,	16226,	12950,
TONSLAND,	97568,	87954,	82003,	62026,	49672,	63504,	58347,	58986,	68615,	58266,
SOPCOF %,	102,	100,	97,	98,	97,	98,	101,	102,	101,	103,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
3,	53,	376,	3108,	956,	1318,	315,	143,	198,	242,	405,
4,	657,	4014,	1400,	5135,	5067,	4313,	1692,	874,	2928,	880,
5,	800,	3366,	4170,	4428,	6619,	8471,	5471,	3613,	3844,	2435,
6,	1825,	1958,	2665,	5409,	3678,	7309,	10112,	6844,	4355,	2410,
7,	2184,	1536,	1550,	2915,	2859,	1794,	6174,	10772,	3884,	2165,
8,	3610,	1172,	1116,	1348,	1775,	1928,	1816,	3223,	4046,	2364,
9,	844,	747,	628,	661,	845,	848,	1087,	858,	1290,	3979,
10,	376,	479,	1549,	496,	226,	270,	380,	838,	350,	846,
11,	291,	74,	216,	498,	270,	191,	151,	228,	196,	237,
12,	135,	23,	51,	58,	107,	135,	55,	40,	56,	91,
13,	185,	72,	30,	27,	24,	76,	76,	6,	54,	48,
14,	226,	71,	14,	48,	1,	10,	37,	5,	15,	12,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
TOTALNUM,	11186,	13888,	16497,	21979,	22789,	25660,	27194,	27499,	21260,	15872,
TONSLAND,	62719,	57101,	66376,	80559,	77247,	82425,	98130,	102737,	79597,	71549,
SOPCOF %,	104,	106,	102,	100,	100,	100,	101,	101,	100,	94,

Table 3.2.3

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN14)

At 4-May-94 15:28

Table 2 Catch weights at age (kg)

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	1.1200,	1.1200,	1.1200,	1.1200,	1.1200,	1.1200,	1.4280,	1.5850,	1.5470,	1.5300,
4,	1.7600,	1.7600,	1.7600,	1.7600,	1.7600,	1.7600,	1.9830,	2.0370,	2.1940,	2.2210,
5,	2.7300,	2.7300,	2.7300,	2.7300,	2.7300,	2.7300,	2.6670,	2.6960,	3.0150,	3.1710,
6,	4.2900,	4.2900,	4.2900,	4.2900,	4.2900,	4.2900,	3.6890,	3.5250,	3.1830,	4.2700,
7,	5.5400,	5.5400,	5.5400,	5.5400,	5.5400,	5.5400,	5.4090,	4.5410,	5.1140,	4.1070,
8,	7.2700,	7.2700,	7.2700,	7.2700,	7.2700,	7.2700,	6.3210,	6.2470,	6.2020,	5.9840,
9,	8.4200,	8.4200,	8.4200,	8.4200,	8.4200,	8.4200,	7.2130,	6.9910,	7.2560,	7.5650,
10,	9.4100,	9.4100,	9.4100,	9.4100,	9.4100,	9.4100,	8.5650,	8.2020,	7.9220,	8.6730,
11,	10.0000,	10.0000,	10.0000,	10.0000,	10.0000,	10.0000,	9.1470,	9.5370,	8.9240,	8.8010,
12,	10.5600,	10.5600,	10.5600,	10.5600,	10.5600,	10.5600,	9.6170,	9.0890,	10.1340,	9.0390,
13,	11.8700,	11.8700,	11.8700,	11.8700,	11.8700,	11.8700,	10.0660,	9.3510,	9.4470,	11.1380,
14,	13.1200,	13.1200,	13.1200,	13.1200,	13.1200,	13.1200,	11.0410,	10.2250,	10.5350,	9.8180,
+gp,	14.0000,	14.0000,	14.0000,	14.0000,	14.0000,	13.1200,	.0000,	.0000,	.0000,	.0000,
SOPCOFAC,	1.0184,	.9996,	.9706,	.9769,	.9691,	.9840,	1.0119,	1.0250,	1.0110,	1.0312,

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
3,	1.6530,	1.6090,	1.4500,	1.5160,	1.2610,	1.4030,	1.6470,	1.2240,	1.2690,	1.3990,
4,	2.4320,	2.1720,	2.1900,	1.7150,	2.0170,	2.0210,	1.9830,	1.9390,	1.9090,	2.1770,
5,	3.3300,	3.1690,	2.9590,	2.6700,	2.5130,	2.1940,	2.5660,	2.4320,	2.5780,	2.8300,
6,	4.6810,	3.9220,	4.4020,	3.8390,	3.4760,	3.0470,	3.0210,	3.1600,	3.2880,	3.7330,
7,	5.4660,	4.6970,	5.4880,	5.0810,	4.7190,	4.5050,	4.0770,	3.6340,	4.1500,	4.4510,
8,	4.9730,	6.4110,	6.4060,	6.1850,	5.9320,	5.8890,	5.7440,	4.9670,	4.8650,	5.5090,
9,	7.4070,	6.4920,	7.5700,	7.3300,	7.5230,	7.1720,	7.0380,	6.6290,	6.1680,	5.3600,
10,	8.1790,	8.3460,	6.4870,	8.0250,	8.4390,	8.8520,	7.5640,	7.7040,	7.9260,	7.0430,
11,	8.7700,	9.4010,	9.6160,	7.9740,	8.7480,	10.1700,	8.8540,	9.0610,	8.3490,	8.1240,
12,	8.8310,	10.3350,	10.4620,	9.6150,	9.5590,	10.3920,	10.6450,	9.1170,	9.0290,	10.1350,
13,	11.0100,	11.0270,	11.7470,	12.2460,	10.8240,	12.5220,	11.6740,	10.9220,	11.5740,	9.1220,
14,	11.1270,	10.6440,	11.9020,	11.6560,	14.0990,	11.9230,	11.4310,	11.3420,	9.4660,	11.5900,
+gp,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
SOPCOFAC,	1.0383,	1.0628,	1.0176,	1.0040,	1.0000,	1.0010,	1.0061,	1.0052,	1.0004,	.9973,

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

Fitted:

Year	a3	a4	a5	a6	a7	a8	a9
1980	0.0837	0.133	0.3062	0.6416	0.8013	0.9195	0.968
1981	0.0957	0.1925	0.2858	0.5353	0.8237	0.9132	0.9675
1982	0.0915	0.2163	0.3835	0.5109	0.7504	0.9242	0.9649
1983	0.0788	0.2081	0.4187	0.6187	0.7316	0.8869	0.9695
1984	0.0637	0.1825	0.4069	0.6528	0.809	0.8767	0.9534
1985	0.0753	0.1509	0.3681	0.6416	0.8307	0.917	0.9489
1986	0.0407	0.1753	0.3167	0.6032	0.8237	0.9275	0.9665
1987	0.0199	0.0996	0.3568	0.5475	0.7987	0.9242	0.9709
1988	0.053	0.0504	0.2241	0.5915	0.7594	0.9119	0.9695
1989	0.0731	0.1274	0.1217	0.4297	0.7907	0.8917	0.9643
1990	0.08	0.1707	0.2759	0.2655	0.6629	0.9079	0.9555
1991	0.0776	0.185	0.3494	0.4986	0.4854	0.8369	0.9626
1992	0.0698	0.1801	0.3719	0.5835	0.7218	0.7111	0.9305
1993	0.0698	0.1638	0.3681	0.6071	0.7852	0.8695	0.8653

