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Exploration of the Sea

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REPORT OF THE NORTH-WESTERN WORKING GROUP

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*General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
DENMARK

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1 INTRODUCTION

1.1 Participants

G. Bech	Greenland
J. Boje	Greenland
J.S. Campbell	Canada
J.J. Engelstoft	Greenland
J.M. Grastein	Faroe Islands
A. Gudmundsdottir	Iceland
H. Hovgaard	Greenland
G. Johannesson	Iceland
A. Kristiansen	Faroe Islands
J. Magnusson	Iceland
K.H. Nedreaas	Norway
A. Nicolajsen	Faroe Islands
S.A. Pedersen	Greenland
H.J. Rätz	Germany
J. Reinert	Faroe Islands
S.A. Schopka (Chairman)	Iceland
V.N. Shibanov	Russia
B.Æ. Steinarsson	Iceland
G. Stefánsson	Iceland

1.2 Terms of Reference

At the 80th Statutory Meeting it was decided (C.Res. 1992/2:8:10) that the North-Western Working Group should meet at ICES Headquarters from 3-11 May 1993 to:

a) assess the status of and provide catch options for 1993 for East and West Greenland cod and for 1994 for Icelandic cod;

b) assess the status of and provide catch options for 1994 and 1995 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) describe as far as possible the technical and biological interactions and evaluate the likely effects;

d) update the information provided in 1992 on the stock identity, migration, spawning areas, and state of exploitation of the oceanic stock of *Sebastes mentella*, especially paying attention to the question of assessment based on acoustic and catch data representing the total exploitable stock taking into account the latest survey data;

e) describe, as far as possible, the fishery in waters beyond coastal state jurisdiction in ICES Sub-areas XII, especially catch statistics by species, fleet, and gear.

In addition to this at its Eleventh Annual Meeting in November 1992 NEAFC requested ICES to provide additional information concerning:

> an evaluation of the consequences in the medium term of TAC levels for the oceanic stock of *Sebastes mentella* in the range 50,000-150,000 tonnes [i.e, 50,000 t, 100,000 t, 150,000 t] and an indication as to whether these levels are within safe biological limits.

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

2.1 Faroe Plateau Cod

2.1.1 Trends in landings

The nominal landings of cod (1983-1992) from the Faroe Plateau by nations as officially reported to ICES are given in Table 2.1.1.A. 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 6,700 tonnes were taken in 1992. This was the lowest catch on record.

In recent years, statistics for the Faroese fishery in that part of Subdivision 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 2.1.1.B under the row labelled "Total used in the assessment". Included, also, are the non-officially reported French catches of Faroe Plateau cod.

During the last 15 years, the Faroe Plateau Cod has been exploited almost entirely by the Faroese fishing fleet. Table 2.1.2 shows the nominal landings disaggregated between the most important fleet categories. The data in this table are the preliminary statistics which were available at the time of compiling the catch-at-age data for the corresponding years. Minor changes are expected in the final data. In recent years, longliners and pairtrawlers have taken most of the catches. The longliners, at least those less than 100 GRT, have a directed fishery for cod during the year while the pairtrawlers take cod mainly as by-catch in the saithe fishery. Longliners less than 100 GRT have not been affected by the fishing regulations which consist of closed areas and fishing days limitation. In 1992, however, the spawning area was closed to all fishing during the main spawning period (1 month).

Figure 2.1.2 shows the catch rates per day from 1985 to 1992 for two subgroups of longliners less than 100 GRT.

The catch rates have steadily decreased during this period. The 1987 year class became available to the smaller longliners as 2 year olds in 1989 and the catch rates increased. Figure 2.1.3 shows the catch rates per day for different categories of trawlers. The decrease follows the same pattern as for longliners with the exception of 1989. Preliminary information from the fishery during the first months of 1993 indicates slightly lower catch rates than in the same period in 1992.

2.1.2 Catch at age

Catch in numbers-at-age in 1992 are provided for the Faroese fishery in Table 2.1.3. 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 other fleets fishing cod on Faroe Plateau were raised using the overall Faroese age composition. As in 1990 and 1991, the 1987 year class (age group 5) was the most important age group in the catches. The catch-at-age in number in recent years was revised according to updated fishery statistics.

2.1.3 Mean weight at age

Mean weight-at-age data for 1992 are provided for the Faroese fishery in Table 2.1.4. 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 1992 showed a discrepancy of 2%.

Data on the mean weight-at-age by year are available from 1978. Figure 2.1.4 A and B show plots of the mean weights for age groups 2 to 5 and 6 to 9, respectively. The weights seem to have been relatively stable, although a decreasing trend for age groups 4 and 5 can be observed in recent years.

2.1.4 Maturity at age

The proportions of mature cod by age are given in Table 2.1.5. The data were obtained during the Faroese groundfish surveys carried out in the spawning period (March). Thus the data for 1993 are available to be used in the predictions of spawning stock biomass.

2.1.5 Stock assessment

2.1.5.1 Tuning and estimates of fishing mortality

Three catch and effort series were available for tuning the VPA. These were also used in the 1991 assessment of the Faroe Plateau cod. One series is derived from annual groundfish surveys initiated in 1982 (Table 2.1.6). The estimates of stratified catches in numbers by age groups per unit time are used since the surveys represented one fleet with constant effort for all the years in the tuning process.

The research vessel "Magnus Heinason" has been used in the survey each year. Three cruises per 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 (Figure 2.1.5). From 1992, one-third of the trawl stations are now fixed stations. In the 1993 survey all stations were fixed stations. The standard abundance estimates are the stratified mean catches per hour calculated using smoothed age/length keys.

The other two catch and effort series are both obtained from subgroups of longliners less than 100 GRT (Table 2.1.7). Only those longliners which have more than a certain number of fishing days each year are included in the dataset. Catches are broken down using the age composition from the sampling of longliners less than 100 GRT.

A retrospective analysis of the tuning using the Laurec-Shepherd (L-S) and the Extended Survivors Analysis (XSA) was carried out. The data for 1983 to 1985 in the research vessel series were not included in the runs due to negative blocks in the log catchability residuals. Analyses based on the L-S method were made with and without shrinkage while the tuning with the XSA method was run with shrinkage. The average fishing mortalities for age groups 3 to 7 from the retrospective analysis are shown in Figures 2.1.6, 2.1.7 and 2.1.8. The fishing mortalities from the L-S method with or without shrinkage appeared less consistent than those from the XSA method. The parameters in the diagnostic output from the XSA tuning are given in Table 2.1.8. It was decided to use the XSA method to tune the final VPA.

The estimated fishing mortalities are shown in Table 2.1.9 and in Figure 2.1.9 A. The average F for age groups 3 to 7 in 1992 is estimated to be 0.50 compared to 0.56 in 1991. Although the average fishing mortality has decreased in recent years, it is still at a high level.

2.1.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.1.10. A summary of the VPA, with recruitment set at 2 years old, and biomass estimates are given in Table 2.1.11 and in Figure 2.1.9 B. The stock-recruitment relationship is presented in Figure 2.1.10. 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 declined steadily since 1984. In 1992 it is estimated to be only 17,000 t which is the lowest level on record.

2.1.6 Predictions of catch and biomass

2.1.6.1 Input data

The input data for the short-term prediction are given in Table 2.1.12. The exploitation pattern estimated from the final VPA was used in the predictions. As no trends are obvious in the weight-at-age data for recent years, the average of 1990 to 1992 was used. The proportion mature observed in the Faroese groundfish surveys in 1993 was used for 1993 while for 1994 and 1995 the average of the maturity ogive for 1991 to 1993 was used.

Estimates of the year classes 1988 and older were used as estimated in the final VPA. The 1989 to 1991 year classes were predicted using the RCT3-program. As input for running RCT3, stratified mean catch-per-hour of age groups 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 2.1.13). Figure 2.1.11 shows the stratification of the 0-group surveys. The output of the RCT3 recruitment prediction program is given in Table 2.1.14. Regarding the 1992 year class, no indices are available from the groundfish surveys. The indices from the 0-group survey in 1992 indicate a poor 1992 year class, however. In recent years recruitment to the Faroe Plateau cod stock has been poor. Based on this, the average of the 1988 to 1990 year classes, as estimated from VPA and RCT3 (6 millions at an age of 2), was used as input for the 1993 and 1994 year classes.

The input data for the yield-per-recruit calculations (long-term predictions) are given in Table 2.1.15. As input for the fishing exploitation pattern, the estimated exploitation pattern from the final VPA was used. As input for mean weight-at-age the average for 1978 to 1992 was used, and for the proportion mature by age, the average for the years 1983 to 1993 was used.

2.1.6.2 Biological reference points

The output from the yield per recruit calculations is shown in Table 2.1.16. and in Figure 2.1.12.C. $F_{0.1}$ and F_{max} are calculated to be 0.10 and 0.24, respectively. These values should be compared with the present average fishing mortality in 1992 of 0.50. From Figure 2.1.10, showing the spawning stock biomass-recruitment relationship, the values of F_{med}=0.45 and F_{high}=1.60 were estimated.

2.1.6.3 Projections of catch and biomass

The results of the short-term predictions are shown in Table 2.1.17 and in Figure 2.1.12.D. Assuming the same average fishing mortality in 1993 and 1994 as in 1991, 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 recorded level.

2.1.7 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. The reason for the low recruitment is not known. Due to the poor recruitment, the catches have decreased substantially in recent years.

Last year the ACFM indicated that the spawning stock was below the minimum biologically acceptable level (MBAL) and recommended that no fishing should take place until there was evidence of a substantial increase in recruitment and biomass. The Working Group noted that this advice has not been followed and that no additional regulations have been introduced. Given the low level of stock biomass and continuous poor recruitment, the Working Group reiterates that the advice given last year ahould be followed.

2.1.8 Comments on the assessment

The assessment is based on one tuning series from the annual groundfish surveys (1986-1992) and on two commercial catch/effort series (1985-1992). The distribution of 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 in catches in recent years, the amounts on 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.

2.2 Faroe Bank Cod

2.2.1 Trends in landings and effort

Total nominal landings of Faroe Bank cod from 1983 to 1992 as officially reported to ICES are given in Table 2.2.1. Figure 2.2.1 shows the landings for 1965-1992. The catches reached a maximum of 5,000 t in 1973. In recent years the catches have declined from 3,500 t in 1987 to only 340 t in 1992. 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 advised in 1990 that the Bank should be closed to all fishing. This advice was followed in June 1990 for depths shallower than 200 meters and is still in force. The catches reported for 1991 and 1992, therefore, partly originate from the deeper parts of the Bank outside the closed area.

2.2.2 Stock assessment

The available data for Faroe Bank cod are not adequate to allow a detailed analytical assessment of the stock.

The Faroese groundfish surveys include waters on the Faroe Bank (Figure 2.1.5). The catches of cod per trawl hour (Figure 2.2.2) declined from 250 kg in 1986 to only 25 kg in 1990. In recent years (1991-1993) an increasing trend in catches has been observed although they still remain low. The length distribution for 1993 is given in Figure 2.2.3. This information indicates that a year class appeared in 1993 at a length of 65-75 cm.

Data from 1985 to 1992 on catch per unit effort for longliners over 100 GRT were presented to the Working Group (Figure 2.2.4). These data also show a declining trend in the fishery similar to that in the groundfish surveys. The data for 1991 and 1992 should be treated with care due to the total closure of the Bank shallower than 200 meters to fishing.

In 1992 longliners less than 100 GRT and jiggers were allowed to participate in an experimental fishery on the Faroe Bank. Due to a misunderstanding, the catches from this fishery (about 160 t) may not have been officially reported. In 1993, one longliner more than 100 GRT was allowed to fish on the Bank for two weeks in April. The average CPUE of 129 kg can be compared to the data presented in Figure 2.2.4. Due to differences in the time of fishing and the vessel's efficiency, the Working Group felt that the results are not comparable.

2.2.3 Management considerations

There is some evidence indicating a recruitment failure of the Faroe Bank cod in recent years. In 1993 a new year class appeared in the groundfish survey catches, however. In spite of this, the data presented indicate that the Faroe Bank cod stock remains at a low level of abundance. The Working Group, therefore, recommends that the fishing ban should be maintained.

Since the groundfish surveys do not seem to describe the state of the stock accurately enough, the Working Group recommends that a strictly controlled fishery be set up in order to obtain the required indices of abundance. This must be based on the same vessels every year using comparable gears.

2.3 Faroe Haddock

2.3.1 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 less than 5,000 t (Table 2.3.1). Catches from the Faroe Bank since 1982 have varied between 700 and 1,600 t, with the lowest catch in 1991. The catch in 1990, 1991 and 1992 was 1,100 t, 500 t and 1,200 t, respectively, even though the fishery on the shallower parts of the Bank has been closed since 1 June 1990 (Table 2.3.2). The catches reflect an increase in the Scottish fishery outside the closed area and a Faroese experimental fishery on the bank proper in 1992. Some minor French catches in Division Vb, not officially reported to ICES, 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 2.3.1).

Faroese vessels took almost the entire catch. Table 2.3.3 and Figure 2.3.1 show the catches by fleet category from 1982 to 1992. The proportion of the catch taken by trawlers has decreased steadily in recent years, in particular in the case of single trawlers. Pair trawlers now take most of the trawl catches. The largest proportion of the catches are now taken by longliners, especially the group less than 100 GRT. Due to poor catches and economic problems, the effort of the longliners 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 has had an impact on the haddock fishery as well. The catch per unit effort for this fleet has declined drastically since 1990 (Tables 2.3.10 - 2.3.11 and Figure 2.3.2).

2.3.2 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 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 2.3.4 shows the catch-at-age in numbers in 1992 by fleet category. Catches of some minor fleets, trawlboats and snella (jiggers) have been included in the category called single trawlers less than 1,000 HP. There are differences in selectivity between the different fleet categories; these are mainly due to different fishing areas, but different gear selectivities also play a role. Due to poor sampling, the same age composition had to be assumed for the Faroese catches on the Faroe Bank for all fleet categories, and the catches by all vessels were pooled. No catch-at-age data were available from other nations fishing in Faroese waters. Therefore, catches by UK and German trawlers were assumed to have the same age composition as Faroese single trawlers greater than 1000 HP. The Norwegian longliners were assumed to have the same age distribution as the Faroese longliners greater than 100 GRT. The most recent data were revised according to the final catch figures (Table 2.3.5).

2.3.3 Weight at age

Mean weight-at-age data are provided for the Faroese fishery (Table 2.3.6). The sum-of-products check for 1992 showed a discrepancy of 5%. Figure 2.3.3 shows that the mean weights-at-age for most age groups have been declining since the mid-1980s, but they seem to have stabilized at a low level over the last 2-3 years.

2.3.4 Maturity at age

Maturity-at-age data were available from the Faroese Groundfish Surveys 1983-1993 (Table 2.3.7). The surveys are carried out in March-April, so the maturity at age is determined just prior to the spawning of haddock in Faroese waters.

2.3.5 Assessment

2.3.5.1 Estimates of fishing mortality

Catch and effort data from the Faroese Groundfish Surveys in 1988-1992 and commercial longliners, 25-40 GRT and 40-60 GRT, for the period 1988-1992 were used for tuning the VPA (Tables 2.3.8-2.3.11). 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 the two groups of longliners. Tables 2.3.8-2.3.11 contain data back to 1983 for the survey and back to 1985 for the commercial series. In this assessment, it was decided to use only the most recent 5 years' data due to a block of negative log catchability residuals for all fleets in the first part of the period as well as some very high values for some ages in these same years. A plot of the log catchability residuals derived from a Laurec-Shepherd tuning procedure without shrinkage and tri-cubic weighting of the data for 1983-1992 (Figure 2.3.4) shows no trends in the residuals. However, there seem to be two levels, especially for the survey. This was another reason for using only the most recent years for tuning.

Several tuning methods with different options were applied to the data. Most of them gave comparable estimates of terminal F. Results from a retrospective analysis of Laurec-Shepherd without shrinkage and with shrinkage of 0.5, respectively, and XSA shrunk by 0.5, 0.3 and 0.1, respectively, are presented in Figure 2.3.5.

It was decided to apply the XSA shrunk by 0.1 to give an estimate of the terminal F values. Table 2.3.12 shows the diagnostic outputs from the XSA. Mean fishing mortality for the fully recruited age groups 3-7 is 0.43.

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 extended VPA. The resulting fishing mortalities are given in Table 2.3.13 and Figure 2.3.6.

Generally, there has been an increase in fishing mortality during the most recent years. This is consistent with the decreasing stock sizes and the anecdotal information on increased effort (more hooks per set) and decreased hook sizes in the longline fishery. However, the mean F for ages 3-7 is slightly lower in 1992 than in 1991 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.

2.3.5.2 Stock estimates and recruitment

The stock size in numbers is given in Table 2.3.14 and a summary of the VPA with the biomass estimates is given in Table 2.3.15 and Figure 2.3.6. The spawning stock biomass has decreased from over 63,000 t in 1985 to about 16,700 t in 1992. 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 1983 and 1984 year classes, but the decline since then was partly due to poor year classes since the mid-1980s, as well as the very pronounced decline in the mean weights at age in the stock (Figure 2.3.3).

No indices of future recruitment from O-group surveys or groundfish surveys have been of use in estimating future recruitment of Faroe Haddock up to now because of poor correlations between these indices and the corresponding VPA values. However, the results from the present VPA do not indicate better recruitment. The same tendency is seen in the Faroese Groundfish Surveys (Table 2.3.9 and Figure 2.3.10).

2.3.6 Prediction of catch and biomass

2.3.6.1 Input data

The input data for the short-term predictions are given in Table 2.3.16. The year classes up to 1989 are from the final VPA while the average for the period 1986-1991 was used for the most recent year classes. Reasons for not using the RCT3 and for using only the average of the most recent 6-year period have been explained in Section 2.3.5.2. The exploitation pattern used in the prediction was derived from the fishing mortality matrix from the extended VPA as mean F values for the years 1990-1992. These were scaled to give the same mean F for ages 3-7 as the XSA gave in the terminal year. Mean weights-at-age have been calculated as the mean values for the period 1990-1992. The maturity ogive for 1993 is based on samples from the Faroese Groundfish Surveys 1993. Maturity ogives for 1994-1995 are calculated as mean values for the period 1988-1993.

It was decided to present two yield- and spawning stock biomass per recruit (age 2) curves because of the varying recruitment in the long-term VPA period 1961-1992, the pronounced decline in mean weights at age since the mid-1980s and the recent change in exploitation pattern. The input data for the long-term yield and spawning stock biomass are listed in Table 2.3.18 and Table 2.3.20. In the first case, the input data are much the same as used in the short-term prediction, the only difference being that maturity at age is now calculated as the average of the years 1983-1993. In the second case, mean weights-at-age and recruitment are calculated as long-term averages and the exploitation pattern was derived from the fishing mortality matrix from the extended analysis as mean F-values for the period 1983-1992.