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	0.13	0.57	0.84	0.96	0.96	1	0.94

Table 3.2.5

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN12)

At 4-May-94 14:38

Table 5 Proportion mature at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0840,	.0960,	.0910,	.0790,
4,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.1330,	.1920,	.2160,	.2080,
5,	.2700,	.2700,	.2700,	.2700,	.2700,	.2700,	.3060,	.2860,	.3840,	.4190,
6,	.6300,	.6300,	.6300,	.6300,	.6300,	.6300,	.6420,	.5350,	.5110,	.6190,
7,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8010,	.8240,	.7500,	.7320,
8,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9190,	.9130,	.9240,	.8870,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9680,	.9670,	.9650,	.9700,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
3,	.0640,	.0750,	.0410,	.0200,	.0530,	.0730,	.0800,	.0780,	.0700,	.0700,
4,	.1830,	.1510,	.1750,	.1000,	.0500,	.1270,	.1710,	.1850,	.1800,	.1640,
5,	.4070,	.3680,	.3170,	.3570,	.2240,	.1220,	.2760,	.3490,	.3720,	.3680,
6,	.6530,	.6420,	.6030,	.5480,	.5910,	.4300,	.2660,	.4990,	.5840,	.6070,
7,	.8090,	.8310,	.8240,	.7990,	.7590,	.7910,	.6630,	.4850,	.7220,	.7850,
8,	.8770,	.9170,	.9280,	.9240,	.9120,	.8920,	.9080,	.8370,	.7110,	.8690,
9,	.9530,	.9490,	.9660,	.9710,	.9700,	.9640,	.9560,	.9630,	.9300,	.8650,
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

Saithe in the Iceland Grounds (Fishing Area Va) 13:44 Tuesday, May 3, 1994 2

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	0.0080	0.0358	0.0690	0.0656	0.0504	0.0464	0.0066	.0027

Saithe in the Iceland Grounds (Fishing Area Va) 13:44 Tuesday, May 3, 1994 3

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	0.0110	0.0219	0.0624	0.0396	0.0267	0.0217	0.0513	0.0103	.0023	.0008

Saithe in the Iceland Grounds (Fishing Area Va) 13:44 Tuesday, May 3, 1994 1

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	3844	4355	3884	4046	1290	350	196	56	69
1993	36	405	880	2435	2410	2165	2364	3979	846	237	91	60

Table 3.2.7

VPA Version 3.1 (MSDOS)

4-May-94 10:30

Extended Survivors Analysis

Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN8)

CPUE data from file /users/ifad/ifapwork/wg_109/sai_icel/FLEET.RU8

Data for 1 fleets over 24 years
Age range from 3 to 12

Fleet,	Alpha,	Beta
FLT04: TRW EFFORT	, .000	, 1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 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

Regression weights

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

Fishing mortalities

Age,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3,	.001,	.012,	.047,	.009,	.024,	.010,	.006,	.007,	.016,	.012
4,	.029,	.124,	.058,	.101,	.061,	.100,	.065,	.046,	.137,	.073
5,	.073,	.201,	.184,	.262,	.183,	.137,	.178,	.193,	.292,	.162
6,	.260,	.255,	.242,	.385,	.361,	.317,	.240,	.354,	.375,	.301
7,	.384,	.363,	.330,	.455,	.362,	.300,	.486,	.436,	.349,	.324
8,	.572,	.366,	.492,	.537,	.560,	.445,	.568,	.509,	.289,	.371
9,	.553,	.217,	.341,	.617,	.786,	.576,	.487,	.581,	.392,	.514
10,	.863,	.718,	.952,	.498,	.440,	.628,	.556,	.895,	.499,	.484
11,	1.651,	.400,	.864,	.980,	.561,	.847,	.909,	.786,	.533,	.766
12,	.864,	.522,	.534,	.598,	.575,	.615,	.632,	.653,	.444,	.510

Continued....

Table 3.2.7 (Cont'd)

XSA population numbers

YEAR ,	AGE 3,	4,	5,	6,	7,	8,	9,	10,		
1984 ,	4.64E+04,	2.57E+04,	1.26E+04,	8.82E+03,	7.58E+03,	9.16E+03,	2.19E+03,	7.19E+02,	3.98E+02,	2.58E+02,
1985 ,	3.40E+04,	3.79E+04,	2.05E+04,	9.60E+03,	5.57E+03,	4.23E+03,	4.23E+03,	1.03E+03,	2.48E+02,	6.25E+01,
1986 ,	7.55E+04,	2.75E+04,	2.74E+04,	1.37E+04,	6.09E+03,	3.17E+03,	2.40E+03,	2.79E+03,	4.13E+02,	1.36E+02,
1987 ,	1.17E+05,	5.90E+04,	2.13E+04,	1.87E+04,	8.81E+03,	3.58E+03,	1.59E+03,	1.40E+03,	8.81E+02,	1.42E+02,
1988 ,	6.25E+04,	9.51E+04,	4.36E+04,	1.34E+04,	1.04E+04,	4.58E+03,	1.72E+03,	7.01E+02,	6.95E+02,	2.71E+02,
1989 ,	3.66E+04,	5.00E+04,	7.33E+04,	2.97E+04,	7.64E+03,	5.93E+03,	2.14E+03,	6.40E+02,	3.70E+02,	3.25E+02,
1990 ,	2.64E+04,	2.97E+04,	3.70E+04,	5.23E+04,	1.77E+04,	4.63E+03,	3.11E+03,	9.85E+02,	2.79E+02,	1.30E+02,
1991 ,	3.10E+04,	2.15E+04,	2.28E+04,	2.54E+04,	3.37E+04,	8.94E+03,	2.15E+03,	1.57E+03,	4.63E+02,	9.21E+01,
1992 ,	1.72E+04,	2.52E+04,	1.68E+04,	1.54E+04,	1.46E+04,	1.78E+04,	4.40E+03,	9.84E+02,	5.24E+02,	1.73E+02,
1993 ,	3.84E+04,	1.38E+04,	1.80E+04,	1.03E+04,	8.65E+03,	8.42E+03,	1.09E+04,	2.44E+03,	4.89E+02,	2.52E+02,

Estimated population abundance at 1st Jan 1993

,	.00E+00,	3.11E+04,	1.05E+04,	1.25E+04,	6.22E+03,	5.12E+03,	4.76E+03,	5.36E+03,	1.23E+03,	1.86E+02,

Taper weighted geometric mean of the VPA populations:

,	3.80E+04,	3.04E+04,	2.41E+04,	1.65E+04,	1.00E+04,	5.47E+03,	2.54E+03,	1.08E+03,	4.27E+02,	1.69E+02,

Standard error of the weighted Log(VPA populations) :

,	.5381,	.5526,	.5164,	.5395,	.5509,	.5529,	.6186,	.5552,	.5812,	.7631,

YEAR ,	AGE
1984 ,	
1985 ,	
1986 ,	
1987 ,	
1988 ,	
1989 ,	
1990 ,	
1991 ,	
1992 ,	
1993 ,	

Estimated population abundance at 1st Jan 1993

,

Taper weighted geometric mean of the VPA populations:

,

Standard error of the weighted Log(VPA populations) :

,

Continued...

Table 3.2.7 (Cont'd)

Log catchability residuals.

Fleet : FLT04: TRW EFFORT

Age	1980	1981	1982	1983
3	.47	.67	1.36	-.73
4	.29	.43	.50	.69
5	.68	.22	.45	-.22
6	.58	.79	.19	.04
7	.38	.48	.23	.32
8	.48	-.20	.01	.44
9	.50	-.30	-.20	-.01
10	.82	.78	-.28	-.84
11	.03	-1.28	.66	-4.24
12	.47	-1.23	.95	-1.78

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	-1.97	.34	1.73	-.20	.68	-.30	-.98	-.80	.26	.23
4	-.82	.66	-.05	.23	-.34	.07	-.58	-.89	.45	.09
5	-.86	.28	.29	.35	-.05	-.44	-.39	-.26	.40	.08
6	-.15	-.02	-.22	.14	.08	-.14	-.63	-.17	.14	.18
7	-.40	.13	.02	-.01	-.12	-.54	-.07	-.05	.01	.21
8	.54	-.14	.07	.09	-.08	-.69	-.25	-.07	-.14	.37
9	-.07	-.46	-.13	.09	.30	-.12	-.48	-.16	.23	.76
10	.99	.29	.15	-.45	-.83	-.10	-.54	.16	.19	.43
11	1.72	-.87	.82	-.22	-.33	.42	.43	.11	.35	.98
12	1.13	-2.48	.55	-.21	-.67	.25	-.05	-.36	.17	.58

Mean log catchability and standard error
of ages with catchability independent of year class strength

Age ,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12
Mean Log q,	-8.2633,	-6.2935,	-5.4864,	-4.9765,	-4.9238,	-4.9568,	-5.0229,	-4.7445,	-4.8440,	-4.8440,
S.E(Log q),	.9622,	.5326,	.4063,	.3148,	.2673,	.3368,	.3602,	.5620,	1.3200,	1.0169,

Age ,	13
Mean Log q,	.0000,
S.E(Log q),	.0000,

Regression statistics :

Ages with q constant w.r.t. time

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
3,	.85,	.304,	8.60,	.31,	14,	.86,	-8.26,
4,	1.08,	-.253,	5.95,	.49,	14,	.61,	-6.29,
5,	1.14,	-.473,	4.85,	.56,	14,	.48,	-5.49,
6,	1.41,	-1.759,	3.01,	.66,	14,	.41,	-4.98,
7,	1.02,	-.121,	4.84,	.79,	14,	.29,	-4.92,
8,	.98,	.095,	5.03,	.72,	14,	.35,	-4.96,
9,	.84,	1.084,	5.49,	.82,	14,	.30,	-5.02,
10,	.95,	.165,	4.86,	.51,	14,	.56,	-4.74,
11,	.84,	.226,	5.03,	.18,	14,	1.17,	-4.84,
12,	.56,	1.865,	5.03,	.65,	14,	.50,	-5.02,

Continued...

Table 3.2.7 (Cont'd)

Age 6 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 ,	6459.,	.287,	.265,	.92,	4,	.753,	.291
F shrinkage mean ,	5546.,	.50,,,,				.247,	.332

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6220.,	.25,	.20,	5,	.815,	.301

Age 7 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 ,	5402.,	.246,	.122,	.49,	5,	.805,	.309
F shrinkage mean ,	4118.,	.50,,,,				.195,	.389

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5124.,	.22,	.11,	6,	.505,	.324

Age 8 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 ,	5118.,	.244,	.117,	.48,	6,	.808,	.349
F shrinkage mean ,	3495.,	.50,,,,				.192,	.477

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4756.,	.22,	.12,	7,	.536,	.371

Age 9 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 ,	5548.,	.258,	.201,	.78,	7,	.789,	.500
F shrinkage mean ,	4694.,	.50,,,,				.211,	.569

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5356.,	.23,	.17,	8,	.732,	.514

Continued...

Table 3.2.7 (Cont'd)

Age 10 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 ,	1378.,	.312,	.092,	.29,	8,	.720,	.442
F shrinkage mean ,	913.,	.50,,,,				.280,	.609

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1228.,	.26,	.11,	9,	.400,	.484

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

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT ,	176.,	.481,	.127,	.26,	9,	.520,	.797
F shrinkage mean ,	198.,	.50,,,,				.480,	.734

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
186.,	.35,	.09,	10,	.261,	.766

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: TRW EFFORT ,	118.,	.574,	.155,	.27,	10,	.431,	.529
F shrinkage mean ,	128.,	.50,,,,				.569,	.496

Weighted prediction :

Survivors, at end of year.	Int, s.e.	Ext, s.e.	N, .	Var, Ratio.	F

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN8)

At 4-May-94 10:31

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
3,	.0013,	.0123,	.0466,	.0091,	.0236,	.0096,	.0060,	.0071,	.0157,	.0117,	.0115,
4,	.0286,	.1243,	.0579,	.1012,	.0607,	.1002,	.0651,	.0461,	.1372,	.0728,	.0854,
5,	.0727,	.2007,	.1839,	.2616,	.1835,	.1367,	.1783,	.1927,	.2919,	.1618,	.2155,
6,	.2596,	.2553,	.2419,	.3854,	.3615,	.3169,	.2403,	.3540,	.3754,	.3005,	.3433,
7,	.3836,	.3634,	.3302,	.4551,	.3618,	.3003,	.4856,	.4360,	.3488,	.3238,	.3695,
8,	.5722,	.3659,	.4924,	.5372,	.5598,	.4448,	.5676,	.5085,	.2887,	.3714,	.3895,
9,	.5533,	.2171,	.3413,	.6168,	.7863,	.5760,	.4873,	.5814,	.3916,	.5141,	.4957,
10,	.8633,	.7181,	.9522,	.4982,	.4404,	.6282,	.5556,	.8948,	.4991,	.4844,	.6261,
11,	1.6505,	.3998,	.8641,	.9805,	.5611,	.8466,	.9094,	.7865,	.5333,	.7664,	.6954,
12,	.8643,	.5216,	.5341,	.5983,	.5747,	.6154,	.6318,	.6534,	.4442,	.5100,	.5359,
+gp,	.8643,	.5216,	.5341,	.5983,	.5747,	.6154,	.6318,	.6534,	.4442,	.5100,	
FBAR 4- 9,	.3117,	.2544,	.2746,	.3929,	.3856,	.3125,	.3374,	.3531,	.3056,	.2907,	

Continued..