2.3.6.2 Biological reference points

The yield- and spawning stock biomass per recruit (age 2) curves based on data from the most recent period are shown in Table 2.3.19 and Figure 2.3.7. Compared to the 1992 fishing mortality level for ages 3-7 of 0.43 the reference values for F_{max} and $F_{0.1}$ are 0.95 and 0.17, respectively. From Figure 2.3.9, showing the recruit/spawning stock relationship and from Figure 2.3.7, F_{med} and F_{high} were calculated to be 0.2 and 0.8, respectively.

The yield- and spawning stock biomass per recruit (age 2) based on the long-term data are shown in Table 2.3.21 and Figure 2.3.8. F_{max} and $F_{0.1}$ are indicated here as 0.51 and 0.16, respectively. From Figure 2.3.9, showing the recruit/spawning stock relationship, and from Figure 2.3.8, F_{med} and F_{high} were calculated to be 0.2 and 0.9, respectively.

The yield-per-recruit values based on data from the most recent years are about 80-85% of the yield per recruit values based on long-term data.

2.3.6.3 Projections of catch and biomass

The results of the short-term prediction are shown in Table 2.3.17 and Figure 2.3.7D. Assuming an unchanged fishing mortality compared to that estimated for 1992, the yields predicted in 1993 and 1994 are about 5,000 t in both years. The spawning stock biomass would be expected to increase slightly from about 13,500 t in 1993 to about 14,500 t in 1995.

2.3.7 Managements considerations

The present assessment confirms that the stock is in very poor condition. The spawning stock biomass is at the lowest level on record. Reasons for this are mainly due to the low level of recruitment and the pronounced decline in mean weight-at-age in the most recent years. Last year ACFM advised that the fishing mortality should be reduced in order to increase the spawning stock biomass from its lowest observed level. So far no direct regulation on the haddock fishery has been introduced.

2.3.8 Comments on the assessment

Assessments for this stock have been unreliable in the past due to inadequate tuning data. These data were revised last year, and this year the tuning period has been shortened to the most recent 5 years due to very inconsistent fleet data, especially in the first years of the former tuning series. CVs for the survey and for some ages in the commercial series are still high, but the catch-at-age data seem to be reliable.

2.4 Faroe Saithe

2.4.1 Landings and trends in the fishery

The catches of saithe in the Faroe area were stable at around 40,000-45,000 t during the period 1985-1989 (Table 2.4.1). After an increase to over 60,000 t in 1990, the highest on record, catches dropped to about 54,000 t in 1991, and in 1992 declined even further to about 37,000 t. The preliminary catch figures for the first three months of 1993 were about 7,200 t compared to about 8,300 t in 1992.

Catches not officially reported to ICES have been included in the assessment (Table 2.4.2).

2.4.2 Catch at age

Catch-at-age data in the years 1988 to 1991 were revised according to the final catch statistics. The total catch in numbers at age in 1992 reflects the age composition in the Faroese catches for that year (Table 2.4.3).

2.4.3 Weight at age

The SOP for 1992 shows a discrepancy of 5% which was not corrected for by the Working Group. Since 1985, the average mean weight at age generally declined and remained at a lower level for 1990 to 1991 but in 1992 there was a slight increase in the average weights at age (Table 2.4.4).

2.4.4 Maturity at age

Maturity at age data are available for the period 1983-1993 and were updated for the last year (Table 2.4.5).

2.4.5 Stock assessment

2.4.5.1 Estimation of fishing mortality

Data from the groundfish survey were not suitable for the tuning of this species. Two groups of pair trawlers greater than 1000 GRT were available (Table 2.4.6.A and 2.4.6.B). Several retrospective analyses for both the XSA and the L/S tuning were made with different combinations of fleets and shrinkage factors. The retrospective XSA and L/S tunings are provided in Figures 2.4.1-2.4.3. In the end, it was decided to use a 0.5 shrinkage XSA tuning with age groups 4 to 10 and only one CPUE series (Table 2.4.6), since this produced the best statistics (Log catchability residuals are shown in Figure 2.4.4). The series used consisted of eight pair trawlers greater than 1000 GRT which target their fishery specifically on saithe. The series extends back to 1982 and accounts for 5,000 - 8,000 t each year.

The estimates of fishing mortality from the XSA tuning method are presented in Table 2.4.7. The average fishing mortality for age groups 4 to 8 is 0.49.

The exploitation pattern from the XSA tuning proved to be rather irregular so it was decided to run a separable VPA with the same level of Fbar 4-8 yr as obtained from the tuning. The separable VPA was run with F = 0.719 on age group 6 and terminal S = 1 yielding the same average level of fishing mortality as the XSA tuning for age groups 4 - 8 (Table 2.4.8). The fishing mortalities from the extended VPA are given in Table 2.4.9.

2.4.5.2 Stock estimates and recruitment

The stock size in numbers at age as estimated by the extended VPA is given in Table 2.4.10. The high total numbers in the stock in 1986 to 1990 are due to good recruitment. Spawning stock biomass is given in Table 2.4.11 and Figure 2.4.5.B. A summary of recruitment, total biomass, spawning stock biomass etc. for the period 1983 to 1992 is given in Table 2.4.12. Though the recruitment has been well above average in this period, the spawning stock biomass in 1992 is still low compared to the mid-1970s.

2.4.6 Prediction of catch and biomass

2.4.6.1 Input data

The input data for the short-term predictions with management option tables and for the long-term predictions are given in Tables 2.4.13 and 2.4.15. The stock in numbers in year classes up to 1988 are from the final VPA while the average stock in numbers of the 1975-1988 year classes was used for 1989 and 1990. In view of the low mean weight at age in the last years, the average for 1990 to 1992 was used in the prediction. Similar trends were detected in the maturity and an average maturity ogive for 1990 to 1992 was used for 1994 and 1995. For 1993 the maturity ogive for that year was used. The exploitation pattern used in the prediction was derived from the separable VPA scaled to the same level of fishing mortality as in the extended analysis for age groups 4 to 8. Similar input was used in the long-term prediction except that the average maturity ogive for 1990 to 1992 was used for all years.

2.4.6.2 Biological reference points

The yield and spawning stock biomass-per-recruit curves are presented in Figure 2.4.6. Compared to the fishing mortality level in 1992 of $F_{4\text{-}8}$ = 0.49, the reference values for F_{max} and $F_{0.1}$ are 0.43 and 0.15, respectively. F_{med} and F_{high} were estimated to be 0.25 and 0.42, respectively, from the recruitment/spawning stock relationship (Figure 2.4.7) and the spawning stock biomass-per-recruit/fishing mortality relationship (Figure 2.4.6.C).

2.4.6.3 Projection of catch and biomass

The results from the short- and long-term prediction are given in the management option table (Table 2.4.14) and yield per recruit table (Table 2.4.16). From Figure 2.4.6.D it will been seen that with the present level of fishing mortality the spawning stock biomass will be approximately 55,000 t in 1995. With continued fishing mortality at the 1992 level, catches should remain stable at about 34,000 t in 1993 and 1994.

2.4.7 Management considerations

In this assessment the spawning stock biomass has reached a historically low level. The probability of good recruitment is highest when the spawning stock biomass is between 90,000 t and 100,000 t (Figure 2.4.7). There are indications that when the spawning stock biomass drops below 85,000 t the probability of poor recruitment increases. It is, therefore, advisable to maintain a spawning stock biomass above 85,000 t.

2.4.8 Comments on the assessment

The fishing mortality in the last year has been overestimated in the last five assessments thus underestimating the stock (Working Paper 16). No explanation was suggested by the Working Group as to why this happens repeatedly.

The concept of spawning stock biomass is of course dependent on the maturity ogive which again is dependent on the timing of sampling in relation to the actual spawning time. Some artifacts in the data may be present due to the small sampling size for some years. Smoothing of maturity data should be attempted to alleviate this problem.

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 needs 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 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 the highest recorded (103,000 t). Preliminary reported landings for 1992 are 79,000 t compared to 77,000 t expected by the Working Group last year.

3.2.2 Catch in numbers

Catch-at-age data for 1980-1991 were revised according to new information on how catch by gears were distributed within the year. Data from bottom trawl and gillnets, which represented 93-97% of the Icelandic landings, were used to calculate catch-in-numbers for the period in view. For 1992, age composition data from the same sources were available for landings by Iceland which represented more than 97% of the total landings. These data were used to calculate the catch at age of the total landings used as input for the VPA (Table 3.2.2).

3.2.3 Mean weight at age

Weight-at-age data from 1980-1991 were revised using the same data as those used for the catch-at-age calculations. The mean weights prior to 1980 were derived from the report of the Saithe Working Group (Anon., 1981). The differences between the new and old weight-at-age data sets are minor. For the year 1992, data from the same sources were used (Table 3.2.3).

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 1990 to 1992 period. For long-term yield and spawning stock biomass predictions, the average over 1980-1992 for all age groups was used.

3.2.4 Maturity at age

In 1991, a decrease in proportion mature at age was observed for all age groups compared to 1990. This is especially pronounced for older age groups (7-9) (Table 3.2.4). The low proportions mature in 1991 (especially of age group 7) might be related to year-class strength and migration.

The raw maturity at age data used earlier can be misleading due to the nature of the fishery and of the species. A model was developed for predicting maturity at age, in order to alleviate some of the problems involved with the sampling. The basic model used was a GLM with a Logit link function describing maturity at age as a function of age, year class strength, weight at age and a year effect. Of those factors, age and year-class strength were both significant and no other independent variables were needed. This model was then applied, using the raw data given in Table 3.2.4, to predict the entire maturity at age table for 1980-1995 (Tables 3.2.4 and 3.2.5 and Figure 3.2.1).

For long-term predictions, averages over 1980-1992 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 trawler landings with the annual CPUE. This tuning data set was then constructed from this effort measure along with catch-in-numbers from the same fleet.

3.2.5.2 Estimates of fishing mortality

Retrospective analyses were made for six different combinations of fleets and methods (Table 3.2.7 and Figure 3.2.2 A-F). For each of the two fleets separate runs were made with XSA and Laurec-Shepherd. In addition one run was similar to the method used last year (Laurec-Shepherd without shrinkage using trawler CPUE as tuning data), and finally the Time Series Analysis (TSA) method was applied, using only catch at age data. The TSA seems to be the most consistent one and has a relatively low standard error in the last year, C.V.=0.15 on the most relevant age groups (Table 3.2.11). The bad diagnostics (high standard errors) from both XSAs (Tables 3.2.9 and 3.2.10) and Laurec-Shepherd indicate that little is gained in using them. The TSA method gives the same indications: using tuning data does not improve the estimates of F in the final year. The second most consistent method seems to be the XSA, but it ends up with a higher reference F (age groups 4-9) of about 0.37 compared with the TSA, which gives 0.29 (Table 3.2.8 and Figure 3.2.3), and the former is not within the 95% confidence interval of the TSA. The terminal Fs from the TSA were used to run a traditional VPA and the Fs for the oldest age group were taken as the mean of the four younger ages. The results of this run are given in Tables 3.2.12 - 3.2.14 and Figures 3.2.4.A and 3.2.4.B.

3.2.5.3 Spawning stock and recruitment

The spawning stock biomass is shown in Figure 3.2.4B and Table 3.2.14. After a decline from 1970-1980, the spawning stock biomass was at the level of about 150 - 160,000 t in 1980-1989 and increased to 190,000 t in 1992. The estimated spawning stock biomass in the beginning of 1993 is 205,000 t. Estimates of recruitment at age 3 are plotted in Figure 3.2.4.B. Recruitment has fluctuated in recent years without any clear trend. The 1983, 1984 and 1985 year classes are well above the 1967-1985 long-term averages (40 million). As no information is available for the more recent year classes, the 1988-1992 year classes were set at the same level as the average for the 1967-1985 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 3.2.15. It is assumed that the agreed proportional TAC of the fishing years 1992/1993 and 1993/1994 of 90,000 t will be taken in 1993. Based on these landings, options for 1994 were calculated and are given in Table 3.2.16 and Figure 3.2.5.D.

3.2.6.2 Biological reference points

The yield- and spawning stock biomass-per-recruit (age 3) curves shown in Figure 3.2.5.C have been calculated using an exploitation pattern taken as the averages of the Fs from 1980-1992 from the standard VPA run. Averages over 1980-1992 for maturity and mean weight at age for all age groups were used, along with a natural mortality of 0.2 (Table 3.2.17). Compared to the 1992 fishing mortality level of F(4-9) = 0.29, the reference values for F_{max} and $F_{0.1}$ are 0.44 and 0.18, respectively. From Figure 3.2.6 showing the recruit/spawning stock relationship and Figure 3.2.5C showing the spawning stock biomass-per-recruit relationship, F_{med} and F_{high} were estimated to be 0.28 and 0.8, respectively.

3.2.6.3 Projections of catch and biomass

As can be read from the prediction table (Table 3.2.16), the reference F(4-9) will be 0.35 in 1993, assuming a total catch of about 90,000 t in that year. The resulting stock size at the beginning of 1994 will be about 400,000 t compared to 410,000 t at the beginning of 1993. The spawning stock biomass at the beginning of 1994 will be similar to that in 1992, i.e. about 200,000 t. The same reference F in 1994 as in 1992 will result in a yield of 74,000 t, and both total and spawning stock in 1995 will be at about the same level as in the two previous years. Higher fishing mortalities in 1994 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 1995.

3.2.7 Management considerations

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

3.2.8 Comments on the assessment

The catch-at-age data seem to be relatively stable which is reflected in a low standard deviation 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 saithe and do not seem to be appropriate for the purpose of tuning the VPA. Maturity at age as well as mean weight at age have to be recalculated back to 1961 in order to have more reliable spawning stock and recruitment data.

3.3 Icelandic Cod (Division Va)

3.3.1 Groundfish survey design

The 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-stratification 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 stratum 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.

In 1985, 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. Stations have been fixed since 1985, with the exception of some non-trawlable stations which have been dropped and some new stations which were added in 1993 in shallow water. Trawling is done both by day and night, and sampling is distributed uniformly over the 24 hours.

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

3.3.2 Trends in landings and effort

In the period 1978-1981, landings of cod increased from 328,000 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 landings. The 1992 catch amounted to only 265,000 t which is the lowest catch level since 1948. Effort on cod in 1992 was unchanged compared to 1991 but catch rates of the trawler fleet declined substantially (25-30%) in the latter half of 1992.

3.3.3 Catch in numbers at age

The fleets (or "metiers") are defined by the gear, season and area combinations. The three basic gears are long lines, bottom trawl and gillnets. 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 bottom trawl. The basic area is split between the "northern" and "southern" areas. In the historical data set, seasons are split into the "spring" season (January-May) and "fall" (June-December). Thus, there are a total of 3*2*2 or 12 basic current "fleets". 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 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 are given in Table 3.3.2 and the proportion of F and M before spawning (1 April) in Table 3.3.3. For the longer VPA runs the catches in number at age 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 the period January to May, and not for shorter time periods, it is assumed that 60% of those catches were taken during the period January to March, i.e., before spawning time.

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 provides 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

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

The maturity at age data are given in Table 3.3.6.

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

3.3.6 Stock Assessment

3.3.6.1 Tuning data

Commercial trawler CPUE data are analysed as described in Stefánsson (1988) to yield 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 1988-1992.

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

The Icelandic groundfish survey data (Pálsson *et al.*, 1989) are used as part of the assessment. The basic data are age-disaggregated (Pálsson and Stefánsson, 1991) and indices are computed using the Gamma-Bernoulli (G-B) model of Stefánsson (1991). This is done for each of the three areas separately. This survey analysis results in indices for each age from 1 to 14 and for the years 1985-1993.

The resulting indices are given in Table 3.3.7 by fleet, area and age group.

3.3.6.2 Assessment method

A preliminary assessment of the stock was given in WP 6.

As noted above, migrations from Greenland into the Icelandic cod stock can have major effects and hence these need to be taken into account in the assessments. An ADAPT-type of method has been used for assessing the Icelandic cod stock. The specific method is based on the principles described in Stefánsson (1988) and has been applied to this stock earlier (Anon., 1992). The Laurec-Shepherd and XSA methods have not been developed to account for migration, and hence these methods are not applicable for this stock.

It is assumed that migrations are fixed but in unknown numbers, and that the fish appear at the beginning of a year. When a backwards VPA is performed, these numbers are simply subtracted after the stock size has been computed for the beginning of a year, before continuing to the previous year.

To estimate these unknown quantities, only those years and ages in which noticeable migration is expected to have occurred are considered. For the Icelandic cod in 1983-1991, this leads to the estimation of two parameters - the migrations of the 1984 year class in 1990 and 1991. For any given value of these, the above estimation procedure allows computation of an error sum of squares (SSE). Thus, the migration can be estimated simply by minimising the SSE over that as well as over the fishing mortality.

The procedure adopted fixes the fishing pattern in the last year to the average of some previous year and then estimates only the terminal fishing mortality multiplier (along with migrations). Since there is some indication of a selection pattern change, a relatively short period (1989-1991) is used in the average. An alternative would be to use a longer time period, but since the year 1988 is highly unusual in terms of the high fishing mortalities, it is not ideal to use a short period including this year, and a longer period would seem inappropriate in view of selection pattern changes.

The SSE consists of one component for each fleet and age group. Each component is simply the sum (across years) of squared deviations from the log-log regression of CPUE/survey on stock in numbers. When minimizing the SSE, a reasonable choice of weight to each component is important. An attempt was made to weight the components in accordance with the importance of the different age groups and the accuracy of the various indices. An initial set of weights was computed on the basis of the relative catches of each age group, giving equal weight to each of the 9 sets of "fleets". After fitting the model once, the weights were revised on the basis of the resulting SSE-values. The weights used in the latter iteration are given in Table 3.3.8.

Diagnostic outputs from the estimation procedure are given in Table 3.3.8 and Fig. 3.3.1.

3.3.6.3 Stock and recruitment estimates

The resulting stock sizes and fishing mortalities are given in Tables 3.3.9-11. The migration estimates obtained are 31 million in 1990 and no migration in 1991.

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 1983-1991 are as before, but migration of the 1973 year class is estimated with the procedure above, based on the trawler logbook data analyzed for the period 1979-1984, as described in Anon. (1992). The migration estimates give 39 and 7 million immigrants of the 1973 year class in 1980 and 1981, respectively. 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 backcalculation revises the 1973 and 1984 year class estimates to 428 and 334 millions, respectively. The resulting SSB and recruitment estimates are given in Table 3.3.12 (and Figure 3.3.2b) along with average fishing mortalities. A better estimate might be obtained by backcalculating 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 (Figure 3.3.2a).

In Table 3.3.12 recruitment in the most recent years (year classes 1988-1992 as 3-year-olds in 1991-1995) is estimated using RCT3 as described in Section 3.3.7.3.

3.3.7 Prediction of catch and biomass

3.3.7.1 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 3.3.13 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 1993-1996. For 1994 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 1989-1992 is used.

Great care needs to be taken with the maturity at age in the prediction. Firstly, the maturity at age is at record high levels in 1992 and 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. The approach used is therefore to use a long-term (1984-1993) average for 1995 and observed January-March data for 1993. For the purpose of obtaining an orderly development of trends in the maturity at age, the average of 1993 and 1995 was used for 1994.

The exploitation pattern from the VPA (fixed as the average over the years 1989-1991, see Section 3.3.6.2) was used for the short-term predictions.

3.3.7.2 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) where no significant density-dependent relationships were found concerning growth.

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

The exploitation pattern obtained from the VPA has been used as input since this pattern was fixed as the average over some recent years.

Naturally, any stock-recruitment relationship will affect yield-potential calculations.

3.3.7.3 Recruitment

The G-B method for the analysis of the Icelandic Groundfish Survey has considerable intuitive appeal and is found to fit the VPA well (Stefánsson, 1991; Anon., 1992b) and this has therefore been used for recruitment prediction. The resulting estimates are given in Table 3.3.14.

The size of the 1988-1992 year classes has been estimated using RCT3, with the output as given in Table 3.3.15. Default values have been used in RCT3, except for the CV value, which was raised to 0.3. The reason for this is that the 2-group indices seem to have a considerably higher correlation with the 3-group VPA recruits than any of the other indices. This is somewhat unlikely since the 3- and 4-group indices are expected in reality to be a better measure of recruitment. 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.

3.3.7.4 Long-term prediction

The yield-per-recruit curve along with biological reference points is given in Figure 3.3.3 and Tables 3.3.16-17). A plot of the spawning stock biomass and recruitment is given in Figure 3.3.2. When using the full period (1952-1992, where the SSB is extrapolated back 3 years) the reference points F_{med} and F_{high} are about 0.45 and 0.85, respectively. In the same figure, fitted Beverton-Holt and Ricker curves are also shown. It is seen that F_{high} will result in stock collapse if the Ricker curve is assumed, but an equilibrium is obtained if the Beverton-Holt curve is assumed.

Values for the Beverton-Holt curve are poorly determined. Figure 3.3.2 shows the resulting curve when the full time period available is used. In this case, values of a=2.32 and K=98.5 are obtained. However, if the first three years (1952-1954) are omitted, the resulting parameter estimates are a=1.86 and K=132.9, with a considerable change in interpretation. Thus, it is seen that merely omitting 3 data points results in a considerable change in predicted maximum recruitment (from 229 to 248) and to the SSB level which gives 50% of the maximum recruitment (from 99 to 133).

The Ricker curve (a=0.85, K=728) gives a slightly worse fit to the data than does the Beverton-Holt curve, but the difference is marginal. Neither curve fits the data well, and a simple log-log regression of R on S yields a slope which is only significant at the 12% level.

3.3.7.5 Projections of catch and biomass (short-term prediction)

Input to the projections is given in Table 3.3.18. Results from projections up to 1995 with different fishing mortalities are given in Table 3.3.19. It is seen that fishing at current levels of fishing mortality will further reduce the spawning stock and result in lower catches.

A 20% reduction in fishing mortality from the 1992 level will result in a slightly decreasing (10%) SSB up to 1995. Catches will initially drop to 205,000 t from an expected 230,000 t in 1993.

A 40% reduction in fishing mortality will slightly increase the SSB in 1995. This will require an initial catch limit of about 162,000 t.

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 about 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 from these year classes is somewhat lower or about 210,000 t per year.

3.3.7.6 Medium term prediction

Some medium term predictions were presented to the group. These are described in Appendix A.

3.3.7.7 Management considerations

The SSB-recruitment relationship has a major effect on the long-term predictions, if such a relationship exists. From Table 3.3.12 it is seen that low recruitment (below the median value of 171 million) occurred 13 times out of 19 in years when the SSB was below the median value of 440,000 t. When the SSB was above 440,000 t, poor recruitment only occurred in 6 out of 19 years. The increased probability of poor recruitment at low SSB levels is of major concern and the possibility of an SSB-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.

In a nutshell, the choice is between:

a) Keeping current (1993) mortality levels with 1994 catches of about 225,000 t. In this case the catches will automatically start decreasing since this catch cannot be maintained. Further, the SSB will be driven below historical levels;

b) Reducing the catches to some 175,000 t (30% reduction in fishing mortality). In this case the spawning stock is expected to remain stable in the near future. The probability of perpetual poor recruitment seems high at this level of spawning stock biomass. There is considerable danger of further reductions in the spawning stock size with the corresponding probability of reduced recruitment.

c) An immediate reduction of catches to levels (about 150,000 t) at which the SSB 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. It should be noted that there is a considerable difference between "increasing the SSB fast" and "increasing the SSB with high certainty" (Appendix A).

3.3.8 Comments on the assessment

All short-term results depend heavily on the assumed development in maturity at age. The question should be raised as to whether the currently high maturity rates are true reflections of high rates in the stock, or whether these could to some extent be artefacts since the samples are based on commercial gears. Naturally, if a constant maturity ogive is used, then the current estimate of the SSB drops.

An effort has been initiated to improve the separation of the catch data into different fleets. This has been done for several purposes: (1) to facilitate advice which is directed to the quota year, which starts on 1 September; (2) to ease the computation of the spawning stock biomass at the time of spawning; (3) eventually to enable advice for the cod to be based on seasons and fleets and (4) to use methods that can later be used for other species and thus facilitate advice which takes into account multi-fleet, multi-species technical interaction concerns.

The first two criteria can best be met if seasons are defined to start on 1 September and 1 May, and hence the approach taken is to split the year into three four-month parts (and the same seaasonal split will also work for most other stocks in Division Va). It is envisaged that this work will be completed in the near future and thus future assessments may be based on different seasons and "years" than the current one. At present, seasonal data are available for the years 1984-1992/93.

In view of the fact that non-quarterly seasons are appropriate for Division Va, **the Working Group recommends that future ICES prediction software should include the facility to work on a four-month seasonal basis.**

Since the newer method of computing catch-at-age requires disaggregation into 3 seasons, 2 areas and 3 gears, a total of 18 data "cells" per year are needed. In some years, some of these cells may not have much data. In particular, it is not uncommon for cells (or métiers) with low catches not to have good corresponding otolith samples, in some cases there may be not be any otolith samples and in a few instances there may not even be length distributions. Some consistent treatment of the data is therefore required.

In the case of few otoliths in a given sampling cell, these otoliths can be used to estimate the mean length at age (since the otoliths are randomly sampled), the proportion at age and the variance of length at age. These data can then be used to regenerate a "filled" age-length key where a gamma density function, parametrised with the mean and variance, is used to obtain the frequency of lengths at age. The observed proportions at age are then used to scale the age groups back to the original scale. In this instance, all lengths will have a positive total in the key and the key can therefore be used with the observed length distribution to obtain mean lengths and proportions at age. It should be noted that when this approach is used, an age group that is not present in the otolith samples will not be present in the filled keys either. However, all length groups will be present in the filled keys.

In cases in which there are no otoliths in a given cell, a more complex model is needed. In this instance, a collection of cells is taken and a model is fitted describing, e.g., the mean lengths at a fixed age in gillnets in the south as a function of the corresponding mean lengths in the same cell in the year before (of the same cohort) and of the mean lengths of the same age groups in other gears. This model can then be used to predict the mean length at age in a given cell where no key data exist. Standard deviations of length at age can be fitted using a similar model and proportions (or numbers) at age are fitted using a GLM with a binomial distribution and a logit link function. Thus one obtains the mean length, variance and proportion at age for each age group. These values are then inserted as parameters into the gamma density as above to obtain a filled age-length key.

The last (and poorest) instance is the one where no data exist at all - not even length distributions. In this case, a model is fitted where the proportion at length is described as a function of the corresponding proportion in other cells in the same year. In order to keep basically one approach, the age-length key is modelled using the approach above and the length distribution is then combined with the key in the usual manner to obtain proportions at age. It should be noted that for the Icelandic cod these cells always correspond to low catches and in most cases approximately the same results in terms of annual totals are obtained as were obtained in earlier assessments in which gears were usually combined when data were inadequate.

Similar models can be used to obtain maturity at age in cases of missing or inadequate data.

Unfortunately, it was not possible fully to modify the prediction and assessment to incorporate the revised seasonal data. The revised data have therefore not been used in this assessment, but it is envisaged that they will be used at the next meeting of the Working Group.

The revised analyses of historical data described above also give mean weights at age of mature individuals in each age group. These values are of course more appropriate for SSB computations than those presently used, where the mean weight in an age group is based on immature as well as mature fish. In future assessments it is likely that only observed weights of mature fish will be used when the SSB is computed.

It should be noted that there are 3 sets of mean weights at age which should be used in assessments. In most cases two of these will be the same, but this does not always happen. In particular, for the Icelandic cod the stock biomass and SSB biomass computations do not and will not rely on the same weights at age. **The Working Group therefore recommends that ICES software be modified so as to incorporate 3 sets of weight at age data: for catches, stock biomass and spawning stock biomass computations.**

There is further interest in knowing the landings of mature fish (particularly on a fleet basis) and these data are available, but the ICES package does not easily incorporate two different maturity ogives.

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 (Figure 4.1.1). 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 Icelandic 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 0-group surveys carried out in the East Greenland-Iceland area since 1970 it becomes quite evident that the drift of 0-group cod from the Iceland spawning grounds to the diferent nursery areas at Iceland varies from year to year. The same applies to the drift of 0-group cod with the currents from Iceland to East Greenland waters (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 waters and, to some extent, to the spawning area off the southwest coast of Iceland.

This migration of mature cod from Greenland to Iceland influences the assessment of these stocks (Schopka, 1991) and it cannot therefore be ignored in the assessments.

5 COD STOCKS IN THE GREENLAND AREA

5.1 Survey and Research

5.1.1 Groundfish survey of the Federal Republic of Germany

Abundance and biomass estimates have been derived using annual 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. Because of favourable weather and ice conditions and to avoid spawning concentrations, the autumn season (Oct.-Dec.) was chosen for the survey time. Surveys were carried out by the research vessel R/V WALTHER HERWIG throughout the time period with the exception of 1984, when R/V ANTON DOHRN was used. The fishing gear used was a standardized 140-feet bottom trawl. The net frame was rigged with heavy ground gear because of the rough fishing grounds. A small mesh liner (10mm) was used inside the cod end. The horizontal distance between wing-ends amounted to 25m at 300m depth, while the vertical net opening was 4m.

Figures presented here result from combining the two previously separate surveys for West and East Greenland. Combining the two seems appropriate as the ship and gear were identical and the surveys were conducted directly one after the other. The only difference was the survey strategy applied to the West and East Greenland components. In order to make the surveys equivalent, both survey areas were restratified. The survey area off West Greenland now extends from 59°-67°N while the area off East Greenland is now limited to 66°N.

Pronounced spatial heterogeneity in cod abundance required the subdivision of shelf areas and the continental slope into different geographic and depth strata. Both survey areas off West and East Greenland were split into four and three geographic strata, respectively. Each geographic stratum was subdivided into two depth strata covering the 0-200m and 201-400m zones. Figure 5.1.1 and Table 5.1.1 indicate names of the 14 strata, their geographic boundaries, depth ranges and areas in square nautical miles (nm^2). All strata were delimited by 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. Strata below 400m were disregarded due to inconsistent and insufficient sampling effort. Stratum areas for East Greenland have been revised this year based on a new bathymetric chart and so differ significantly from values given in former Working Group reports. However, the reliability of bathymetric maps of the East Greenland area is believed to be questionable and effort should be made to compile new bathymetric maps.

Stratified abundance estimates were calculated from catch-per-tow data applying the 'swept area' method. Trawl parameters are listed in Table 5.1.2. Towing time was usually 30 minutes at a speed of 4.5 knots. Survey hauls which experienced net damage or hangup before 15 minutes towing time had elapsed were rejected. In 1987 and 1988, some hauls were not excluded as their towing time was intentionally reduced to 10 minutes due to large catches expected observed from echo sounder traces. Strata with less than five valid sets were rejected from the calculation. The coefficient of catchability was set arbitrarily at 1.0 implying that estimates are merely indices of abundance and biomass. Confidence intervals are given at the 95% level of significance of the stratified mean.

Fifty percent of the trawl stations were allocated proportionally to strata area and the remaining fifty percent were apportioned by reviewing the historical cod trawl survey abundance. Hauls were randomly distributed within trawlable areas of the strata. Weather, ice, technical difficulties and changes in strategy of the East Greenland surveys have caused deviations from this design. Figure 5.1.1 shows the positions of 1,969 hauls carried out successfully during 1982-1992. It can be seen that haul distribution is not evenly distributed over the total survey area. Non-trawlable areas are mainly located at the inshore edge of the banks. Strata off East Greenland are especially characterized by extremely rough and non-trawlable fishing grounds. Numbers of valid sets per stratum are listed in Table 5.1.3. The main feature of this table is the predominance of hauls allocated to shallow strata off West Greenland (1.1, 2.1, 3.1 and 4.1) ranging from 0-200m depth. Significantly lower numbers of hauls were carried out in strata 1.2, 2.2, 3.2 and 4.2 (201-400m depth). In contrast, the sampling effort off East Greenland has varied significantly due to changes in sampling strategy and has been mainly concentrated in deeper strata (5.2, 6.2 and 7.2) ranging from 200-400m. Stratum 7.1 has not been sampled adequately, because of the rough bottom throughout the time series. In September and December 1992, only 47 and 6 hauls were carried out off West and East Greenland, respectively, due to technical problems.

For the periods 1984-1986 and 1988-1992, length and age compositions were separated by stratum. Different age length keys were applied to West and East Greenland strata. In 1982-1983 and 1987, age-disaggregated abundance indices were calculated using relative age compositions reported by the ICES Working Group on Cod Stocks off East Greenland (Anon., 1984, 1988). During the past four years (1989-92) total numbers of age readings amounted to 3,519, 2,513, 1,953 and 245, respectively.

Potential inconsistencies in the definition of stratum areas and the existence of large untrawlable regions cast some doubt on the validity of the indices as absolute biomass estimates at East Greenland. Nevertheless, after comparing trends in catches and abundance estimates, the Working Group accepted that the survey results indicated the present status of the stock.

Tables 5.1.4 and 5.1.5 lists abundance and biomass indices by stratum off West and East Greenland from 1982 to 1992. Indices vary significantly between strata and years. Trends in the estimates are shown in Figures 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 1984 and 1985 year classes which were mainly distributed in the northern strata 1.1, 2.1 and 3.1 off West Greenland during 1987-1989. High indices of abundance and biomass have not been observed in strata off East Greenland although these indices increased during the period 1989-1991 suggesting an eastward migration. Since 1987 and 1989, stock abundance and biomass off West and East Greenland have decreased dramatically to 5 and 10 million individuals, and 5,000 and 33,000 t, respectively in 1991.

In 1992, the survey effort off West Greenland was reduced by 50% and the survey off East Greenland had to be terminated due to technical problems after conducting only a few hauls at Dohrn Bank. This caused a break in the time series. The West Greenland estimates showed a decline to 2 million fish (down by 57% compared to 1991) equivalent to 607 tonnes (down by 88% compared to 1991). These results are by far the lowest since the beginning of the surveys in 1982. Estimates based on the six hauls in stratum 7.2 off East Greenland in 1992 are also the lowest ever seen for this stratum. In 1991, abundance and biomass maxima were observed in this stratum.

Length compositions are illustrated for the period 1989-1992 in Figure 5.1.4. With decreasing trends in abundance, the mean length increased from 50.1 cm in 1989 and 53.1 cm in 1990 to 58.0 cm in 1991. This is due to the prevalence of the dominant 1984 and 1985 year classes and poor subsequent recruitment. In 1992, very small cod, ranging between 25.5-34.5 cm, predominated off West Greenland while the length composition in stratum 7.2 off East Greenland showed no pronounced peak and ranged from 10.5 cm to 82.5 cm.

Cod age compositions off West and East Greenland were found to differ substantially (Tables 5.1.6-5.1.8). The calculated mean age was 4.6, 5.3 and 5.7 years in 1989, 1990 and 1991, respectively, reflecting the predominance of the 1984 and 1985 year classes (Figure 5.1.5). The change in abundance of age groups from West to East Greenland with increasing age suggests an eastward migration. In 1992, age groups 0 to 8 and 12 were found in stratum 7.2 off East Greenland, while the cod stock off West Greenland consisted of the recruiting 1990 year class which contributed 72% of the abundance. Disappearance of the previously predominant 1984 and 1985 year classes contributed substantially to this result.

5.1.2 Greenland trawl survey

A stratified-random trawl survey was carried out by Greenland off East and West Greenland during July-October 1992, using the chartered commercial trawler M/tr PAAMIUT (722 GRT). The area covered extended from 59°N to 72°30' N at West Greenland and from 59° 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. However, as the main purpose of the survey was to estimate shrimp abundance, haul density was higher in the shrimp fishing areas off West Greenland than off South and East Greenland. The stratification used in the shrimp areas of West Greenland was as given by Carlson and Kanneworff (1992). For this area, a restratification was performed to allow comparison with the concurrent German survey. Stratification and haul allocation in southwest Greenland and East Greenland were designed to match the German survey. A total of 291 hauls were made within the 200 nm zone of Greenland (Figure 5.1.6).

The survey gear used was a Skjervoy 3000/20 trawl with a bobbin groundrope and a double-bag 44 mm mesh size codend. The trawl doors were of the type 'Perfect'. Standard hauls were of 60 min. duration with a mean towing speed of 2.4 knots. Trawling was restricted to the daytime (0900-1900 UTC). Cod abundance was calculated by the swept area method in which trawling distance was calculated from GPS registrations and wing-spread was taken as the average of Scanmar measurements (27.7 m).

The survey showed an extremely low biomass of cod at both West and East Greenland (Table 5.1.9). At West Greenland total abundance and biomass was estimated to be 0.5 million fish and 198 t, respectively. For the East Greenland area the total abundance was estimated to be 0.3 million fish equivalent to a biomass of 71 t.

As 1992 was the first year for the Greenland survey, it is impossible to use the result as an indicator of changes in stock size. The very low catches are consistent with the findings in the German survey and are also in line with the low catches seen in the commercial fishery.

5.1.3 West Greenland young cod survey

During June-July 1992 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-sizes as found since 1987. The recruitment time series is shown in Table 5.1.10.

The 1984 and 1985 year classes, both believed 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 1989 year class, recruiting in 1993, is very poor in both areas, however, whereas the 1990 year class is about average.

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 closely 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 poundnet (Table 5.2.1). Since the spring of 1991, however, no offshore fishery has taken place. Catches in 1992 amounted to only 5,665 t (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 fishery increased to 112,000 t in 1989. Catches have since declined with yields of 68,000 t in 1990 and 20,000 t in 1991. The catch in 1992 of only 5,700 t is the lowest observed since the commencement of the fishery in the 1920s.