Table 3.2.7 (Cont'd)

Terminal year survivor and F summaries :

Age 3 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 ,	39181.,	1.009,	.000,	.00,	1,	.197,	.009
F shrinkage mean ,	29361.,	.50,,,,				.803,	.012

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
31079.,	.45,	.26,	2,	.577,	.012

Age 4 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 ,	11963.,	.505,	.071,	.14,	2,	.495,	.064
F shrinkage mean ,	9308.,	.50,,,,				.505,	.082

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
10539.,	.36,	.13,	3,	.369,	.073

Age 5 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 ,	14009.,	.356,	.239,	.67,	3,	.663,	.146
F shrinkage mean ,	10091.,	.50,,,,				.337,	.197

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
12543.,	.29,	.19,	4,	.665,	.162

Table 3.2.8

VPA Version 3.1 (MSDOS)

4-May-94 14:16

Extended Survivors Analysis

Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN10)

CPUE data from file /users/ifad/ifapwork/wg_109/sai_icel/FLEET.R10

Data for 2 fleets over 24 years
Age range from 3 to 12

Fleet,	Alpha,	Beta
FLT06: TRW CPU JAN.-	.000	.420
FLT08: TRW CPU JUNE	.420	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 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 19 iterations

Regression weights

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

Fishing mortalities

Age,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3,	.001,	.012,	.048,	.010,	.025,	.010,	.006,	.007,	.017,	.012
4,	.029,	.125,	.058,	.104,	.066,	.109,	.066,	.046,	.142,	.080
5,	.073,	.201,	.185,	.262,	.189,	.149,	.196,	.197,	.292,	.168
6,	.259,	.255,	.242,	.390,	.363,	.329,	.267,	.401,	.387,	.300
7,	.383,	.363,	.329,	.456,	.367,	.302,	.514,	.507,	.419,	.339
8,	.573,	.365,	.492,	.535,	.561,	.455,	.573,	.559,	.360,	.489
9,	.551,	.217,	.340,	.616,	.779,	.579,	.506,	.591,	.456,	.737
10,	.861,	.713,	.955,	.495,	.439,	.616,	.561,	.967,	.513,	.622
11,	1.511,	.398,	.851,	.989,	.555,	.841,	.872,	.800,	.627,	.809
12,	.748,	.417,	.531,	.580,	.585,	.604,	.624,	.599,	.459,	.682

Continued...

Table 3.2.8 (Cont'd)

XSA population numbers

YEAR ,	AGE 3,	4,	5,	6,	7,	8,	9,	10,		
1984 ,	4.61E+04,	2.57E+04,	1.26E+04,	8.83E+03,	7.59E+03,	9.15E+03,	2.20E+03,	7.20E+02,	4.13E+02,	2.83E+02,
1985 ,	3.39E+04,	3.77E+04,	2.04E+04,	9.62E+03,	5.57E+03,	4.24E+03,	4.22E+03,	1.04E+03,	2.49E+02,	7.45E+01,
1986 ,	7.38E+04,	2.74E+04,	2.72E+04,	1.37E+04,	6.11E+03,	3.17E+03,	2.41E+03,	2.78E+03,	4.17E+02,	1.37E+02,
1987 ,	1.09E+05,	5.76E+04,	2.12E+04,	1.85E+04,	8.80E+03,	3.60E+03,	1.59E+03,	1.40E+03,	8.76E+02,	1.46E+02,
1988 ,	5.80E+04,	8.83E+04,	4.25E+04,	1.34E+04,	1.03E+04,	4.57E+03,	1.73E+03,	7.03E+02,	7.00E+02,	2.67E+02,
1989 ,	3.59E+04,	4.63E+04,	6.77E+04,	2.88E+04,	7.60E+03,	5.83E+03,	2.13E+03,	6.49E+02,	3.71E+02,	3.29E+02,
1990 ,	2.64E+04,	2.91E+04,	3.40E+04,	4.78E+04,	1.70E+04,	4.60E+03,	3.03E+03,	9.79E+02,	2.87E+02,	1.31E+02,
1991 ,	3.01E+04,	2.15E+04,	2.23E+04,	2.29E+04,	3.00E+04,	8.32E+03,	2.13E+03,	1.49E+03,	4.57E+02,	9.81E+01,
1992 ,	1.58E+04,	2.45E+04,	1.68E+04,	1.50E+04,	1.25E+04,	1.48E+04,	3.89E+03,	9.64E+02,	4.65E+02,	1.68E+02,
1993 ,	3.82E+04,	1.27E+04,	1.74E+04,	1.03E+04,	8.33E+03,	6.75E+03,	8.44E+03,	2.02E+03,	4.72E+02,	2.03E+02,

Estimated population abundance at 1st Jan 1994

, .00E+00, 3.09E+04, 9.61E+03, 1.20E+04, 6.22E+03, 4.86E+03, 3.39E+03, 3.31E+03, 8.88E+02, 1.72E+02,

Taper weighted geometric mean of the VPA populations:

, 3.70E+04, 2.96E+04, 2.36E+04, 1.61E+04, 9.75E+03, 5.25E+03, 2.46E+03, 1.07E+03, 4.28E+02, 1.73E+02,

Standard error of the weighted Log(VPA populations) :

, .5299, .5434, .4945, .5118, .5159, .4965, .5518, .5244, .5654, .7204,

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,	1.58,	-.804,	23.71,	.17,	14,	1.28,	-18.81,
5,	3.73,	-1.862,	37.26,	.05,	14,	2.34,	-17.38,
6,	1.90,	-2.234,	23.13,	.40,	14,	.66,	-16.78,
7,	1.11,	-.473,	17.33,	.67,	14,	.37,	-16.54,
8,	.67,	1.069,	14.03,	.53,	14,	.46,	-16.67,
9,	.92,	.251,	16.02,	.56,	13,	.53,	-16.69,
10,	3.76,	-1.674,	44.28,	.04,	14,	2.70,	-16.87,
11,	2.62,	-1.528,	33.01,	.12,	10,	1.57,	-16.32,

Log catchability residuals.

Fleet : FLT06: TRW CPU JAN.-

Age ,	1980,	1981,	1982,	1983
3 ,	No data for this fleet at this age			
4 ,	.61,	.64,	.73,	-.10
5 ,	.37,	.10,	1.08,	-.13
6 ,	.16,	.89,	-.74,	.25
7 ,	-.42,	.40,	.02,	.37
8 ,	.11,	-.37,	.54,	.41
9 ,	-.10,	-.69,	.53,	-.56
10 ,	1.31,	-.40,	-.09,	-1.17
11 ,	.08,	99.99,	.96,	99.99
12 ,	No data for this fleet at this age			

Age ,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3 ,	No data for this fleet at this age									
4 ,	.86,	-.87,	.46,	1.24,	-1.09,	-1.08,	.12,	-.83,	.44,	-.01
5 ,	.43,	.10,	1.24,	.45,	-.10,	-1.43,	-.62,	-.40,	.11,	-.24
6 ,	.09,	-.22,	.09,	.29,	.23,	-.05,	-.76,	-.29,	.04,	.37
7 ,	-.39,	.47,	-.59,	-.14,	.15,	.16,	-.07,	-.28,	.02,	.30
8 ,	.63,	.48,	-2.07,	-.17,	.22,	.26,	-.17,	.00,	-.04,	.40
9 ,	-.75,	-.19,	99.99,	-.64,	.97,	.57,	-.20,	.32,	-.01,	.16
10 ,	.10,	-.01,	-1.64,	-.64,	.55,	.84,	.42,	.85,	.02,	-.14
11 ,	99.99,	-.59,	99.99,	-1.04,	.36,	-.21,	.97,	.27,	-.47,	-.05
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,	-18.8112,	-17.3759,	-16.7841,	-16.5368,	-16.6724,	-16.6936,	-16.8743,	-16.3197,
S.E(Log q),	.7962,	.6960,	.4082,	.3201,	.6872,	.5435,	.7789,	.6487,

Continued...