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 off-shore banks and along the slopes of the East Greenland shelf from Dohrn Bank to Cape Farewell. In addition, there is a long-line fishery offshore and a small inshore fishery at Angmagsalik.

Catches in East Greenland fluctuated during the period 1976-82, but decreased sharply from 27,000 t in 1982 to 2,000 t in 1985. In the period from 1986 to 1989, catches increased steadily from 5,000 t to 16,000 t. Combining the TAC for West and East Greenland, reflecting the change in stock distribution, permitted the catch to double and and reach 33,000 t in 1990 at East Greenland. Since then, the nominal catches have decreased to 22,000 t and 11,500 t in 1991 and 1992, respectively (Table 5.2.3).

Most fishing activity in 1992 was concentrated in the areas north of 63°N. 53% of the catch was taken by Germany. UK (England and Wales), Greenland, Norway and UK (Scotland) accounted for 22%, 11%, 10% and

4%, respectively. The German fleet took 92% of the catch during the first two quarters.

Although much effort was spent searching for cod, the fishery collapsed in the second part of 1992 and did not recover in the winter season as usual. Searching continued in the first months of 1993 where ten German trawlers reported their entry into the Greenland economic zone. The fishery has been extremely poor with reported catches of only 129 t during January to April 1993. This is a reduction by 97% compared to the catches of 4,966 t taken in the same area during the same period in 1992.

5.3 Assessment

5.3.1 Catch in numbers

In West Greenland, 15 samples from poundnet landings were used to convert the total inshore catch into numbers at age. Sampling in 1992 was difficult to perform due to the low catch levels. Forty percent of the catch was broken down by samples taken 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. The catch at age in 1992 is given in Table 5.3.1. Catch at age since 1966 is presented in Table 5.3.2.

Catches were dominated by age groups 4 and 5 (65% and 29% of the total catch in numbers, respectively). The formerly important 1984 and 1985 year classes together accounted for about 2% of the catch in numbers.

At East Greenland, six samples were taken from German commercial trawl catches (three samples from the first quarter, two samples from the second and one in the third quarter). Total numbers of length measurements and age determinations were 2,476 and 1,251, 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 (Table 5.3.3). The SOP-check resulted in 96% of the total catch.

The catch off East Greenland in 1992 was still dominated by the 1984 and 1985 year classes which accounted for 87% by number. The majority (59%) were of the 1985 year class although its numbers in the catch decreased from 4.5 million in 1991 to 2.5 million in 1992 or 45%.

5.3.2 Weight at age

Weights-at-age for West Greenland cod were based on samples from commercial fisheries. Mean weights at age by area are given in Table 5.3.1. The overall mean weight was derived by weighting according to catch size from the various areas and months .

Mean weights at age for the two important age groups (4 and 5) were slightly below that found in 1991 and well below the historical mean (Table 5.3.4). The mean weights of older fish were higher than the values found in 1991 but low compared to the long-term mean. It should be noted, however, that the mean weights are based on inshore cod only and that it has been commonly observed that size at age in the inshore catches is significantly smaller than that concurrently observed offshore. It may therefore be misleading to interpret changes in overall weight at age without considering changes in the proportion of catches taken inshore and offshore.

Mean weights-at-age in the East Greenland catch were derived from German commercial samples. Because of a lack data in 1992, the values for East Greenland were calculated using a length-weight relationship based on survey data and commercial samples. The overall weights-at-age were determined by weighting with the catch at age per quarter (Table 5.3.5).

East Greenland mean weights-at-age in 1992 were the highest on record for the the recruiting 1987 and 1988 year classes. In contrast, the estimates for the 1983 to 1985 year classes are close to the historical minimum.

5.3.3 Assessment

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 of West Greenland. As year-class strength in this areas differs considerably from that observed offshore, it was impossible to calibrate VPAs with survey indices from the offshore areas (Anon., 1992). As a result of these problems, and considering the near absence of cod in survey catches, the Working Group decided not to attempt a VPA, but instead based its evaluation on the results of the surveys and the trends observed in the fisheries.

5.4 Management Considerations

The 1992 swept area biomass in West Greenland, as observed by the German survey, was estimated to be only 607 t. This estimate is by far the lowest on record and is less than 0.1% of the high survey biomass observed in the late 1980s. The Greenland survey, conducted for the first time in 1992, estimated the biomass to be 198 t. Due to technical problems, the German survey in 1992 could not cover the East Greenland area but the Greenland survey estimated the biomass to be only 71 t. The trends in the fisheries are consistent with the low biomass from the surveys as no offshore cod fishery has taken place in West Greenland since the spring of 1991 and the catches off East Greenland decreased to almost nil during the second part of 1992 (Section 5.2).

The offshore stock may, therefore, be considered to be almost non-existent at the present time. As no pre-recruit year classes of any significance were observed on the surveys, no substantial recruitment is expected in the next few years. The prospects for the offshore stock and fisheries is considered to be poor in the foreseeable future. Therefore, no fishing should take place until a substantial increase in recruitment and biomass is evident.

Based on historical catch levels, an inshore fishery of about 5,000-10,000 t annually may be expected in the West Greenland area where local fjord populations can sustain recruitment (Section 5.1.3). The inshore fishery has historically been small compared to the offshore fishery and this stock component has never been assessed separately. Data collected from the inshore fishery should be compiled so that this stock can be adequately assessed in the future.

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 1980-1992 in Tables 6.1.1-6.1.4. During the period 1982-1986, catches were stable at about 31,000 - 34,000 t. In the years 1987-1989 catches increased to about 61,000 t followed by a decrease to about 39,000 t in 1990 and 38,000 t in 1991. The total catch in 1992 amounted to 35,000 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. It should be noted that since 1990 the fishery has been expanding to deeper waters.

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 6.2.1. 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 generally, but since then CPUE has decreased and is now at the lowest level recorded. Since 1977, effort has been increasing with some fluctuations to a peak in 1989. The effort decreased in the following years but increased again in 1992 to a value about 14% less than the record value in 1989.

6.3 Catch in Numbers

The catches in number at age were updated according to the final catch figures for the years 1991 and 1992, 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 6.3.1).

6.4 Weight at Age

The mean weights at age in the catch are shown in Table 6.4.1. 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 long-term average mean weights (1976-1992) 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

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 6.5.1).

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 6.2.1 were used to tune the VPA (with weighted regressions). Two tuning methods, Laurec-Shepherd and XSA, based on the years 1985 to 1992 were applied to make an estimate of terminal F values. It turned out that there was too much noise in the Fs for the 13-year-old fish and therefore the Group decided to reject the 13-year-old fish from the reference F. New tuning runs were made using age groups 8 to 12 for the reference F. With the help of retrospective analysis, the Working Group decided to use the XSA tuning method with shrinkage of 0.5 (Figure 6.6.1 and Table 6.6.1). Based on the Fs from the XSA with shrinkage of 0.5 a traditional VPA was carried out (Table 6.6.2 and Figure 6.6.2).

6.6.2 Spawning stock and recruitment

The recruitment shows a decrease from 40 million in 1980 and 1981 to 28 million in 1983. The recruitment reached 45 million again in 1986 but has been declining since then and is estimated to be approximately 30 million in 1990 (Table 6.6.3). Spawning stock biomass is given in Table 6.6.4.

6.7 Prediction of Catch and Biomass

6.7.1 Input data

The input data for the predictions are given in Table 6.7.1. Annual recruitment of 33 million at age 5 in 1991-1993 is based on the average recruitment for the years 1976-1990. Stock size is derived by using the fishing mortalities from the VPA with recalculated values for ages 6 and 7 to get average recruitment for these year classes. Mean weights were derived from the long-term average over the years 1976-1992. Maturity at age was derived by averaging over the years 1982-1984 and 1991 and 1992 where data were available. A catch level of 30,000 t, equal to the national TAC of Iceland for the 1992/1993 fishing year, was used as the predicted total catch in 1993. The fishing pattern for the short- and long-term projections was based on the average F levels from 1990-1992 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 0.18 and F_{max} 0.44. Due to the short time series of data for this stock, it was not meaningful to calculate F_{med} and F_{high}.

6.7.3 Projections of catch and biomass

Table 6.7.2 and Figure 6.7.1 show the results of the predictions. At the beginning of 1993, the total stock is estimated to be about 210,000 t and the spawning stock to be about 75,000 t. Given average recruitment, catches of about 30,000 t in 1993 and 1994 will allow a slight increase (10%) in SSB to about 83,000 t in 1995.

6.8 Management Considerations

According to the present assessment the continuation of the present fishing mortality will lead to stable SSB.

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 recruiment process. Repeated surveys could be used for examining these issues.

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

7.1 Species and Stock Identification

In the northeast Atlantic there are at least three species of redfish: *Sebastes viviparus*, *S. marinus*, and *S. mentella*. 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.

Within ICES assessment working groups, these species have been considered as five separate stocks:

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

The North-Western Working Group has to deal with and assess three of these stocks, i.e., the *S. marinus* and *S. mentella* Greenland/Iceland/Faroes stocks, and the oceanic stock of *S. mentella* in the Irminger Sea.

From time to time it has been questioned whether it is correct to consider *S. marinus* and *S. mentella*, respectively, from Greenland, Iceland, and Faroes waters as single stock units. At present, the Working Group has no evidence at hand which would justify splitting these stocks into separate stock units. Work related to this topic has been carried out on *S. marinus* by a Nordic group of scientists. Some differences have been observed both in genetic analyses and isotope studies. It would, however, be premature to draw any definitive conclusions from these studies, since they are incomplete and there may be some gaps in the sampling which have to be filled.

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.

Data on oceanic *S. mentella* presented at last year's meeting (Anon., 1992) supported the hypothesis on the life-cycle presented in an earlier Study Group Report (Anon., 1990b) and in the report of the North-Western Working Group for 1990 (Anon., 1990a) and 1991 (Anon., 1991). New information from the Icelandic acoustic survey in 1992 shows that in June that year, as in 1991, oceanic *S. mentella* were more abundant in the western part of the Irminger Sea than in the eastern part. The "spawning", however, took place in the eastern area of the Irminger Sea and the fishery started much further to the northeast even extending into Division Va.

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.

During the 1991 and 1992 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. These findings might put this stock into a new perspective in terms of its distribution.

According to hydroacoustic information, oceanic *S. mentella* was most abundant in the 100-200 m depth range and at temperatures between 4° and 5°C at the time of the June 1991 survey. In 1992, the depth distribution was similar, but the temperature was somewhat lower, being from 3.5°- 5°C. Results of the Russian expeditions show that this tendency started in 1990 (Table 7.5.7).

7.2 Stock Distribution with Respect to National Fisheries Zones

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 zones 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.

The conditions are different for the oceanic *S. mentella* stock. Reported catches have so far all been taken in Sub-areas XII and XIV, almost exclusively in international waters, i.e., outside the national fisheries zones of the neighbouring countries with the exception of minor catches within the national fisheries zones of Greenland and Iceland. In 1992 Iceland took about 900 t in Division Va.

From the information available, it is obvious that a substantial part of the adult oceanic *S. mentella* is, at least at times, to be found within the national fisheries zones of Iceland and Greenland.

In 1991, Iceland commenced a fishery in late April on spawning concentrations of the oceanic stock within its national zone. In 1992, the Icelandic fleet started fishing at the beginning of April on concentrations of pre-spawners within the EEZ of Iceland and also in late March in 1993. In a short cruise to the area in early April it was confirmed that pre-spawning oceanic *S. mentella* could be found as far north as 65°N. On the other hand, investigations during the feeding migration indicated that aggregations of this stock were within the East Greenland zone. The Icelandic acoustic surveys in 1991 and 1992 (Figure 7.5.6) confirmed these aggregations within the East Greenland zone. The Icelandic catch within the EEZ of Iceland amounted to some 2,000 t in 1992.

With the present state of knowledge, there is no way to quantify the proportion of the adult stock occurring in the respective national fisheries zones.

The Working Group noted that the new information (Magnusson *et al.*, 1992) on the distribution of deep-sea *S. mentella* in the Irminger Sea might have an implication for stock distribution with respect to national fisheries zones.

7.3 Landings and Trends in the Fisheries

The total catch of redfish in 1990, excluding catch figures from the "oceanic" fishery, remained at the same level (111,000 t) as in 1989. In 1991 the catches increased to about 123,000 t, i.e. an increase of about 11%. The catches decreased in 1992 by about about 9% to the 1990 level.

In Division Va (Iceland), the CPUE of the Icelandic fleet was rather stable until 1992, when it showed a definite decline. This is also reflected in the relatively stable total redfish landings from that Division (Tables 7.3.1-7.3.2). The catch in 1989 and 1990 remained at the same level of about 92,000 t and increased to 97,000 t in 1991, but declined to 94,000 t in 1992.

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 t in 1991 and remained at the same level in 1992. This decline in the fishery is due to the decrease in the catches by the Federal Republic of Germany fleet from 5,142 t in 1986 to 441 t in 1990, and a decrease in the Faroese landings from 15,244 t in 1986 to 10,014 t in 1990. The increase of about 3,000 t in 1991 and 1992 is mainly due to increased Faroese catches.

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

The fishery on oceanic *S. mentella* stock took place mainly outside the national zones in Sub-areas XIV and XII. In 1992 minor Icelandic catches were reported from Division Va and some 2,000 t were taken within the

EEZ of Iceland (Tables 7.3.7, 7.3.8, 7.3.13 and 7.3.14). The landings amounted to 38,200 t in 1989, 31,500 t in 1990 and 22,800 t in 1991 but increased to 56,500 t in 1992, i.e. almost 2.5 times.

From Sub-area XIV (East Greenland) (Tables 7.3.9 and 7.3.10), the total landings (excluding oceanic *S. mentella*) were about 3,000 t in 1989 and increased from 7,000 t in 1990 to 10,000 t in 1991 but decreased again to about 3,400 t in 1992. This is to be explained by the increase of the catches by the German fleet from about 3,300 t in 1990 to about 9,000 t in 1991 and a decrease of about 3,500 t in 1990 to about 1,200 t in 1991 taken by the Japanese fleet in Sub-area XIV. In 1992 the German catches decreased again to about 2,200 t and there no Japanese catches were reported. The proportional fluctuation in the catches of *S. marinus* remained at a very low level.

Apart from oceanic *Sebastes mentella* the redfish catches in 1992 have not been allocated to species. The allocation up to 1992 is given in Tables 7.3.11 and 7.3.12.

7.4 Redfish 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 15.6 suggesting good year classes in those years. During the ten-year period 1975-1984, the index was below average, particularly in 1976 and from 1979-1984. Values were high in 1985, 1987 and 1990. 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 index of 11.6 is below the overall average of 15.6. The 1986 and 1989 indices were slightly below average. Thus, the indices suggest generally strong year classes after 1984, following a period of poor ones (1975-1984).

7.5 Redfish Assessment

7.5.1 Traditional stocks

7.5.1.1 CPUE analysis

In last year's report an analysis of redfish CPUE in Division Va was presented. The basic conclusion was that the CPUE has remained fairly stable during the 1980s. Although the models (GLMs and various averages) presented in that report attempt to account for fleet changes, the possibility remains that some factors (spatial distribution changes, new vessels learning during the period, etc.) may affect these measures adversely.

An analysis of the CPUE data is presented in Figures 7.5.1-7.5.2. This analysis (Stefánsson, Working Document 12) attempts to reduce the various confounding effects by reducing the original logbook data to measurements of redfish CPUE in standardized locations by chosen vessels. This is done by first allocating a redfish "trip" in a statistical rectangle in a given month where a redfish trip is defined as a trip in which a vessel catches more than 50% redfish. A subset of rectangles is then chosen on the criteria that a square must have at least 10 recorded redfish trips, and that the median catch and towing time must be among the 25 largest. After this subset of the data has been selected, the 25 vessels with the largest number of recorded logbook returns in the past 10 years are selected for further analysis. All the selected vessels returned logbook data in all the years.

Results based on analyses of these data are given in Figures 7.5.1 and 7.5.2. Figure 7.5.1 shows the estimated CPUE trends based on different analyses of these data, using the mean, median and geometric mean of the values within each year. All three lines indicate a drop in the CPUE in the most recent years.

Figure 7.5.2 shows histograms of the time series of average CPUE within each statistical rectangle. It is noted that this figure indicates a drop in the CPUE sub-regions in most of the area covered.

7.5.1.2 Management considerations

In last year's Working Group report the stability of the CPUE series in recent years indicated that the combined fisheries of *S. marinus* and *S. mentella* in Division Va was in no imminent danger. It was also indicated that both in Division Vb and Sub-area XIV (and possibly in Division Va), a depletion of *S. marinus* might be taking place. In 1992, the CPUE of the combined fisheries of *S. marinus* and *S. mentella* in Division Va declined considerably, a decline which might have already started in 1991. In the Icelandic groundfish survey data there is a considerable drop in CPUE of *S. marinus* in Division Va from 1987 - 1993 (Figure 7.5.3). It should be noted that the groundfish survey does not cover the entire fishable stock. The survey indicates highly variable recruitment but does not indicate that it has decreased in recent years.

7.5.2 Oceanic *S. mentella*

7.5.2.1 Landings and CPUE

Oceanic *S.mentella* are mostly taken from Sub-areas XII and XIV, but in 1992 Iceland also caught 877 t in Division Va (Tables 7.3.13 and 7.3.14). The fishery for oceanic *S.mentella* started exploiting the virgin adult stock in 1982 with landings of about 60,000 t and an increase to about 105,000 t in 1986. The landings then dropped suddenly from about 91,000 t in 1988 to about 38,000 t in 1989 due to a decrease in the Russian effort.

The decreasing trend in landings continued and in 1991 the total landings were 22,804 t. In 1992 the participation and the effort in the fishery increased, and the total landings also increased to 56,547 t.

CPUE data for the oceanic *S.mentella* fisheries in Sub-areas XII and XIV are given in Table 7.5.1. It is seen from the table that the CPUE for the Russian fleet has declined more or less continuously since the fishery started in 1982. The shorter series for Norway shows, on the contrary, an increasing trend. The Working Group believe that the latter fact is explained by technical modifications, by the use of trawls with larger openings and by the gain in experience. However, since the Russian fleet has used the same trawl since the start in 1982, its time series may better reflect the stock situation, although the Russian effort has varied. Although keeping the technical parameters constant, it is still reasonable to believe that a minimum amount of effort or some kind of scouting is required to get comparable stock-reflecting catch-rates from year to year.

7.5.2.2 Surveys in 1992

During May-July 1992, Russia conducted the traditional trawl-acoustic survey (TAS) in the international waters of the Irminger Sea and in the East Greenland zone. Biological and oceanographic data were collected from the area surveyed. The main redfish concentrations were distributed along the Greenland zone boundaries (Figure 7.5.4). Abundance and biomass of oceanic *S. mentella*, as estimated from the Russian TAS results, are given in Table 7.5.2. The exploitable stock of *S. mentella* in the open area of the Irminger Sea has been estimated to be 0.9-1.1 million t or 1.5-1.7 billion fish. In the 200-mile fishing zone of East Greenland the TAS was estimated to be 550,000 - 650,000 t or 900 - 1000 million redfish individuals.