Table 3.2.8 (Cont'd)

Fleet : FLT08: TRW CPU JUNE

Age	1980	1981	1982	1983
3	-1.71	1.07	.88	-.20
4	-1.15	.47	.09	1.68
5	-.03	.23	.29	.19
6	.12	.51	.42	-.27
7	.65	.27	.47	.42
8	.77	-.31	.02	.20
9	1.50	-.45	-.49	-1.43
10	1.87	.60	-.44	-1.17
11	.26	99.99	99.99	99.99
12	.74	-.81	.64	99.99

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	-1.50	.52	1.65	.13	.43	-1.24	-.02	-.66	-.01	.40
4	-.97	1.08	-.32	-.09	-.13	-.12	-.27	-.93	.45	.22
5	-1.76	.56	.05	.28	-.04	-.51	.08	-.25	.56	.32
6	.02	.34	-.36	-.19	.14	-.18	-.32	.03	.20	-.03
7	-.64	-.05	.05	.27	-.13	-.63	-.28	.30	.19	-.17
8	.99	-.95	.27	.63	.09	-.51	-.89	.27	-.02	-.03
9	-.02	-.30	.44	.96	.20	.44	-1.47	-.36	.19	.90
10	1.28	.53	.69	.23	-1.06	.53	-1.31	-.07	-.63	.31
11	1.78	99.99	1.32	-.02	-1.48	.45	-.37	99.99	-1.02	-.22
12	.94	99.99	1.23	.11	99.99	.41	99.99	99.99	99.99	-.16

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	-19.9161	-17.8955	-17.2118	-16.6797	-16.6934	-16.7264	-16.8713	-16.5589	-16.0573	-16.0573
S.E(Log q)	.9160	.7273	.5806	.2616	.3736	.5656	.8134	.8779	1.0417	.7724

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	.79	.498	17.90	.36	14	.75	-19.92
4	1.30	-.549	20.19	.26	14	.98	-17.90
5	1.07	-.161	17.68	.39	14	.65	-17.21
6	1.18	-.941	17.92	.75	14	.31	-16.68
7	.83	.866	15.43	.74	14	.31	-16.69
8	.88	.333	15.78	.47	14	.52	-16.73
9	.88	.274	15.80	.36	14	.75	-16.87
10	.91	.173	15.71	.29	14	.84	-16.56
11	9.83	-.776	103.41	.00	9	10.56	-16.06
12	1.66	-.649	22.51	.19	8	1.12	-15.66

Continued...

Table 3.2.8 (Cont'd)

Terminal year survivor and F summaries :

Age 3 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.-,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT08: TRW CPU JUNE ,	46121.,	.961,	.000,	.00,	1,	.213,	.008
F shrinkage mean ,	27710.,	.50,,,,				.787,	.013

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
30887.,	.44,	.45,	2,	1.019,	.012

Age 4 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.-,	9474.,	.864,	.000,	.00,	1,	.169,	.081
FLT08: TRW CPU JUNE ,	10964.,	.620,	.113,	.18,	2,	.327,	.070
F shrinkage mean ,	8870.,	.50,,,,				.504,	.086

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9614.,	.35,	.08,	4,	.229,	.080

Age 5 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.-,	12415.,	.612,	.334,	.55,	2,	.242,	.163
FLT08: TRW CPU JUNE ,	14404.,	.478,	.284,	.59,	3,	.396,	.142
F shrinkage mean ,	9659.,	.50,,,,				.362,	.205

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
12023.,	.30,	.17,	6,	.550,	.168

Continued....

Table 3.2.8 (Cont'd)

Age 6 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.-,	7369.,	.412,	.282,	.69,	3,	.279,	.259
FLT08: TRW CPU JUNE ,	6085.,	.299,	.195,	.65,	4,	.531,	.306
F shrinkage mean ,	5174.,	.50,,,,				.189,	.352

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
6225.,	.22,	.13,	8,	.606,	.300

Age 7 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.-,	5764.,	.311,	.113,	.36,	4,	.390,	.293
FLT08: TRW CPU JUNE ,	4596.,	.287,	.146,	.51,	5,	.459,	.355
F shrinkage mean ,	3701.,	.50,,,,				.151,	.425

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
4859.,	.19,	.09,	10,	.487,	.339

Age 8 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.-,	3179.,	.378,	.166,	.44,	5,	.358,	.515
FLT08: TRW CPU JUNE ,	3642.,	.342,	.047,	.14,	6,	.437,	.462
F shrinkage mean ,	3250.,	.50,,,,				.205,	.506

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3389.,	.23,	.07,	12,	.293,	.489

Age 9 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.-,	2491.,	.439,	.192,	.44,	6,	.358,	.894
FLT08: TRW CPU JUNE ,	3451.,	.433,	.170,	.39,	7,	.367,	.715
F shrinkage mean ,	4507.,	.50,,,,				.276,	.587

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3306.,	.26,	.12,	14,	.472,	.737

Continued...

Table 3.2.8 (Cont'd)

Age 10 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.-,	861.,	.504,	.079,	.16,	7,	.339,	.636
FLT08: TRW CPU JUNE ,	926.,	.521,	.118,	.23,	8,	.317,	.603
F shrinkage mean ,	882.,	.50,,,,				.344,	.625

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
888.,	.29,	.05,	16,	.185,	.622

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

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	189.,	.595,	.062,	.10,	8,	.316,	.758
FLT08: TRW CPU JUNE ,	122.,	.685,	.131,	.19,	9,	.238,	1.013
F shrinkage mean ,	193.,	.50,,,,				.447,	.746

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
172.,	.33,	.07,	18,	.214,	.809

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: TRW CPU JAN.-,	79.,	.857,	.182,	.21,	8,	.193,	.711
FLT08: TRW CPU JUNE ,	60.,	.769,	.145,	.19,	10,	.240,	.866
F shrinkage mean ,	99.,	.50,,,,				.567,	.604

Weighted prediction :

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN10)