Given the duration of the survey from May to July and the possibility that redfish migrated in a southwesterly direction, it is important to note that some fish may have been observed more than once.

Redfish concentrations were found in the frontal zone which divided the water masses of Arctic and Atlantic origin. Redfish from the frontal zone were concentrated in areas of local upwellings at midwater depths. Thermal conditions over the TAS area in 1992 were colder than that of the long-term mean. The densest redfish aggregations were seen in 1992 at lower temperatures than in 1991.

The redfish length distributions and age composition are presented in Tables 7.5.3 and 7.5.4. *S. mentella* biological parameters during the TAS were quite similar to those obtained in previous years (Table 7.5.5).

In 1992, Iceland conducted an acoustic survey on oceanic redfish from 16 June to 7 July 7 on R/V "Bjarni Sæmundsson" (B9/92). About 82,000 n m^2 were covered between 64°N and 57°N (see Figure 7.5.5).

A 38 KHz SIMRAD EK500 split-beam echo-sounder and BI500 postprocessing system was used for the acoustic data collection. In order to have values directly comparable to the results of the redfish survey in 1991, the same threshold of -72 dB was used. A total of 27 hauls were taken of which 5 were deep-sea hauls (>500 m depth). The biological sampling was carried out according to the survey plan agreed by the ICES Study Group on Redfish Stocks. Temperature measurements were carried out by means of bathythermograph (XBT) down to 760 m depth and zooplankton samples were collected by means of longer nets.

The target strength used was based on the results of an analysis of target data obtained on this survey, giving the target strength of a single fish as -40.2 dB and -38.1 dB for 1 kg. These values are representative for redfish in the depth interval 100-200 m with a mean length of 36.4 cm and mean weight of 623 g.

The Icelandic acoustic estimate of the stock size of oceanic redfish was 1.3 million t in the area surveyed.

According to echo values oceanic redfish were most abundant in the western part of the survey area and were aggregated in 100-200 m depth, as in 1991. The maximum densities were observed north of 61°N, at 60°N and south of Cape Farvel between 58°N and 59°N (Figure 7.5.6). A correlation between temperature distribution and abundance of oceanic *S. mentella* was observed both horizontally and vertically as in 1991. Oceanic redfish were most abundant in temperatures between 3.5° and 4.5°C which is somewhat lower than in 1991.

The length range was 23-46 cm (mean 36.35 cm). The average length for males was 35.58 and for females 36.98 cm (Table 7.5.6).

The average weight of (2005) individually weighed fish in the length range 23-46 cm was 623 g while it was 599 g for males and 646 g for females.

Because of the time differences in the Russian and Icelandic surveys it was difficult to combine the results of the acoustic estimation. However, the southern part of the Russian survey (i.e. south of 57°N) was carried out at the time the Icelandic vessel was operating in the southernmost part of its survey area. The Russian estimate from that part of the survey area, i.e. the area between 57^{0}N and 53^{0}N and 48^{0}W and 35^{0}W which is about 80,000 nm^2 in size, amounted to about 630,000 t. Adding this amount to the Icelandic acoustic assessment of ca. 1.3 million t, the total estimate covering an area of about 165,000 nm^2 is 1.9 million t. It should be pointed out that this estimate dose not cover the entire area of distribution of oceanic redfish partly because of ice and also because of bad weather conditions.

Compared to the results of the surveys in 1991, the cold water isotherm ($<3.5^0$C) was higher in the water column in 1992. This is clearly indicated in the vertical temperature distribution along 60^0N latitude and along the 42^045'W longitude (Figures 7.5.7-7.5.8). In 1992 the Russian survey showed that the redfish were concentrated at lower temperatures than in previous years (Table 7.5.7).

A comparison was made of the acoustic estimates for areas covered in the Icelandic survey in 1991 and 1992. In that particular area the estimate was about 615,000 t in 1991 and 571,000 t in 1992.

7.5.2.3 Stock trajectories for oceanic *S.mentella* based on 1992 surveys

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. This work was based on a similar approach during last year's assessment and a working paper (WP no. 15) presented to this year's Working Group by Gunnar Stefansson.

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. Norwegian and Russian age readings have not been included in this model due to discrepancies between different methods of reading (Figure 7.5.9).

A simplified growth curve, w -(w -w0)exp(-Kw(a-tw0)), is used based on data from the acoustic survey in June/July 1992 (w and w0 are the maximum and minimum observed weights, respectively; tw0 is the time when the weight w0 is achieved; Kw is an unknown parameter). The selection pattern is assumed to be of the form 1-exp(-K*(a-a0-1)), where a0 is the first age in the analysis and K is an unknown constant. It is assumed that the same selection pattern applies to the acoustically measured stock as to the catches.

The unknown parameters are thus the natural mortality, the constant recruitment, the parameter in the selection function (K) and the two parameters of the growth function (Kw and tw0). Projections of the stock are possible for any given value of the parameters based on the usual catch equations and the given catches taken from the stock in the years 1982-1992. Combined results from the Icelandic and the Russian acoustic survey in June/July 1992 yielded a biomass estimate of 1.9 million tonnes. A projection of the fishable stock from 1982 onwards should match the biomass estimate in 1992. For a given value of natural mortality and weight parameters, the single recruitment parameter can be determined such that the stock biomass trend matches this 1992 measured value.

The mean, standard deviation and skewness of the distribution of weights are computed from both the survey and the simulated population. The sum of squared deviances of these quantities are then used as a basis for determining whether the parameters are in accordance with the distribution of weights. For a given set of weight and selection parameters, the system of equations can be made to fit the catches and acoustic estimate. Thus the selection pattern and weights-at-age are determined solely from the histogram of weights. It follows that different parameterisations of the selection pattern can be compensated by choosing a different weight-at-age function. The only unestimable parameter is thus the natural mortality and it is left as such, with scenarios considered for values of M=0.03, M=0.05, M=0.1 and M=0.2.

In the first runs values of M=0.05 and M=0.1 were tested. For each of these, a well-fitting selection curve and growth curve were estimated. Each of the two pairs of "best" curves was then used with each M value (resulting in 4 different initial population structures). The two growth curves were very similar, while the two selection patterns were totally different (Figures 7.5.10 a,b).The four combinations gave projected stock sizes under different catch assumptions. Since there is considerable interest in how far the stock will be driven down in relative terms, Figure 7.5.11 shows the ratio of final (year 2001) to virgin biomass (year 1982). In this figure, the most optimistic scenario (with M=0.1) as well as the worst case scenario (with M=0.05) are shown. From these projections it is seen that an annual harvest of 150 thousand tonnes will at worst bring the biomass to about 50% of its virgin level.

The Working Group decided to do some more runs with a fixed and, on present knowledge, more probable selection pattern (Figure 7.5.12). There may also be some variance and uncertainties connected with the acoustic estimate, and projections were therefore made using a 1992-biomass of 1.0, 1.5 and 2.5 million tonnes. The results are given in Table 7.5.8. This fixed selection pattern gives a smaller stock, and in that sense leads to more pessimistic results with regard to the stock structure and the prognosis compared to the first runs. An annual harvest of 100 thousand t will at worst (if the

1992 biomass is only 1.0 million t and M=0.05) bring the biomass to about 35% of its virgin level. If we base our projections on the acoustic estimate of 1.9 million t (also having in mind that the survey did not cover the entire area of distribution), an annual TAC of 100 thousand tonnes for the next decade or so will not reduce the stock below 50% of its virgin biomass level.

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 commences, in order to determine more precisely the effects of catches on the stock. Under the current state of knowledge it is conceivable that a TAC of over 100 thousand tonnes would reduce the stock to below 50% of its virgin state. It is therefore recommended that this TAC should not be exceeded.

7.5.2.5 Proposals for future international research work on oceanic *S. mentella*

The Working Group emphasizes that the oceanic *S. mentella* fisheries in Sub-areas XII and XIV have the status of a large international fishery. The migration processes and formation of schools for this species of redfish take place both in international waters and within the 200 mile economic zones of Greenland and Iceland. For this reason the Working Group recommends that the international effort to investigate the migration patterns and abundances in Division Va and Sub-areas XII and XIV should be continued. In 1992 the Study Group on Redfish Stocks made the following recommendations for further research:

1. In addition to Iceland and Russia, other countries having interests in the oceanic *S. mentella* fishery should participate in the acoustic surveys so that the large distribution area of this species could be covered simultaneously.

2. Research surveys in autumn/early winter (e.g., the time of copulation) should be promoted to find out how and where the oceanic *S. mentella* are distributed at that time of the year. All research surveys need to have access to the entire distribution area.

3. Biochemical (genetic), meristic and morphometric research on oceanic and deep-sea *S. mentella* should continue and the results, including those from historical studies, should be summarised. This research should aim at finding objective and diagnostic criteria for distinguishing between the two types of *S. mentella*. It is important that the characteristics also enable a correct classification of 0- and 1-group redfish.

4. The Study Group will encourage scientists to continue doing research on age reading as a basis for VPA assessment.

5. Further research on defining the nursery areas of the oceanic *S. mentella* should be promoted.

8 DEEP-WATER FISHERIES INSIDE AND BEYOND COASTAL STATE JURISDICTION

In this context the Working Group decided to gather available information and present preliminary statistics on non-traditional species that are not considered by other working groups. It should be noted that the statistics on 'skates nei' and 'skarks nei' for some countries also include shallower living species. In the following sections available information on national fisheries and research are summarised. Official landings of the most common deep-sea species are given in Tables 8.1 - 8.6. The countries supplying information are listed in alphabetic order below.

Faroes

Since the late 1970s Faroese trawlers have conducted deep-sea fisheries to the SW of the Faroes in national and international waters. Target species have been redfish and blue ling, with minor catches of ling, tusk, anglerfish (*Lophius* spp.), halibut, Greenland halibut and skates. Catches of grenadiers, black scabbardfish (*Aphanopus carbo*) and various sharks have been discarded.

In recent years more effort has been exerted on this mixed trawl fishery utilizing most species in the catches. The fishing activities have gradually expanded to deeper waters. In 1992 and 1993, an exploratory trawl fishery for orange roughy (*Hoplostethus atlanticus*) has been conducted in national and international waters. However, the commercial fleet has not yet entered this fishery.

Since 1991, a licensed fishery with gillnets for anglerfish has been conducted with a limited number of vessels.

On several occasions, exploratory fisheries have been carried out with long line in deep waters around the Faroes; the species composition has been the same as in the trawl catches, but no commercial effort have so far been introduced to this fishery.

France

Due to the decrease in catch rates on the continental shelf west of Scotland, the French trawler fleet has moved to the continental slope in recent years. This deep-water fishery takes place on fishing grounds below 700 m. The fishery began in 1989 in ICES Sub-area VI and has spread into ICES Sub-area VII in 1991.

Roundnose grenadier (*Coryphaenoides rupestris*) and orange roughy are the two target species. The other species in the catch are black scabbard and several species of dogfish (*Centroscymnus coelopedis*, *Centrophorus squalomus*, *Centroscymnus crepidater* and *Scymnodon ringens*) which are recorded together in the landing statistics, the Portuguese shark (*Centroscymnus coelolepis*) being the most important.

The first large landings of roundnose grenadier and of black scabbard were recorded in 1989 and they increased considerably in 1990 and in 1991 for both species. While this was still the case in 1992 for the black scabbard, the catches of roundnose grenadier have changed slightly from 1991 to 1992. The first large landings of orange roughy and deep sea dogfishes were recorded in 1991. Catches of orange roughy decreased in 1992 but those of deep sea dogfishes doubled.

Germany

Small catches of deep water species were taken as by-catch in an exploratory fishery targeted at redfish and blue ling in Sub-area XIV.

Greenland

In October 1987 and July 1988, two bottom trawl surveys were carried out jointly by Japan and Greenland between 60°N and 67°N (Sub-area XIV) along the continental slope at depths down to 1400 m. An account of all species caught as well as biomass estimates have been presented in ICES reports (Yatsu and Jørgensen, 1988, 1989). Roundnose and roughhead grenadiers (*Macrourus berglax*) were the most numerous in the deeper waters off Greenland.

Iceland

Iceland has shown interest in the deep-sea resources. In the 1970s and early 1980s, several cruises and single hauls were directed to the deep sea around Iceland. Thus, the distribution of several deep-sea species is known in Icelandic waters. However, the quantity and the catchability have not been examined thoroughly.

In addition to the landings given in Tables 8.1 - 8.6, Iceland caught 498 t and 106 t of *Chimaera* spp. in 1991 and 1992, respectively. In 1992, a catch of 10 t of smooth-head (*Alepocephalus bairdii*) is also reported.

In March 1993, Iceland conducted a deep-sea fishing survey with two vessels in the Reykjanes Ridge area using both pelagic and bottom trawl. Hauls were taken in depths of approximately 550-1500 m. Over 90 species of fish were recorded during the survey.

Apart from species already commercially exploited there are several deep sea species which might have commercial potential in this area. The most likely species are black scabbard fish, smooth-head, roundnose grenadier, orange roughy, *Rhinochimæra atlantica*, black dogfish (*Centroscyllium fabricii*), *Centroscymnus crepidater*, *Deania calceus*, Portuguese shark (*Centroscymnus coelolepis*) to name some. All these species were taken south of 63°N.

Norway

Norwegian research on 'deep-sea' fishes in the North-Atlantic has been a spinoff of exploratory fisheries with long-lines. During the traditional long-line fishery for ling, blueling, tusk and Greenland halibut on the continental slopes and on deeper banks, bycatches of lesser known species have always been taken. It has therefore been of interest and importance to get better utilization of this bycatch to improve the profit for the long-liners. Two exploratory fishery expeditions with long-lines in the North Atlantic took place in May-June 1991 and 1992 (Myklebust and Olsen, 1991; Stene and Buuer, 1991; Sele and Olsen, 1992).

Greater fork-beard (*Phycis blennoides*) is taken as a bycatch in the traditional long-line fishery. Of the other species, rough-head grenadier, mora (*Mora moro*) and different deep-sea shark species are of special interest, and it may be possible to conduct a directed long-line fishery on these species, but at greater depths (700-1000 m). The interest in these fishes in the future will fully depend on how these non-traditional species will be put to use and marketed.

Different skates and rays have been landed for a longer time. As for deep-sea sharks, there is a mixture of several species and so it will be difficult to identify species in the official statistics. Roundnose grenadier is taken both as a bycatch, and in a more directed fishery, especially in the fjords and in deep trenches on the continental shelf. Most of the catches are taken by trawl.

Orange roughy is a valuable slow-growing and long-lived deep-water species about which many fishermen are concerned. Norwegian fishermen have experienced fishing this species off Australia/New-Zealand, but they have not conducted any exploratory fishing in the Atlantic.

In addition to the catches presented in Tables 8.1 - 8.6, Norway landed 832 t and 466 t of roughhead grenadier in 1991 and 1992, respectively (Sub-area II). The landings of *Mora moro* amounted to 6 t in 1991 and 26 t in 1992 (Division Vb and Sub-area VI).

Russia

During the last ten years Russia has successfully developed a deep-sea fishery in Sub-area XII, and studied the deep-sea resources in Sub-area Vb. *Coryphaenoides rupestris, Aphanopus carbo*, spiny dogfishes and some other deap-sea fish species were the main object of Russian fisheries in both sub-areas. The Russian catches of *C. rupestris* in Sub-area XII were stable at around 12,000-15,000 t in the period 1980-1988. After 1988 catches declined to 4,000 t due to current difficulties in the Russian fishing industry.

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Table 2.1.1.A

Faroe Plateau COD (Subdivision Vb1).
Nominal catches (t) 1983-1992, as officially reported to ICES.

Nation/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992 1)
Faroe Islands	37,916	36,914	39,422	34,492	21,303	22,272	20,535	12,232	8,203	6,460
France 2)	13	34	29	4	17	17				
Germany	128	9	5	8	12	5	7	24	16	2
Norway	76	22	28	83	21	163	285	124 1)	80 1)	41
UK England					8				1	75
UK Scotland 3)										
Denmark				8	30	10				
Total	***38,133***	***36,979***	***39,484***	***34,595***	***21,391***	***22,467***	***20,827***	***12,380***	***8,300***	***6,578***

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

Table 2.1.1.B

Faroe Plateau COD (Subdivision Vb1).
Catches (t) 1983-1992, as used in the assessment.

Nation/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Faroe Islands	37,916	36,914	39,422	34,492	21,303	22,272	20,535	12,232	8,203	6,460
France	13	34	29	4	17	17				
Germany	128	9	5	8	12	5	7	24	16	2
Norway	76	22	28	83	21	163	285	124	80	41
UK England					8				1	75
UK Scotland										
Denmark				8	30	10				
Total	38,133	36,979	39,484	34,595	21,391	22,467	20,827	12,380	8,300	6,578
Faroese catches in IIA within Faroe area jurisdiction						715	1,229	1,090	351	154
French catches as reported to Faroese authorities and nonofficially to ICES							12	17	4	3
Total used the assessment	***38,133***	***36,979***	***39,484***	***34,595***	***21,391***	***23,182***	***22,068***	***13,487***	***8,655***	***6,735***

Table 2.1.2

Nominal landings (t) by faroese vessels of Faroe Plateau Cod 1983-1992 disaggregated into fleet categories.										
Category/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Open boats	99	235	5,960	2,357	2,345	234	1,903	456	431	151
Longliners <100 GRT	3,975	6,884	8,351	5,754	3,434	2,745	6,047	4,735	2,645	1,442
Longliners >100 GRT	2,987	2,825	2,562	1,828	2,359	3,080	3,887	2,571	1,250	771
Trawlers <400 HP	3,228	3,367	3,268	2,062	1,500	1,173	1,368	650	582	553
Trawlers 400-1000 HP	7,969	4,908	2,838	1,871	1,580	1,764	1,277	448	270	174
Trawlers >1000 HP	4,791	4,392	4,300	3,090	1,879	1,558	1,218	516	363	212
Pairtrawlers <1000 HP	5,358	4,454	4,754	10,411	6,359	6,475	2,285	910	685	689
Pairtrawlers >1000 HP	3,550	2,131	1,994	4,635	3,334	3,674	1,901	1,368	1,091	1 106
Not allocated	5,959	7,718	5,395	2,483	-1,487	2,284	1,878	1,668	1,238	1,516
Total	**37,916**	**36,914**	**39,422**	**34,492**	**21,303**	**22,987**	**21,764**	**13,322**	**8,554**	6,614

Table 2.1.3

Extended survivors analysis.