At 4-May-94 14:17

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
3,	.0013,	.0123,	.0477,	.0098,	.0254,	.0097,	.0060,	.0073,	.0171,	.0118,	.0121,
4,	.0287,	.1252,	.0580,	.1037,	.0655,	.1087,	.0664,	.0460,	.1419,	.0796,	.0892,
5,	.0725,	.2008,	.1853,	.2624,	.1888,	.1488,	.1959,	.1973,	.2918,	.1683,	.2191,
6,	.2594,	.2547,	.2422,	.3895,	.3630,	.3289,	.2666,	.4014,	.3874,	.3003,	.3630,
7,	.3828,	.3631,	.3292,	.4559,	.3674,	.3021,	.5139,	.5066,	.4191,	.3387,	.4215,
8,	.5729,	.3648,	.4919,	.5345,	.5614,	.4552,	.5728,	.5591,	.3605,	.4893,	.4696,
9,	.5513,	.2175,	.3399,	.6156,	.7788,	.5789,	.5058,	.5910,	.4561,	.7367,	.5946,
10,	.8614,	.7130,	.9552,	.4951,	.4389,	.6163,	.5606,	.9672,	.5133,	.6215,	.7007,
11,	1.5112,	.3982,	.8507,	.9889,	.5551,	.8412,	.8725,	.8004,	.6271,	.8091,	.7455,
12,	.7479,	.4170,	.5306,	.5797,	.5852,	.6037,	.6235,	.5990,	.4587,	.6823,	.5800,
+gp,	.7479,	.4170,	.5306,	.5797,	.5852,	.6037,	.6235,	.5990,	.4587,	.6823,	
FBAR 4- 9,	.3113,	.2544,	.2744,	.3936,	.3875,	.3204,	.3536,	.3836,	.3428,	.3522,	

Continued...

Table 3.2.9 The results from the TSA

FINAL ESTIMATES

STOCK

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
4	44346.	22959.	16478.	18759.	27265.	39606.	28808.	59753.	85509.	49268.	30863.	29049.	34170.	27508.
5	30640.	33956.	17616.	12483.	13892.	21356.	28214.	22196.	43313.	65084.	36375.	23638.	22596.	25252.
6	9609.	20528.	23893.	11966.	8815.	9924.	14566.	19451.	14214.	29509.	44937.	24895.	16042.	15018.
7	8051.	5633.	12390.	14740.	7525.	5577.	6230.	9271.	11046.	8414.	18099.	27562.	14291.	9444.
8	3167.	4496.	3245.	6447.	8378.	4214.	3249.	3692.	4959.	6198.	4961.	9626.	14201.	8067.
9	983.	1440.	2378.	1565.	3250.	4074.	2310.	1732.	1829.	2445.	3274.	2449.	4684.	7681.
10	588.	465.	691.	1142.	826.	1673.	2293.	1243.	839.	863.	1256.	1676.	1195.	2509.
11	413.	266.	224.	320.	619.	409.	907.	1192.	602.	424.	443.	646.	793.	629.

STANDARD DEVIATION OF STOCK ESTIMATES

4	2735.	1374.	999.	1090.	1410.	2287.	1580.	3681.	5604.	3717.	2912.	3173.	6439.	11758.
5	1736.	2210.	1098.	800.	871.	1126.	1779.	1262.	2833.	4328.	2970.	2335.	2536.	5260.
[illegible]	732.	1302.	1636.	819.	581.	644.	830.	1338.	931.	2097.	3124.	2239.	1786.	2047.
7	616.	440.	880.	1092.	547.	386.	416.	583.	901.	645.	1427.	2106.	1601.	1321.
8	296.	405.	298.	583.	679.	364.	242.	271.	387.	608.	436.	952.	1417.	1137.
9	178.	197.	265.	195.	372.	466.	232.	160.	178.	265.	398.	288.	653.	973.
10	120.	110.	135.	171.	119.	252.	295.	149.	106.	119.	178.	255.	192.	434.
11	86.	78.	68.	86.	99.	74.	151.	173.	92.	68.	76.	112.	159.	121.

FISHING MORTALITY RATES

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
4	0.067	0.062	0.069	0.086	0.044	0.133	0.061	0.122	0.065	0.104	0.067	0.050	0.100	0.055
5	0.198	0.150	0.184	0.142	0.134	0.182	0.170	0.237	0.184	0.166	0.179	0.188	0.206	0.154
6	0.319	0.301	0.283	0.263	0.256	0.258	0.252	0.356	0.315	0.289	0.284	0.351	0.328	0.237
7	0.383	0.348	0.437	0.360	0.379	0.332	0.316	0.425	0.374	0.328	0.429	0.463	0.371	0.317
8	0.540	0.437	0.522	0.485	0.521	0.393	0.424	0.499	0.506	0.438	0.506	0.517	0.412	0.418
9	0.519	0.499	0.531	0.432	0.463	0.359	0.411	0.524	0.551	0.466	0.469	0.516	0.424	0.483
10	0.536	0.500	0.539	0.395	0.502	0.404	0.447	0.524	0.482	0.466	0.464	0.546	0.441	0.453
11	0.511	0.440	0.484	0.387	0.487	0.402	0.431	0.534	0.505	0.483	0.473	0.519	0.449	0.448

STA .D DEVIATIONS OF LOG(F)

4	0.13	0.13	0.09	0.10	0.12	0.17	0.13	0.22	0.29	0.20	0.14	0.13	0.22	0.33
5	0.08	0.10	0.08	0.07	0.07	0.10	0.08	0.09	0.10	0.12	0.10	0.11	0.13	0.15
6	0.12	0.09	0.11	0.10	0.11	0.11	0.09	0.09	0.09	0.10	0.12	0.11	0.12	0.13
7	0.10	0.09	0.09	0.11	0.10	0.10	0.11	0.09	0.09	0.09	0.10	0.11	0.12	0.14
8	0.09	0.11	0.10	0.09	0.12	0.11	0.11	0.11	0.10	0.11	0.11	0.11	0.13	0.15
9	0.13	0.10	0.12	0.12	0.12	0.13	0.13	0.13	0.12	0.12	0.13	0.13	0.14	0.16
10	0.14	0.14	0.13	0.14	0.15	0.14	0.15	0.14	0.14	0.14	0.14	0.15	0.15	0.17
11	0.15	0.15	0.15	0.15	0.16	0.15	0.16	0.15	0.15	0.15	0.16	0.16	0.16	0.17

STATE VECTORS

17	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15	-1.15
18	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27
19	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
20	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
21	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
22	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47	-1.47

Table 3.2.10

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN12)

At 4-May-94 14:38

Traditional vpa using screen input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	.0573,	.0226,	.0117,	.0030,	.0123,	.0096,	.0109,	.0116,	.0257,	.0037,
4,	.1946,	.1860,	.1880,	.0959,	.0740,	.1095,	.0646,	.0666,	.0798,	.1160,
5,	.1795,	.2120,	.2920,	.2524,	.1538,	.1777,	.2174,	.1191,	.1955,	.1042,
6,	.1905,	.2070,	.3476,	.2810,	.2120,	.3574,	.3693,	.3662,	.2399,	.2622,
7,	.2583,	.3319,	.4000,	.2336,	.3290,	.3420,	.3778,	.3657,	.5583,	.3620,
8,	.4571,	.3735,	.3934,	.3540,	.3531,	.3120,	.5534,	.4547,	.5942,	.6747,
9,	.4450,	.3573,	.3324,	.4772,	.3025,	.1715,	.2760,	.4935,	.6595,	.5262,
10,	.4650,	.4667,	.4916,	.3587,	.3310,	.7625,	.2293,	.2781,	.5316,	.3497,
11,	.5993,	.3366,	.3600,	.4977,	.3039,	.6698,	.3939,	.0763,	.1007,	.1134,
12,	.3331,	.6969,	.3386,	.3536,	.5249,	.5861,	.2524,	.8706,	.0572,	.0267,
13,	.3176,	.4184,	1.0598,	.2025,	.5662,	.6027,	.1374,	.5457,	.7539,	.0041,
14,	.4290,	.4800,	.5630,	.3530,	.4310,	.6560,	.2530,	.4430,	.3610,	.1230,
+gp,	.4290,	.4800,	.5630,	.3530,	.4310,	.6560,	.2530,	.4430,	.3610,	.1230,
FBAR 4- 9,	.2875,	.2779,	.3256,	.2824,	.2374,	.2450,	.3098,	.3110,	.3879,	.3409,

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
3,	.0013,	.0120,	.0465,	.0088,	.0250,	.0095,	.0052,	.0068,	.0120,	.0100,	.0096,
4,	.0284,	.1244,	.0562,	.1008,	.0589,	.1067,	.0647,	.0396,	.1315,	.0550,	.0754,
5,	.0712,	.1984,	.1839,	.2517,	.1824,	.1322,	.1915,	.1910,	.2434,	.1540,	.1961,
6,	.2603,	.2485,	.2384,	.3839,	.3425,	.3137,	.2303,	.3878,	.3695,	.2370,	.3314,
7,	.3931,	.3640,	.3180,	.4439,	.3599,	.2791,	.4766,	.4094,	.3979,	.3170,	.3748,
8,	.5629,	.3794,	.4924,	.5050,	.5360,	.4405,	.5052,	.4930,	.2648,	.4510,	.4029,
9,	.5631,	.2133,	.3597,	.6149,	.6961,	.5341,	.4795,	.4773,	.3742,	.4510,	.4341,
10,	.9943,	.7394,	.9052,	.5385,	.4397,	.5006,	.4888,	.8577,	.3643,	.4510,	.5577,
11,	.8860,	.5317,	.9192,	.8642,	.6415,	.8357,	.5856,	.6181,	.4945,	.4510,	.5212,
12,	.7249,	.1500,	.8853,	.6856,	.4506,	.7939,	.6182,	.2995,	.2983,	.4510,	.3496,
13,	.7008,	1.1666,	.2973,	2.3198,	.6888,	.6773,	1.7242,	.1221,	.8454,	.4510,	.4728,
14,	.8260,	.6470,	.7520,	1.1020,	.5550,	.7020,	.8540,	.4740,	.5010,	.4510,	.4753,
+gp,	.8260,	.6470,	.7520,	1.1020,	.5550,	.7020,	.8540,	.4740,	.5010,	.4510,	
FBAR 4- 9,	.3132,	.2547,	.2748,	.3834,	.3626,	.3011,	.3246,	.3330,	.2969,	.2775,	

Table 3.2.11

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN12)

At 4-May-94 14:38

Traditional vpa using screen input for terminal F

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

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
3,	25123,	25927,	31233,	21672,	49431,	55196,	27992,	19384,	22047,	31684,
4,	21173,	19424,	20752,	25274,	17690,	39976,	44757,	22670,	15687,	17592,
5,	15722,	14270,	13204,	14078,	18799,	13450,	29335,	34352,	17365,	11858,
6,	20067,	10757,	9452,	8073,	8955,	13198,	9219,	19325,	24967,	11692,
7,	16659,	13580,	7161,	5466,	4990,	5931,	7558,	5217,	10970,	16082,
8,	10100,	10534,	7978,	3930,	3543,	2940,	3449,	4241,	2963,	5139,
9,	3973,	5235,	5937,	4407,	2258,	2038,	1762,	1624,	2204,	1339,
10,	2426,	2085,	2998,	3486,	2239,	1366,	1405,	1095,	812,	933,
11,	851,	1248,	1070,	1501,	1994,	1317,	522,	915,	679,	391,
12,	546,	383,	730,	611,	747,	1205,	552,	288,	694,	502,
13,	173,	320,	156,	426,	351,	362,	549,	351,	99,	537,
14,	41,	103,	173,	44,	285,	163,	162,	392,	166,	38,
+gp,	63,	175,	46,	181,	172,	0,	0,	0,	0,	0,
TOTAL,	116917,	104041,	100888,	89150,	111456,	137142,	127263,	109853,	98651,	97787,

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	GMST
AGE												
3,	46194,	34912,	75489,	120248,	58763,	36721,	30508,	32165,	22407,	44901,	0,	366
4,	25844,	37773,	28244,	59000,	97587,	46921,	29780,	24848,	26156,	18127,	36396,	291
5,	12825,	20566,	27307,	21861,	43674,	75325,	34527,	22855,	19555,	18775,	14047,	214
6,	8748,	9778,	13808,	18602,	13915,	29796,	54035,	23342,	15459,	12552,	13178,	148
7,	7365,	5521,	6244,	8907,	10375,	8089,	17827,	35141,	12968,	8747,	8108,	91
8,	9167,	4070,	3141,	3720,	4678,	5927,	5010,	9062,	19106,	7132,	5216,	50
9,	2143,	4275,	2280,	1572,	1838,	2241,	3124,	2475,	4532,	12004,	3719,	25
10,	648,	999,	2828,	1303,	696,	750,	1076,	1583,	1257,	2552,	6260,	13
11,	538,	196,	391,	936,	622,	367,	372,	540,	550,	715,	1331,	6
12,	285,	182,	94,	128,	323,	268,	130,	170,	238,	275,	373,	3
13,	400,	113,	128,	32,	53,	169,	99,	57,	103,	145,	143,	1
14,	438,	163,	29,	78,	3,	22,	70,	14,	42,	36,	76,	
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	19,	
TOTAL,	114597,	118548,	159983,	236385,	232527,	206596,	176557,	152253,	122372,	125960,	88866,	

Table 3.2.12

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: RUN12)

At 4-May-94 14:38

Table 16 Summary (without SOP correction)