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	2149,	4396,	998,	210,	257,	509,	2237,	243,	190,	215,
3,	5771,	5234,	9484,	3586,	1362,	2122,	2151,	2849,	446,	479,
4,	2760,	3487,	3795,	8462,	2611,	1945,	2187,	1481,	2129,	490,
5,	2746,	1461,	1669,	2373,	3083,	1484,	1121,	852,	615,	959,
6,	1204,	912,	770,	907,	812,	2178,	1026,	404,	300,	309,
7,	510,	314,	872,	236,	224,	492,	997,	294,	141,	139,
8,	157,	82,	309,	147,	68,	168,	220,	291,	92,	57,
9,	104,	34,	65,	47,	69,	33,	61,	50,	52,	31,
+gp,	102,	66,	80,	38,	26,	25,	9,	26,	24,	36,
TOTALNUM,	15503,	15986,	18042,	16006,	8512,	8956,	10009,	6490,	3989,	2715,
TONSLAND,	38133,	36979,	39484,	34595,	21391,	23182,	22068,	13487,	8655,	6735,
SOPCOF %,	97,	97,	95,	96,	96,	101,	98,	99,	106,	102,

Table 2.1.4

Extended survivors analysis.

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	1.3380,	1.1950,	.9050,	1.0990,	1.0930,	1.0610,	1.0100,	.9450,	.7790,	.9890,
3,	1.9500,	1.8880,	1.6580,	1.4590,	1.5170,	1.7490,	1.5970,	1.3000,	1.2710,	1.3640,
4,	2.4030,	2.9800,	2.6260,	2.0460,	2.1600,	2.3000,	2.2010,	1.9590,	1.5700,	1.7790,
5,	3.1070,	3.6790,	3.4000,	2.9360,	2.7660,	2.9140,	2.9340,	2.5310,	2.5240,	2.3120,
6,	4.1100,	4.4700,	3.7520,	3.7860,	3.9080,	3.1090,	3.4680,	3.2730,	3.1850,	3.4770,
7,	5.0200,	5.4880,	4.2200,	4.8990,	5.4610,	3.9760,	3.7500,	4.6520,	4.0860,	4.5450,
8,	5.6010,	6.4660,	4.7390,	5.8930,	6.3410,	4.8960,	4.6820,	4.7580,	5.6560,	6.2750,
9,	8.0130,	6.6280,	6.5110,	9.6990,	8.5090,	7.0870,	6.1400,	6.7040,	5.9730,	7.6190,
+gp,	8.0310,	10.9810,	10.9810,	8.8150,	9.8110,	8.2870,	9.1560,	8.6890,	8.1470,	9.7250,
SOPCOFAC,	.9695,	.9685,	.9491,	.9612,	.9642,	1.0061,	.9773,	.9897,	1.0597,	1.0197,

Table 2.1.5

Extended survivors analysis.

Table 5 Proportion mature at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	.6300,	.4000,	.0000,	.0000,	.0000,	.0600,	.0500,	.0000,	.0000,	.0600,
3,	.7100,	.9600,	.5000,	.3800,	.6700,	.7200,	.5400,	.6800,	.7200,	.5000,
4,	.9300,	.9800,	.9600,	.9300,	.9100,	.9000,	.9800,	.9000,	.8600,	.8200,
5,	.9400,	.9700,	.9600,	1.0000,	1.0000,	.9700,	1.0000,	.9900,	1.0000,	.9800,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9600,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	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 2.1.6

Stratified mean catch by age in number per trawl hour of COD in the Faroese Groundfish Surveys 1983-1993

Age/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.07	0.33	0.12	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
2	4.72	11.57	3.96	0.84	1.28	1.98	4.46	1.35	2.55	1.48	0.46
3	26.02	22.65	43.99	27.80	20.38	14.14	6.17	8.45	3.55	2.10	4.79
4	17.93	16.85	16.34	101.60	46.80	25.31	10.65	16.63	12.32	4.74	2.44
5	14.49	5.34	6.72	29.68	66.15	17.83	8.94	15.21	3.17	18.33	1.70
6	5.32	3.47	1.43	12.90	10.38	19.00	4.42	4.84	1.51	4.03	3.40
7	1.48	1.40	1.78	6.40	1.13	3.70	7.20	5.65	0.52	1.29	1.21
8	0.51	0.14	0.67	4.41	1.50	0.92	0.71	3.89	0.12	0.66	0.44
9	0.08	0.00	0.00	1.37	0.00	0.28	0.00	0.70	0.23	0.13	0.12

Table 2.1.7

Catch of cod in number ('000) by age and the corresponding effort for two commercial longline categories.

Category : Longliners 25-40 GRT

Age	1985	1986	1987	1988	1989	1990	1991	1992
1	0	0	1	0	0	0	0	0
2	84	6	18	24	112	9	9	4
3	476	79	25	41	71	66	15	7
4	122	151	47	18	52	24	57	6
5	57	43	58	13	23	16	11	8
6	28	18	14	21	21	6	5	2
7	43	5	3	5	17	4	2	1
8	11	3	1	2	3	4	1	0
9	3	1	1	0	0	1	1	0
10	3	0	0	0	0	0	0	0
Effort, days fishing	980	564	578	499	595	369	416	179
Catch, tonnes	1,478	571	353	232	461	215	143	46
Kg. per day	1,508	1,012	611	465	775	583	344	257

Category: Longliners 40-60 GRT

Age	1985	1986	1987	1988	1989	1990	1991	1992
1	0	0	4	0	0	0	0	0
2	174	16	57	109	374	40	31	21
3	983	216	76	185	238	287	52	39
4	253	415	146	82	172	106	202	32
5	118	118	180	60	77	70	38	45
6	57	49	44	95	69	26	16	10
7	89	15	10	23	55	19	6	4
8	23	9	4	8	9	19	3	2
9	5	2	4	2	1	3	2	1
10	6	1	1	1	0	2	1	2
Effort, days fishing	1,729	1,330	1,608	1,455	1,398	1,294	1,240	822
Catch, tonnes	3,050	1,574	1,093	1,053	1,535	933	510	267
Kg. per day	1,764	1,183	680	724	1,098	721	411	325

Table 2.1.8

Extended Survivors Analysis

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

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

Data for 3 fleets over 32 years
Age range from 2 to 9

Fleet,	Alpha,	Beta
LL25: Longliners 25-	, .000	, 1.000
LL40: Longliners 40	, .000	, 1.000
MH86: R/V MAGNUS HEI	, .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 :

Final estimates shrunk towards mean of the last 3 years and 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 35 iterations

Total absolute residual between iterations
34 and 35 = .000

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

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992
2,	.066,	.025,	.029,	.067,	.174,	.080,	.060,	.056
3,	.355,	.358,	.227,	.351,	.444,	.350,	.206,	.211
4,	.510,	.625,	.482,	.588,	.755,	.634,	.481,	.367
5,	.625,	.709,	.489,	.563,	.829,	.769,	.596,	.416
6,	.953,	.858,	.564,	.785,	1.016,	.839,	.689,	.693
7,	1.217,	.907,	.528,	.824,	1.100,	.960,	.822,	.825
8,	1.333,	.673,	.734,	1.012,	1.198,	1.253,	.956,	.993
9,	1.112,	.731,	.798,	1.027,	1.501,	1.028,	.789,	1.076

XSA population numbers

	AGE								
YEAR ,	2,	3,	4,	5,	6,	7,	8,	9,	Plus GP
1985 ,	1.72E+04,	3.50E+04,	1.05E+04,	3.97E+03,	1.39E+03,	1.37E+03,	4.64E+02,	1.07E+02,	1.29E+02,
1986 ,	9.28E+03,	1.32E+04,	2.01E+04,	5.16E+03,	1.74E+03,	4.37E+02,	3.32E+02,	1.00E+02,	7.99E+01,
1987 ,	9.95E+03,	7.41E+03,	7.54E+03,	8.81E+03,	2.08E+03,	6.04E+02,	1.45E+02,	1.39E+02,	5.15E+01,
1988 ,	8.67E+03,	7.91E+03,	4.84E+03,	3.81E+03,	4.42E+03,	9.69E+02,	2.92E+02,	5.68E+01,	4.23E+01,
1989 ,	1.55E+04,	6.63E+03,	4.56E+03,	2.20E+03,	1.78E+03,	1.65E+03,	3.48E+02,	8.68E+01,	1.25E+01,
1990 ,	3.50E+03,	1.07E+04,	3.49E+03,	1.75E+03,	7.86E+02,	5.27E+02,	4.50E+02,	8.60E+01,	4.39E+01,
1991 ,	3.61E+03,	2.64E+03,	6.16E+03,	1.51E+03,	6.66E+02,	2.78E+02,	1.65E+02,	1.05E+02,	4.79E+01,
1992 ,	4.34E+03,	2.79E+03,	1.76E+03,	3.12E+03,	6.83E+02,	2.74E+02,	1.00E+02,	5.20E+01,	5.92E+01,

Terminal population estimates.

0.00E+00, 3.35E+03, 1.85E+03, 9.99E+02, 1.68E+03, 2.80E+02, 9.82E+01, 3.04E+01, 3.11E+01,

(cont'd)

Table 2.1.8 (cont'd)

Log catchability residuals.

Fleet : LL25: Longliners 25-

Age	1985	1986	1987	1988	1989	1990	1991	1992
2	.03	-1.46	-.45	.14	.97	.37	.21	.06
3	.14	-.13	-.79	-.15	.44	.33	.05	.08
4	-.23	-.06	-.33	-.66	.36	.28	.39	.18
5	.02	.06	-.29	-.77	.29	.60	.18	-.10
6	.30	.14	-.44	-.54	.29	.26	.06	-.04
7	.77	.18	-.84	-.52	.10	.22	-.01	.16
8	.51	-.16	-.43	-.18	-.05	.48	-.14	.00

Mean catchability and Standard error.

Age	2	3	4	5	6	7	8	9
Mean Q	-12.11	-11.06	-10.78	-10.76	-10.57	-10.49	-10.47	-10.47
S.E	.69	.37	.37	.41	.32	.47	.34	.64

Fleet : LL40: Longliners 40

Age	1985	1986	1987	1988	1989	1990	1991	1992
2	-.02	-1.55	-.54	.37	1.11	.39	.14	-.02
3	.08	-.20	-.92	.06	.57	.32	-.02	.06
4	-.29	-.13	-.44	-.43	.48	.29	.34	.11
5	-.05	-.02	-.41	-.54	.41	.59	.10	-.12
6	.25	.09	-.51	-.30	.43	.27	-.07	-.15
7	.73	.23	-.84	-.26	.23	.33	-.19	-.17
8	.43	-.18	-.32	-.12	-.06	.53	-.39	.13

Mean catchability and Standard error.

Age	2	3	4	5	6	7	8	9
Mean Q	-11.89	-10.84	-10.56	-10.54	-10.37	-10.30	-10.22	-10.22
S.E	.76	.43	.36	.38	.31	.46	.33	.52

Fleet : MH86: R/V MAGNUS HEI

Age	1985	1986	1987	1988	1989	1990	1991	1992
2		-1.08	-.72	-.13	.15	.40	.99	.27
3		.49	.69	.32	-.29	-.49	-.03	-.61
4		.34	.49	.36	-.37	.29	-.65	-.40
5		.16	.34	-.11	-.13	.60	-.89	.06
6		.56	.04	-.02	-.47	.37	-.70	.26
7		1.19	-1.03	-.19	.06	.90	-.90	.02
8		.98	.75	-.32	-.68	.78	-1.81	.41

Mean catchability and Standard error.

Age	2	3	4	5	6	7	8	9
Mean Q	-12.73	-10.99	-9.85	-9.51	-9.59	-9.52	-9.50	-9.50
S.E	.69	.50	.46	.47	.45	.81	1.00	1.44

Table 2.1.9

Extended survivors analysis.

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	.0994,	.1075,	.0663,	.0253,	.0290,	.0671,	.1737,	.0799,	.0598,	.0564,
3,	.4700,	.3722,	.3553,	.3579,	.2270,	.3514,	.4436,	.3496,	.2063,	.2106,
4,	.5626,	.5849,	.5098,	.6254,	.4824,	.5880,	.7551,	.6340,	.4813,	.3673,
5,	.6560,	.6701,	.6249,	.7089,	.4889,	.5628,	.8287,	.7693,	.5960,	.4157,
6,	.7850,	.4717,	.9528,	.8584,	.5643,	.7853,	1.0162,	.8392,	.6893,	.6932,
7,	1.1263,	.4778,	1.2172,	.9072,	.5277,	.8235,	1.0999,	.9595,	.8219,	.8247,
8,	.9187,	.5265,	1.3326,	.6726,	.7338,	1.0124,	1.1982,	1.2529,	.9559,	.9927,
9,	1.0403,	.5081,	1.1115,	.7308,	.7984,	1.0269,	1.5009,	1.0284,	.7891,	1.0758,
+gp,	1.0403,	.5081,	1.1115,	.7308,	.7984,	1.0269,	1.5009,	1.0284,	.7891,	1.0758,
FBAR 3- 7,	.7200,	.5153,	.7320,	.6916,	.4581,	.6222,	.8287,	.7103,	.5590,	.5023,

Table 2.1.10

Extended survivors analysis.

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE											
2,	25107,	47667,	17192,	9284,	9951,	8666,	15506,	3499,	3615,	4335,	0,
3,	17007,	18611,	35049,	13173,	7411,	7915,	6635,	10671,	2644,	2788,	3355,
4,	7089,	8702,	10502,	20114,	7540,	4836,	4560,	3486,	6159,	1762,	1849,
5,	6308,	3307,	3970,	5164,	8811,	3811,	2199,	1755,	1514,	3116,	999,
6,	2446,	2680,	1385,	1740,	2081,	4425,	1777,	786,	666,	683,	1684,
7,	834,	914,	1369,	437,	604,	969,	1652,	527,	278,	274,	280,
8,	289,	221,	464,	332,	145,	292,	348,	450,	165,	100,	98,
9,	178,	94,	107,	100,	139,	57,	87,	86,	105,	52,	30,
+gp,	171,	181,	129,	80,	51,	42,	12,	44,	48,	59,	31,
TOTAL,	59429,	82378,	70167,	50424,	36733,	31012,	32777,	21303,	15194,	13168,	8325,

Table 2.1.11

Table 16 Summary (without SOP correction)

Extended survivors analysis.

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	FBAR 3- 7,
1983,	25107,	122048,	97633,	38133,	.7200,
1984,	47667,	151238,	114772,	36979,	.5153,
1985,	17192,	130033,	83775,	39484,	.7320,
1986,	9284,	98099,	73099,	34595,	.6916,
1987,	9951,	76810,	60757,	21391,	.4581,
1988,	8666,	65054,	51089,	23182,	.6222,
1989,	15506,	57380,	37427,	22068,	.8287,
1990,	3499,	36572,	27947,	13487,	.7103,
1991,	3615,	24877,	19767,	8655,	.5590,
1992,	4335,	23646,	17007,	6735,	.5023,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),	

Table 2.1.12

Cod in the Faroe Plateau (Fishing Area Vb1)

Prediction with management option table: Input data

Year: 1993								
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	6000.000	0.2000	0.2500	0.0000	0.0000	0.904	0.0560	0.904
3	5300.000	0.2000	0.7300	0.0000	0.0000	1.312	0.2110	1.312
4	2900.000	0.2000	0.7800	0.0000	0.0000	1.769	0.3670	1.769
5	999.000	0.2000	0.9100	0.0000	0.0000	2.456	0.4160	2.456
6	1684.000	0.2000	0.9900	0.0000	0.0000	3.312	0.6930	3.312
7	280.000	0.2000	1.0000	0.0000	0.0000	4.428	0.8250	4.428
8	98.000	0.2000	1.0000	0.0000	0.0000	5.563	0.9930	5.563
9	30.000	0.2000	1.0000	0.0000	0.0000	6.765	1.0760	6.765
10+	31.000	0.2000	1.0000	0.0000	0.0000	8.854	1.0760	8.854
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
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	6000.000	0.2000	0.1000	0.0000	0.0000	0.904	0.0560	0.904
3	.	0.2000	0.6500	0.0000	0.0000	1.312	0.2110	1.312
4	.	0.2000	0.8200	0.0000	0.0000	1.769	0.3670	1.769
5	.	0.2000	0.9600	0.0000	0.0000	2.456	0.4160	2.456
6	.	0.2000	1.0000	0.0000	0.0000	3.312	0.6930	3.312
7	.	0.2000	1.0000	0.0000	0.0000	4.428	0.8250	4.428
8	.	0.2000	1.0000	0.0000	0.0000	5.563	0.9930	5.563
9	.	0.2000	1.0000	0.0000	0.0000	6.765	1.0760	6.765
10+	.	0.2000	1.0000	0.0000	0.0000	8.854	1.0760	8.854
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	6000.000	0.2000	0.1000	0.0000	0.0000	0.904	0.0560	0.904
3	.	0.2000	0.6500	0.0000	0.0000	1.312	0.2110	1.312
4	.	0.2000	0.8200	0.0000	0.0000	1.769	0.3670	1.769
5	.	0.2000	0.9600	0.0000	0.0000	2.456	0.4160	2.456
6	.	0.2000	1.0000	0.0000	0.0000	3.312	0.6930	3.312
7	.	0.2000	1.0000	0.0000	0.0000	4.428	0.8250	4.428
8	.	0.2000	1.0000	0.0000	0.0000	5.563	0.9930	5.563
9	.	0.2000	1.0000	0.0000	0.0000	6.765	1.0760	6.765
10+	.	0.2000	1.0000	0.0000	0.0000	8.854	1.0760	8.854
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PMTAK2
Date and time: 09MAY93:11:25

Table 2.1.13

FARGE PLATEAU COD : GROUNDFISH SURVEYS/0-GROUP DATA

4 13 2

'YCLASS'	'VPA'	'GFAGE2'	'GFAGE3'	'GFAGE4'	'0-GROUP'
1979	13942	-11	-11	17.93	-11
1980	22031	-11	26.02	16.85	-11
1981	25107	4.72	22.65	16.34	-11
1982	47667	11.57	43.99	101.60	305
1983	17192	3.96	27.80	46.80	151
1984	9284	0.84	20.38	25.31	35
1985	9951	1.28	14.14	10.65	38
1986	8666	1.98	6.17	16.63	19
1987	15505	4.46	8.45	12.32	255
1988	3499	1.35	3.55	4.74	169
1989	-11	2.55	2.10	2.44	3
1990	-11	1.48	4.79	-11	23
1991	-11	0.46	-11	-11	1
1992	-11	-11	-11	-11	5

Table 2.1.14

FAROE PLATEAU COD : GROUNDFISH SURVEYS/0-GROUP DATA

Data for 4 surveys over 13 years : 1979 - 1991

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	.89	8.49	.12	.976	5	1.09	9.47	.181	.752
GFAGE3	1.96	3.49	.39	.755	6	1.97	7.35	.923	.035
GFAGE4	1.18	5.91	.74	.423	7	2.87	9.31	.962	.033
0-GROU	.75	6.32	.30	.908	4	3.00	8.58	.581	.089
					VPA Mean =		9.79	.576	.091