Traditional vpa using screen input for terminal F

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 9,
1974,	25123,	434157,	288068,	97568,	.3387,	.2875,
1975,	25927,	387972,	264694,	87954,	.3323,	.2779,
1976,	31233,	347136,	227230,	82003,	.3609,	.3256,
1977,	21672,	300226,	186659,	62026,	.3323,	.2824,
1978,	49431,	307876,	165541,	49672,	.3001,	.2374,
1979,	55196,	342094,	159500,	63504,	.3981,	.2450,
1980,	27992,	345802,	155458,	58347,	.3753,	.3098,
1981,	19384,	326782,	157046,	58986,	.3756,	.3110,
1982,	22047,	313021,	167944,	68615,	.4086,	.3879,
1983,	31684,	304428,	166488,	58266,	.3500,	.3409,
1984,	46194,	346408,	170007,	62719,	.3689,	.3132,
1985,	34912,	336559,	152061,	57101,	.3755,	.2547,
1986,	75489,	409481,	166094,	66376,	.3996,	.2748,
1987,	120247,	513490,	162785,	80559,	.4949,	.3834,
1988,	58763,	534603,	157832,	77247,	.4894,	.3626,
1989,	36721,	505346,	165988,	82425,	.4966,	.3011,
1990,	30508,	499355,	192103,	98130,	.5108,	.3246,
1991,	32165,	425443,	203028,	102737,	.5060,	.3330,
1992,	22407,	372618,	208646,	79597,	.3815,	.2969,
1993,	44901,	380623,	217981,	71549,	.3282,	.2775,
Arith. Mean ,	40600,	386671,	186758,	73269,	.3962,	.3063,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 3.2.13

Saithe in the Iceland Grounds (Fishing Area Va)
Saithe in the Iceland Grounds (Fishing Area Va)

Prediction with management option table: Input data

Year: 1994								
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	0.0700	0.0000	0.0000	1.295	0.0090	1.295
4	32.423	0.2000	0.1600	0.0000	0.0000	2.060	0.0695	2.060
5	25.076	0.2000	0.3400	0.0000	0.0000	2.887	0.1801	2.887
6	13.178	0.2000	0.6000	0.0000	0.0000	3.794	0.3048	3.794
7	8.108	0.2000	0.8000	0.0000	0.0000	4.774	0.3443	4.774
8	5.216	0.2000	0.9100	0.0000	0.0000	5.713	0.3703	5.713
9	3.719	0.2000	0.9500	0.0000	0.0000	6.209	0.3989	6.209
10	6.260	0.2000	1.0000	0.0000	0.0000	6.147	0.5125	6.147
11	1.331	0.2000	1.0000	0.0000	0.0000	8.511	0.4791	8.511
12	0.373	0.2000	1.0000	0.0000	0.0000	9.427	0.3210	9.427
13	0.143	0.2000	1.0000	0.0000	0.0000	10.539	0.4344	10.539
14	0.076	0.2000	1.0000	0.0000	0.0000	10.799	0.4368	10.799
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1995								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	40.000	0.2000	0.0700	0.0000	0.0000	1.295	0.0090	1.295
4	.	0.2000	0.1600	0.0000	0.0000	2.000	0.0695	2.000
5	.	0.2000	0.3400	0.0000	0.0000	2.815	0.1801	2.816
6	.	0.2000	0.5700	0.0000	0.0000	3.780	0.3048	3.780
7	.	0.2000	0.8000	0.0000	0.0000	4.797	0.3443	4.797
8	.	0.2000	0.9100	0.0000	0.0000	5.948	0.3703	5.948
9	.	0.2000	0.9600	0.0000	0.0000	6.483	0.3989	6.483
10	.	0.2000	1.0000	0.0000	0.0000	7.704	0.5125	7.704
11	.	0.2000	1.0000	0.0000	0.0000	8.511	0.4791	8.511
12	.	0.2000	1.0000	0.0000	0.0000	9.427	0.3210	9.427
13	.	0.2000	1.0000	0.0000	0.0000	10.539	0.4344	10.539
14	.	0.2000	1.0000	0.0000	0.0000	10.799	0.4368	10.799
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	0.0700	0.0000	0.0000	1.295	0.0090	1.295
4	.	0.2000	0.1600	0.0000	0.0000	2.000	0.0695	2.000
5	.	0.2000	0.3400	0.0000	0.0000	2.778	0.1801	2.778
6	.	0.2000	0.5700	0.0000	0.0000	3.736	0.3048	3.736
7	.	0.2000	0.7800	0.0000	0.0000	4.739	0.3443	4.739
8	.	0.2000	0.9100	0.0000	0.0000	5.948	0.3703	5.948
9	.	0.2000	0.9600	0.0000	0.0000	6.671	0.3989	6.671
10	.	0.2000	1.0000	0.0000	0.0000	7.704	0.5125	7.704
11	.	0.2000	1.0000	0.0000	0.0000	8.511	0.4791	8.511
12	.	0.2000	1.0000	0.0000	0.0000	9.427	0.3210	9.427
13	.	0.2000	1.0000	0.0000	0.0000	10.539	0.4344	10.539
14	.	0.2000	1.0000	0.0000	0.0000	10.799	0.4368	10.799
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PRED94
Date and time: 05MAY94:14:06

Table 3.2.14

Saithe in the Iceland Grounds (Fishing Area Va)

Saithe in the Iceland Grounds (Fishing Area Va)

Prediction with management option table

Year: 1994					Year: 1995					Year: 1996	
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	0.2780	388233	204597	72593	0.6000	0.1668	387881	200388	45656	412428	217718
.	.	.	.	.	0.7000	0.1946	.	200388	52444	405045	211721
.	.	.	.	.	0.8000	0.2224	.	200388	59020	397895	205931
.	.	.	.	.	0.9000	0.2502	.	200388	65392	390970	200339
.	.	.	.	.	1.0000	0.2780	.	200388	71566	384262	194939
.	.	.	.	.	1.1000	0.3058	.	200388	77549	377763	189722
.	.	.	.	.	1.2000	0.3336	.	200388	83349	371465	184683
.	.	.	.	.	1.3000	0.3614	.	200388	88972	365362	179814
.	.	.	.	.	1.4000	0.3892	.	200388	94424	359446	175110
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED94
Date and time : 05MAY94:14:06
Computation of ref. F: Simple mean, age 4 - 9
Basis for 1994 : F factors

Table 3.2.15

Saithe in the Iceland Grounds (Fishing Area Va)

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	40.000	0.2000	0.0700	0.0000	0.0000	1.480	0.0400	1.480
4	.	0.2000	0.1600	0.0000	0.0000	2.070	0.2300	2.070
5	.	0.2000	0.3300	0.0000	0.0000	2.780	0.5100	2.780
6	.	0.2000	0.5500	0.0000	0.0000	3.670	0.8900	3.670
7	.	0.2000	0.7600	0.0000	0.0000	4.680	1.1400	4.680
8	.	0.2000	0.8900	0.0000	0.0000	5.830	1.6100	5.830
9	.	0.2000	0.9500	0.0000	0.0000	6.980	1.6100	6.980
10	.	0.2000	1.0000	0.0000	0.0000	7.980	1.6100	7.980
11	.	0.2000	1.0000	0.0000	0.0000	8.950	1.6100	8.950
12	.	0.2000	1.0000	0.0000	0.0000	9.680	1.6100	9.680
13	.	0.2000	1.0000	0.0000	0.0000	10.890	1.6100	10.890
14	.	0.2000	1.0000	0.0000	0.0000	11.220	1.6100	11.220
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YIELD
Date and time: 04MAY94:16:02