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	
GFAGE2	1.00	8.28	.22	.921	6	1.70	9.97	.299	.521
GFAGE3	1.33	5.66	.50	.663	7	2.25	8.65	.714	.091
GFAGE4	1.26	5.62	.72	.441	8	2.59	8.89	.941	.053
0-GROU	.67	6.77	.30	.886	5	5.55	10.49	.479	.203
					VPA Mean =		9.69	.594	.132

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	1.00	8.23	.24	.887	7	.85	9.08	.325	.547
GFAGE3	1.30	5.89	.58	.542	8	1.52	7.85	.944	.065
GFAGE4	1.24	5.76	.72	.411	9	1.75	7.94	1.052	.052
0-GROU	.65	6.71	.45	.713	6	5.14	10.06	.621	.150
					VPA Mean =		9.68	.556	.187

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	

(cont'd)

Table 2.1.14 (cont'd)

GFAGE2	1.41	7.55	.48	.756	8	1.27	9.34	.596	.364
GFAGE3	1.18	6.24	.50	.724	9	1.13	7.58	.758	.225
GFAGE4	1.16	6.03	.62	.603	10	1.24	7.47	.918	.153
0-GROU	1.75	1.48	1.90	.173	7	1.39	3.90	3.617	.010
					VPA Mean =		9.51	.722	.248

Yearclass = 1990

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
GFAGE2	1.42	7.54	.49	.751	8	.91	8.83	.626	.379
GFAGE3	1.18	6.25	.51	.722	9	1.76	8.32	.679	.322
GFAGE4									
0-GROU	1.78	1.33	1.95	.165	7	3.18	6.99	2.769	.019
					VPA Mean =		9.50	.727	.281

Yearclass = 1991

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
GFAGE2	1.43	7.52	.50	.746	8	.38	8.06	.716	.505
GFAGE3									
GFAGE4									
0-GROU	1.83	1.11	2.03	.155	7	.69	2.37	4.464	.013
					VPA Mean =		9.48	.733	.482

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1986	11369	9.34	.17	.24	1.84	8666	9.07
1987	19220	9.86	.22	.26	1.47	15505	9.65
1988	9913	9.20	.24	.30	1.57	3500	8.16
1989	5684	8.65	.36	.51	2.04		
1990	6761	8.82	.39	.30	.62		
1991	5846	8.67	.51	.71	1.97		

Table 2.1.15

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	0.1300	0.0000	0.0000	1.047	0.0560	1.047
3	.	0.2000	0.6500	0.0000	0.0000	1.542	0.2110	1.542
4	.	0.2000	0.9000	0.0000	0.0000	2.194	0.3670	2.194
5	.	0.2000	1.0000	0.0000	0.0000	2.980	0.4160	2.980
6	.	0.2000	1.0000	0.0000	0.0000	3.720	0.6930	3.720
7	.	0.2000	1.0000	0.0000	0.0000	4.721	0.8250	4.721
8	.	0.2000	1.0000	0.0000	0.0000	5.668	0.9930	5.668
9	.	0.2000	1.0000	0.0000	0.0000	7.298	1.0760	7.298
10+	.	0.2000	1.0000	0.0000	0.0000	9.623	1.0760	9.623
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YRAK1
Date and time: 09MAY93:19:31

Table 2.1.16

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	5.517	23049	4.293	21549	4.293	21549
0.1000	0.0502	0.188	986	4.581	15430	3.361	13936	3.361	13936
0.2000	0.1005	0.287	1301	4.089	11878	2.872	10390	2.872	10390
0.3000	0.1507	0.351	1411	3.771	9844	2.557	8362	2.557	8362
0.4000	0.2010	0.398	1445	3.542	8531	2.332	7055	2.332	7055
0.5000	0.2512	0.434	1449	3.365	7611	2.158	6141	2.158	6141
0.6000	0.3014	0.463	1442	3.222	6929	2.018	5465	2.018	5465
0.7000	0.3517	0.487	1430	3.103	6400	1.901	4942	1.901	4942
0.8000	0.4019	0.508	1417	3.000	5976	1.802	4523	1.802	4523
0.9000	0.4522	0.526	1404	2.911	5626	1.716	4179	1.716	4179
1.0000	0.5024	0.542	1391	2.833	5332	1.641	3890	1.641	3890
1.1000	0.5526	0.556	1379	2.763	5080	1.573	3644	1.573	3644
1.2000	0.6029	0.569	1368	2.700	4861	1.513	3430	1.513	3430
1.3000	0.6531	0.581	1357	2.642	4669	1.458	3243	1.458	3243
1.4000	0.7034	0.592	1347	2.590	4499	1.409	3078	1.409	3078
1.5000	0.7536	0.602	1337	2.542	4346	1.363	2930	1.363	2930
1.6000	0.8038	0.611	1329	2.497	4208	1.321	2797	1.321	2797
1.7000	0.8541	0.620	1320	2.456	4083	1.283	2677	1.283	2677
1.8000	0.9043	0.628	1312	2.417	3969	1.247	2567	1.247	2567
1.9000	0.9546	0.635	1305	2.381	3865	1.213	2468	1.213	2468
2.0000	1.0048	0.642	1297	2.348	3768	1.182	2376	1.182	2376
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YRAK1
Date and time : 09MAY93:19:31
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.2013
F-max factor : 0.4749
F-0.1 reference F : 0.1011
F-max reference F : 0.2386
Recruitment : Single recruit

Table 2.1.17

Cod in the Faroe Plateau (Fishing Area Vb1)

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
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	0.5024	27801	20449	7472	0.0000	0.0000	27525	19229	0	36114	27482
.	.	.	.	.	0.2000	0.1005	.	19229	1761	34012	25475
.	.	.	.	.	0.4000	0.2010	.	19229	3346	32122	23676
.	.	.	.	.	0.6000	0.3014	.	19229	4777	30417	22059
.	.	.	.	.	0.8000	0.4019	.	19229	6074	28877	20603
.	.	.	.	.	1.0000	0.5024	.	19229	7251	27480	19287
.	.	.	.	.	1.2000	0.6029	.	19229	8323	26210	18096
.	.	.	.	.	1.4000	0.7034	.	19229	9302	25053	17014
.	.	.	.	.	1.6000	0.8038	.	19229	10198	23996	16029
.	.	.	.	.	1.8000	0.9043	.	19229	11020	23028	15131
.	.	.	.	.	2.0000	1.0048	.	19229	11777	22139	14309
.	.	.	.	.	2.2000	1.1053	.	19229	12475	21321	13556
.	.	.	.	.	2.4000	1.2058	.	19229	13120	20567	12865
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PMTAK2
Date and time : 09MAY93:11:25
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1993 : F factors

Table 2.2.1

Faroe Bank COD in Subdivision Vb2.
Nominal catches (t) by countries 1983-1992, as officially reported to ICES.

Nation/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992 1)
Faroe Islands	2,284	2,189	2,913	1,836	3,409	2,960	1,270	289	297	129
France 2)										
Norway	17	11	23	6	23	94	128	72 1)	38 1)	32
UK (Engl.& Wales)										5
UK Scotland 3)	66	16	25	63	47	37	14	207	90	176
Total	2,367	2,216	2,961	1,905	3,479	3,091	1,412	568	425	342

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

Table 2.3.1 Faroe Plateau (Sub-Division Vb1) HADDOCK. Nominal catches (tonnes) by countries, 1980-1992, 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[2]
Denmark	8	4	-	-	-	-
Faroe Islands	13,954	10,867	13,506	11,106	8,074	4,629
France[1]	22	14	-	-	-	-
Germany	1	-	-	-	+	-
Norway	13	54	111	94[2]	125[2]	71
UK (Engl. & Wales)	2	-	-	7	-	54
UK (Scotland)	-[3]	-[3]	-[3]	-[3]	-[3]	-[3]
Total	14,000	10,939	13,617	11,207	8,199	4,754
Total used in the assessment[4,5]	14,882	12,178	14,325	12,448	8,715	6,005

[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.

Table 2.3.2 Faroe Bank (Sub-Division Vb2) HADDOCK. Nominal catches (tonnes) by countries, 1980-1992 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[2]
Faroe Islands	832	1,160	659	325	217	325
France[1]	-	-	-	-	-	-
Germany	-	-	-	-	-	-
Norway	5	43	16	97[2]	4[1]	23
UK (Engl. & Wales)	-	-	-	-	-	17
UK (Scotland)	45[3]	15[3]	30[3]	725[3]	287	869
Total	882	1,218	705	1,147	508	1,234

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

Table 2.3.3

Catches of haddock in Division Vb in 1982-1992 by fleet category Tonnes nom. weight											
Category	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Open boats	313	233	235	944	93	1665	74	898	186	250	32
Longliners < 100 GRT	2946	3319	3579	4771	6170	5932	4598	7698	8644	4509	2018
Longliners > 100 GRT	902	1250	1408	1547	1667	1611	2018	2301	1877	1482	1017
Single Trawlers	2797	2020	1792	1582	876	911	734	844	474	329	194
Pair trawlers	1923	3860	2554	2813	3692	3507	2242	1658	1443	1440	1082
Others	3056	2212	2812	3686	1979	1256	2512	1128	1824	725	1909
Total	11937	12894	12378	5143	14477	14882	12178	14325	12448	8715	9002

Table 2.3.4

Haddock in ICES Division Vb
Catch at age 1992 by fleet category

Age	Open Boats	LLiners < 100GRT	LLiners > 100GRT	S.trawl < 1000HP	S.trawl > 1000HP	P trawl. < 1000HP	P trawl. > 1000HP	Others	Foreign Trawlers	Foreign Lo-liner	Total
1	0	0	0	0	0	0	0	0	0	0	0
2	1	33	4	0	0	0	0	6	0	0	44
3	4	96	27	6	0	13	1	18	2	3	170
4	15	390	89	64	7	105	34	84	60	8	856
5	18	446	208	47	11	118	95	116	156	20	1235
6	10	262	181	24	14	80	133	118	218	17	1057
7	2	60	91	11	5	19	46	51	76	9	370
8	6	143	68	16	5	21	36	49	61	7	412
9	7	168	59	12	5	25	44	43	73	6	442
10+	3	78	30	4	2	7	13	18	21	3	179
Total	66	1676	757	184	49	388	402	503	667	73	4765
Catch. t	70	1770	883	169	61	391	510	620	848	85	5407

Notes: Numbers in 1000'
Gutted weight in tonnes
Fishery with snella (jigging) included in single trawlers < 1000 HP
Under others mainly catches not included in the sampling system (BIOHAG)
LLiners = Longliners; S.trawl = Single trawlers; P.trawl = Pair trawlers

Table 2.3.5

Run title : Haddock in the Faroe Grounds (Fishing Area Vb) (run name: REIN1.HAD)

At 6-May-93 19:25

Traditional vpa Terminal populations from weighted Separable populations

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	441,	1195,	985,	230,	283,	655,	63,	112,	80,	44,
3,	1969,	1561,	4553,	2549,	1718,	444,	1520,	1354,	1080,	170,
4,	383,	2462,	2196,	4452,	3565,	2463,	659,	2040,	1835,	856,
5,	422,	147,	1242,	1522,	2972,	3036,	2792,	815,	1292,	1236,
6,	93,	234,	169,	738,	1114,	2140,	2559,	1845,	674,	1058,
7,	1444,	42,	91,	39,	529,	475,	1979,	2027,	1139,	370,
8,	740,	861,	61,	130,	83,	151,	542,	939,	723,	412,
9,	947,	388,	503,	71,	48,	18,	133,	286,	328,	442,
+gp,	795,	968,	973,	712,	334,	128,	81,	114,	34,	179,
TOTALNUM,	7234,	7858,	10773,	10443,	10646,	9510,	10328,	9532,	7185,	4767,
TONSLAND,	12894,	12378,	15143,	14477,	14882,	12178,	14325,	12448,	8719,	6005,
SOPCOF %,	106,	106,	106,	101,	102,	97,	100,	102,	106,	105,

Table 2.3.6

Traditional vpa Terminal populations from weighted Separable populations

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	.4700,	.6810,	.5280,	.6080,	.6050,	.5010,	.5800,	.4380,	.5470,	.5250,
3,	.7400,	1.0110,	.8590,	.8870,	.8310,	.7810,	.7790,	.6990,	.6930,	.7240,
4,	1.0100,	1.2550,	1.3910,	1.1750,	1.1260,	.9740,	.9230,	.9390,	.8840,	.8170,
5,	1.3200,	1.8120,	1.7770,	1.6310,	1.4620,	1.3630,	1.2070,	1.2040,	1.0860,	1.0380,
6,	1.6600,	2.0610,	2.3260,	1.9840,	1.9410,	1.6800,	1.5640,	1.3840,	1.2760,	1.2490,
7,	2.0500,	2.0590,	2.4400,	2.5190,	2.1730,	1.9750,	1.7460,	1.5640,	1.4770,	1.4300,
8,	2.2600,	2.1370,	2.4010,	2.5830,	2.3470,	2.3440,	2.0860,	1.8180,	1.5740,	1.5640,
9,	2.5400,	2.3680,	2.5320,	2.5700,	3.1180,	2.2480,	2.4240,	2.1680,	1.9300,	1.6330,
+gp,	3.0400,	2.6860,	2.6860,	2.9220,	2.9330,	3.2950,	2.5140,	2.3350,	2.1530,	2.1260,
SOPCOFAC,	1.0554,	1.0602,	1.0559,	1.0141,	1.0197,	.9695,	1.0008,	1.0195,	1.0628,	1.0488,

Table 2.3.7

Traditional vpa Terminal populations from weighted Separable populations

Table 5 Proportion mature at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	.1500,	.1000,	.0000,	.0000,	.0900,	.0500,	.0000,	.0000,	.2500,	.2200,
3,	.7900,	.7800,	.7200,	.3500,	.2200,	.3800,	.1200,	.1600,	.8200,	.7500,
4,	1.0000,	.9500,	1.0000,	.9200,	.9300,	.8900,	.8600,	.8700,	.9800,	.9300,
5,	1.0000,	1.0000,	1.0000,	1.0000,	.9600,	.9900,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	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 2.3.8

```
FAROE HADDOCK  (ICES DIVISION Vb)
103
R/V MAGNUS HEINASON (Groundfish Surveys)
1983 1992
1 1
2 10
100  27.8  16.8   2.3   1.7   0.0   6.2   2.2   2.5  1.1
100 116.4  23.1  10.3   0.5   0.6   0.2   2.0   0.7  2.6
100  67.3  35.0   6.7   2.2   0.0   0.3   0.2   1.0  0.6
100 114.6  48.5  22.4   4.3   0.8   0.0   0.1   0.3  1.6
100  11.7  26.9  17.2   8.9   1.6   0.0   0.0   0.0  0.1
100  88.5  15.8  22.5  11.5   3.7   1.0   0.1   0.1  0.2
100 150.0 115.2   8.7  24.3  33.3  20.3   2.5   0.0  0.0
100  48.0  65.5  24.7   2.6   7.9   8.1   3.9   0.9  0.1
100  20.0  14.1  10.2   4.0   1.5   1.2   0.3   0.1  0.0
100  27.7   8.8  16.0   7.1   5.4   1.7   1.3   0.6  0.2
LONGLINERS 25-40 BRT
1985 1992
1 1
2 10
980  82 342 106  41   9   3   4  16  40
564  18 155 188  57  28   1   5   2  22
578  22 112 198 122  36  17   2   1  10
499  43  22 111 100  55  10   3   0   2
595   4  89  37 143 116  86  27   6   5
369   0  38  73  17  50  55  29  10   6
416   2  29  47  25  11  22  15   7   1
179   1   3  12  13   8   2   4   5   2
LONGLINERS 40-60 BRT
1985 1992
1 1
2 10
1729 165 683 211  82  18   6   8  32  79
1330  50 428 521 158  76   4  15   4  61
1608  67 345 612 376 111  52   7   4  32
1455 167  87 435 392 214  39  11   1   9
1398  11 243 101 390 317 236  73  17  12
1294   0 154 297  69 203 226 117  41  25
1240  11 156 248 131  60 119  82  36   3
 822   5  16  65  75  44  10  24  28  13
```

Table 2.3.9

Fleet 1. R/V Magnus Heinason - The Faroese Groundfish Surveys 1983-93
Stratified mean catch by age in numbers per trawl hour of haddock

Year/Age	1	2	3	4	5	6	7	8	9	10+	Total
1983	48.09	27.82	16.75	2.337	1.735	0	6.243	2.188	2.529	1.098	108.8
1984	114.8	116.4	23.12	10.31	0.47	0.573	0.212	1.994	0.72	2.606	271.2
1985	200.6	67.25	35.04	6.681	2.151	0	0.285	0.181	1.019	0.627	313.8
1986	26.6	114.6	48.54	22.35	4.322	0.804	0	0.1	0.328	1.593	219.2
1987	42.25	11.65	26.88	17.19	8.914	1.582	0	0	0	0.134	108.6
1988	41	88.49	15.83	22.53	11.46	3.721	0.951	0.131	0.097	0.206	184.4
1989	42.71	150	115.2	8.691	24.28	33.33	20.29	2.46	0	0.018	397
1990	3.109	47.98	65.52	24.74	2.591	7.939	8.057	3.905	0.896	0.014	164.7
1991	5.189	19.97	14.05	10.16	4.012	1.555	1.165	0.322	0.106	0.015	56.5
1992	5.813	27.72	8.759	16.02	7.148	5.351	1.672	1.254	0.586	0.175	74.5
1993	28.82	9.39	10.21	6.416	6.696	5.052	2.798	0.775	0.547	0.892	71.6

Table 2.3.10

Fleet 2 Longliners 25-40 BRT
Catch and effort data of haddock in Division Vb 1985-92
Catch at age in numbers*1000 and effort in days

Age/Year	1985	1986	1987	1988	1989	1990	1991	1992
1	0	0	0	0	0	0	0	0
2	82	18	22	43	4	0	2	1
3	342	155	112	22	89	38	29	3
4	106	188	198	111	37	73	47	12
5	41	57	122	100	143	17	25	13
6	9	28	36	55	116	50	11	8
7	3	1	17	10	86	55	22	2
8	4	5	2	3	27	29	15	4
9	16	2	1	0	6	10	7	5
10+	40	22	10	2	5	6	1	2
Total number	643	476	520	346	513	278	159	50
Total tonnes	712	543	589	373	632	330	169	53
Fishing days	980	564	578	499	595	369	416	179
Tonnes per day	0.727	0.963	1.019	0.747	1.062	0.894	0.406	0.296

Table 2.3.11

Fleet 3 Longliners 40-60 BRT
Catch and effort data of haddock in Division Vb 1985-92
Catch at age in numbers*1000 and effort in days

Age/Year	1985	1986	1987	1988	1989	1990	1991	1992
1	0	0	0	0	0	0	0	0
2	165	50	67	167	11	0	11	5
3	683	428	345	87	243	154	156	16
4	211	521	612	435	101	297	248	65
5	82	158	376	392	390	69	131	75
6	18	76	111	214	317	203	60	44
7	6	4	52	39	236	226	119	10
8	8	15	7	11	73	117	82	24
9	32	4	4	1	17	41	36	28
10+	79	61	32	9	12	25	3	13
Total number	1284	1317	1606	1355	1400	1132	846	280
Total tonnes	1423	1503	1822	1455	1731	1347	901	296
Fishing days	1729	1330	1608	1455	1398	1294	1240	822
Tonnes per day	0.823	1.13	1.133	1	1.238	1.041	0.727	0.36

Table 2.3.12

Extended Survivors Analysis

Haddock in the Faroe Grounds (Fishing Area Vb) (run name: JR32.HAD)

CPUE data from file /users/ifad/ifapwork/wg_109/had_farp/FLEET.H32

Data for 3 fleets over 5 years
Age range from 2 to 9

Fleet,	Alpha,	Beta
MH93: magnus heinaso	, .000	, 1.000
ll1: Longliners 25-4	, .000	, 1.000
ll2: Longliners 40-6	, .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 :

Final estimates shrunk towards mean of the last 3 years and the 3 oldest ages.
S.E. of the mean to which the estimates are shrunk = .100
Minimum standard error for population estimates derived from each fleet = .300
Prior weighting not applied

Tuning converged after 20 iterations

Total absolute residual between iterations
19 and 20 = .000

Regression weights
, .820, .921, .976, .997, 1.000

Fishing mortalities

Age,	1988,	1989,	1990,	1991,	1992
2,	.050,	.005,	.018,	.063,	.039
3,	.087,	.156,	.153,	.243,	.183
4,	.215,	.181,	.325,	.319,	.309
5,	.278,	.404,	.357,	.353,	.370
6,	.349,	.400,	.514,	.567,	.550
7,	.272,	.637,	.645,	.707,	.717
8,	.360,	.573,	.726,	.502,	.605
9,	.323,	.627,	.690,	.607,	.668

XSA population numbers

	AGE								
YEAR ,	2,	3,	4,	5,	6,	7,	8,	9,	Plus GP
1988 ,	1.49E+04,	5.86E+03,	1.41E+04,	1.38E+04,	8.04E+03,	2.20E+03,	5.52E+02,	7.21E+01,	5.09E+02,
1989 ,	1.30E+04,	1.16E+04,	4.40E+03,	9.28E+03,	8.58E+03,	4.64E+03,	1.37E+03,	3.16E+02,	1.90E+02,
1990 ,	6.89E+03,	1.06E+04,	8.12E+03,	3.00E+03,	5.07E+03,	4.71E+03,	2.01E+03,	6.34E+02,	2.49E+02,
1991 ,	1.46E+03,	5.54E+03,	7.42E+03,	4.80E+03,	1.72E+03,	2.48E+03,	2.02E+03,	7.96E+02,	8.16E+01,
1992 ,	1.28E+03,	1.12E+03,	3.56E+03,	4.41E+03,	2.76E+03,	7.99E+02,	1.00E+03,	1.00E+03,	4.01E+02,

Terminal population estimates.

,	0.00E+00,	1.01E+03,	7.64E+02,	2.14E+03,	2.49E+03,	1.31E+03,	3.19E+02,	4.48E+02,	5.90E+02,

(cont'd)

Table 2.3.12 (cont'd)

Log catchability residuals.

Fleet : MH93: magnus heinaso

Age	1988	1989	1990	1991	1992
2	-.61	.04	-.46	.24	.68
3	-.68	.66	.18	-.66	.43
4	-.39	-.19	.30	-.49	.69
5	-.41	.80	-.33	-.37	.29
6	-1.17	.98	.12	-.43	.37
7	-1.21	1.22	.29	-.95	.53
8	-1.41	1.00	1.13	-1.54	.67

Mean catchability and Standard error.

Age	2	3	4	5	6	7	8	9
Mean Q	-9.00	-9.70	-10.45	-11.06	-10.86	-10.87	-11.55	-11.55
S.E	.51	.60	.49	.51	.77	.98	1.28	1.64

Fleet : ll1: Longliners 25-4

Age	1988	1989	1990	1991	1992
2	.83	-1.61	.00	.27	.54
3	-.45	.12	-.16	.14	.28
4	-.12	-.25	.36	-.11	.10
5	-.16	.48	-.06	-.27	.01
6	-.36	.17	.39	-.14	-.10
7	-.92	.47	.49	.12	-.29
8	-.83	.38	.61	-.27	.00

Mean catchability and Standard error.

Age	2	3	4	5	6	7	8	9
Mean Q	-12.76	-11.21	-10.73	-10.76	-10.58	-10.46	-10.34	-10.34
S.E	1.05	.28	.23	.28	.28	.56	.53	.77

Fleet : ll2: Longliners 40-6

Age	1988	1989	1990	1991	1992
2	.82	-1.74	.00	.59	.33
3	-.42	.00	-.29	.46	.16
4	-.09	-.37	.24	.19	-.01
5	-.14	.35	-.20	.02	-.04
6	-.34	.05	.26	.18	-.20
7	-.89	.37	.39	.46	-.46
8	-.88	.24	.47	.06	-.01

Mean catchability and Standard error.

Age	2	3	4	5	6	7	8	9
Mean Q	-12.48	-10.94	-10.46	-10.48	-10.30	-10.20	-10.05	-10.05
S.E	1.13	.34	.24	.21	.24	.58	.48	.81

Table 2.3.13

Extended survivors analysis.

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
2,	.0274,	.0347,	.0310,	.0109,	.0428,	.0498,	.0054,	.0181,	.0626,	.0386,
3,	.2032,	.1281,	.1798,	.1049,	.1049,	.0875,	.1565,	.1529,	.2428,	.1835,
4,	.3667,	.4216,	.2678,	.2681,	.2095,	.2152,	.1812,	.3252,	.3194,	.3092,
5,	.3935,	.2327,	.3903,	.3010,	.2887,	.2777,	.4041,	.3567,	.3528,	.3704,
6,	.1735,	.3953,	.4588,	.4254,	.3768,	.3486,	.3997,	.5141,	.5673,	.5502,
7,	.2805,	.1104,	.2617,	.1792,	.6240,	.2722,	.6369,	.6451,	.7069,	.7173,
8,	.2401,	.2690,	.2320,	.7382,	.7138,	.3596,	.5729,	.7260,	.5021,	.6052,
9,	.2624,	.1909,	.2488,	.4639,	.6783,	.3229,	.6267,	.6900,	.6072,	.6676,
+gp,	.2624,	.1909,	.2488,	.4639,	.6783,	.3229,	.6267,	.6900,	.6072,	.6676,
FBAR 3- 7,	.2835,	.2576,	.3117,	.2557,	.3208,	.2402,	.3557,	.3988,	.4378,	.4261,

Table 2.3.14

Extended survivors analysis.

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE											
2,	18007,	38676,	35625,	23546,	7469,	14890,	12963,	6888,	1457,	1284,	0,
3,	11836,	14344,	30584,	28276,	19070,	5859,	11599,	10557,	5538,	1121,	1011,
4,	1379,	7909,	10332,	20920,	20844,	14058,	4395,	8121,	7418,	3557,	764,
5,	1434,	782,	4248,	6472,	13100,	13840,	9281,	3002,	4803,	4413,	2138,
6,	645,	792,	508,	2354,	3921,	8036,	8584,	5073,	1721,	2763,	2495,
7,	6524,	444,	437,	263,	1259,	2203,	4643,	4712,	2484,	799,	1305,
8,	3831,	4035,	326,	275,	180,	552,	1374,	2011,	2024,	1003,	319,
9,	4535,	2467,	2524,	211,	108,	72,	316,	634,	796,	1003,	448,
+gp,	3784,	6125,	4855,	2100,	740,	509,	190,	249,	82,	401,	590,
TOTAL,	51975,	75574,	89436,	84417,	66690,	60019,	53344,	41246,	26322,	16343,	9069,

Table 2.3.15

Table 16 Summary (without SOP correction)

Extended survivors analysis.

,	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	FBAR 3- 7,
1983,	18007,	66631,	57598,	12894,	.2835,
1984,	38676,	85646,	58255,	12378,	.2576,
1985,	35625,	89459,	63294,	15143,	.3117,
1986,	23546,	87256,	54671,	14477,	.2557,
1987,	7469,	76263,	57382,	14882,	.3208,
1988,	14890,	65577,	53688,	12178,	.2402,
1989,	12963,	57453,	41415,	14325,	.3557,
1990,	6888,	41639,	31433,	12448,	.3988,
1991,	1457,	27171,	25751,	8719,	.4378,
1992,	1284,	17624,	16692,	6005,	.4261,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),	

Table 2.3.16

Prediction with management option table: Input data

Year: 1993								
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	11200.000	0.2000	0.0800	0.0000	0.0000	0.503	0.0400	0.503
3	8890.000	0.2000	0.3900	0.0000	0.0000	0.705	0.1950	0.705
4	764.000	0.2000	0.8100	0.0000	0.0000	0.880	0.3220	0.880
5	2138.000	0.2000	1.0000	0.0000	0.0000	1.109	0.3640	1.109
6	2495.000	0.2000	1.0000	0.0000	0.0000	1.303	0.5510	1.303
7	1305.000	0.2000	1.0000	0.0000	0.0000	1.490	0.6980	1.490
8	319.000	0.2000	1.0000	0.0000	0.0000	1.652	0.6180	1.652
9	448.000	0.2000	1.0000	0.0000	0.0000	1.910	0.6630	1.910
10+	590.000	0.2000	1.0000	0.0000	0.0000	2.205	0.6630	2.205
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
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	11200.000	0.2000	0.0600	0.0000	0.0000	0.503	0.0400	0.503
3	.	0.2000	0.4400	0.0000	0.0000	0.705	0.1950	0.705
4	.	0.2000	0.8900	0.0000	0.0000	0.880	0.3220	0.880
5	.	0.2000	0.9900	0.0000	0.0000	1.109	0.3640	1.109
6	.	0.2000	1.0000	0.0000	0.0000	1.303	0.5510	1.303
7	.	0.2000	1.0000	0.0000	0.0000	1.490	0.6980	1.490
8	.	0.2000	1.0000	0.0000	0.0000	1.652	0.6180	1.652
9	.	0.2000	1.0000	0.0000	0.0000	1.910	0.6630	1.910
10+	.	0.2000	1.0000	0.0000	0.0000	2.205	0.6630	2.205
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	11200.000	0.2000	0.0600	0.0000	0.0000	0.503	0.0400	0.503
3	.	0.2000	0.4400	0.0000	0.0000	0.705	0.1950	0.705
4	.	0.2000	0.8900	0.0000	0.0000	0.880	0.3220	0.880
5	.	0.2000	0.9900	0.0000	0.0000	1.109	0.3640	1.109
6	.	0.2000	1.0000	0.0000	0.0000	1.303	0.5510	1.303
7	.	0.2000	1.0000	0.0000	0.0000	1.490	0.6980	1.490
8	.	0.2000	1.0000	0.0000	0.0000	1.652	0.6180	1.652
9	.	0.2000	1.0000	0.0000	0.0000	1.910	0.6630	1.910
10+	.	0.2000	1.0000	0.0000	0.0000	2.205	0.6630	2.205
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : REIN1.PRED
Date and time: 10MAY93:09:39

Table 2.3.17

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
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	0.4260	22831	13692	5375	0.0000	0.0000	23077	13713	0	29329	19655
.	.	.	.	.	0.1000	0.0426	.	13713	601	28687	19043
.	.	.	.	.	0.2000	0.0852	.	13713	1176	28072	18458
.	.	.	.	.	0.3000	0.1278	.	13713	1728	27484	17898
.	.	.	.	.	0.4000	0.1704	.	13713	2256	26920	17363
.	.	.	.	.	0.5000	0.2130	.	13713	2762	26379	16850
.	.	.	.	.	0.6000	0.2556	.	13713	3248	25861	16360
.	.	.	.	.	0.7000	0.2982	.	13713	3714	25363	15890
.	.	.	.	.	0.8000	0.3408	.	13713	4162	24886	15439
.	.	.	.	.	0.9000	0.3834	.	13713	4592	24427	15008
.	.	.	.	.	1.0000	0.4260	.	13713	5005	23987	14594
.	.	.	.	.	1.1000	0.4686	.	13713	5402	23564	14197
.	.	.	.	.	1.2000	0.5112	.	13713	5784	23157	13816
.	.	.	.	.	1.3000	0.5538	.	13713	6151	22765	13450
.	.	.	.	.	1.4000	0.5964	.	13713	6504	22389	13099
.	.	.	.	.	1.5000	0.6390	.	13713	6845	22026	12761
.	.	.	.	.	1.6000	0.6816	.	13713	7173	21677	12437
.	.	.	.	.	1.7000	0.7242	.	13713	7489	21340	12125
.	.	.	.	.	1.8000	0.7668	.	13713	7793	21016	11825
.	.	.	.	.	1.9000	0.8094	.	13713	8087	20704	11536
.	.	.	.	.	2.0000	0.8520	.	13713	8371	20402	11258
.	.	.	.	.	2.1000	0.8946	.	13713	8644	20111	10991
.	.	.	.	.	2.2000	0.9372	.	13713	8909	19830	10733
.	.	.	.	.	2.3000	0.9798	.	13713	9164	19559	10484
.	.	.	.	.	2.4000	1.0224	.	13713	9411	19297	10245
.	.	.	.	.	2.5000	1.0650	.	13713	9649	19044	10014
.	.	.	.	.	2.6000	1.1076	.	13713	9880	18799	9791
.	.	.	.	.	2.7000	1.1502	.	13713	10103	18562	9576
.	.	.	.	.	2.8000	1.1928	.	13713	10319	18333	9369
.	.	.	.	.	2.9000	1.2354	.	13713	10528	18111	9168
.	.	.	.	.	3.0000	1.2780	.	13713	10731	17896	8975
.	.	.	.	.	3.1000	1.3206	.	13713	10927	17688	8788
.	.	.	.	.	3.2000	1.3632	.	13713	11118	17486	8607
.	.	.	.	.	3.3000	1.4058	.	13713	11302	17291	8432
.	.	.	.	.	3.4000	1.4484	.	13713	11481	17102	8263
.	.	.	.	.	3.5000	1.4910	.	13713	11655	16918	8100
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : REIN1.PRED
Date and time : 10MAY93:09:39
Computation of ref. F: Simple mean, age 3 - 7
Basis for 1993 : F factors

Table 2.3.18

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	0.0855	0.0000	0.0000	0.503	0.0400	0.503
3	.	0.2000	0.4982	0.0000	0.0000	0.705	0.1950	0.705
4	.	0.2000	0.9218	0.0000	0.0000	0.880	0.3220	0.880
5	.	0.2000	0.9955	0.0000	0.0000	1.109	0.3640	1.109
6	.	0.2000	0.9982	0.0000	0.0000	1.303	0.5510	1.303
7	.	0.2000	1.0000	0.0000	0.0000	1.490	0.6980	1.490
8	.	0.2000	1.0000	0.0000	0.0000	1.652	0.6180	1.652
9	.	0.2000	1.0000	0.0000	0.0000	1.910	0.6630	1.910
10+	.	0.2000	1.0000	0.0000	0.0000	2.205	0.6630	2.205
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : REIN16.HAD
Date and time: 10MAY93:11:07

Table 2.3.19

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	5.517	6837	4.136	6037	4.136	6037
0.1000	0.0426	0.153	223	4.757	5343	3.379	4545	3.379	4545
0.2000	0.0852	0.248	338	4.285	4460	2.910	3665	2.910	3665
0.3000	0.1278	0.314	403	3.957	3880	2.585	3087	2.585	3087
0.4000	0.1704	0.363	443	3.714	3469	2.345	2679	2.345	2679
0.5000	0.2130	0.401	469	3.524	3164	2.158	2376	2.158	2376
0.6000	0.2556	0.433	486	3.370	2927	2.006	2142	2.006	2142
0.7000	0.2982	0.459	498	3.242	2738	1.881	1955	1.881	1955
0.8000	0.3408	0.481	507	3.132	2583	1.775	1802	1.775	1802
0.9000	0.3834	0.500	513	3.038	2453	1.683	1674	1.683	1674
1.0000	0.4260	0.517	517	2.955	2342	1.602	1565	1.602	1565
1.1000	0.4686	0.532	521	2.881	2247	1.531	1472	1.531	1472
1.2000	0.5112	0.546	523	2.815	2163	1.468	1390	1.468	1390
1.3000	0.5538	0.558	525	2.755	2089	1.410	1318	1.410	1318
1.4000	0.5964	0.569	527	2.701	2023	1.358	1254	1.358	1254
1.5000	0.6390	0.580	528	2.651	1963	1.311	1196	1.311	1196
1.6000	0.6816	0.589	529	2.604	1909	1.267	1144	1.267	1144
1.7000	0.7242	0.598	529	2.562	1860	1.227	1097	1.227	1097
1.8000	0.7668	0.606	530	2.522	1815	1.190	1054	1.190	1054
1.9000	0.8094	0.614	530	2.485	1774	1.155	1014	1.155	1014
2.0000	0.8520	0.621	530	2.451	1735	1.123	978	1.123	978
2.1000	0.8946	0.628	531	2.418	1700	1.093	944	1.093	944
2.2000	0.9372	0.634	531	2.388	1667	1.065	913	1.065	913
2.3000	0.9798	0.640	531	2.359	1636	1.038	884	1.038	884
2.4000	1.0224	0.646	531	2.331	1607	1.013	856	1.013	856
2.5000	1.0650	0.651	531	2.305	1580	0.989	831	0.989	831
2.6000	1.1076	0.656	530	2.281	1555	0.967	807	0.967	807
2.7000	1.1502	0.661	530	2.258	1530	0.946	785	0.946	785
2.8000	1.1928	0.666	530	2.235	1508	0.926	764	0.926	764
2.9000	1.2354	0.670	530	2.214	1486	0.907	744	0.907	744
3.0000	1.2780	0.675	530	2.194	1466	0.889	725	0.889	725
3.1000	1.3206	0.679	529	2.174	1447	0.871	707	0.871	707
3.2000	1.3632	0.683	529	2.156	1428	0.855	691	0.855	691
3.3000	1.4058	0.686	529	2.138	1411	0.839	675	0.839	675
3.4000	1.4484	0.690	529	2.121	1394	0.824	659	0.824	659
3.5000	1.4910	0.693	528	2.105	1378	0.809	645	0.809	645
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : REIN16.HAD
Date and time : 10MAY93:11:07
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.3987
F-max factor : 2.2376
F-0.1 reference F : 0.1699
F-max reference F : 0.9532
Recruitment : Single recruit

Table 2.3.20

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	0.0855	0.0000	0.0000	0.519	0.0420	0.519
3	.	0.2000	0.4982	0.0000	0.0000	0.777	0.2020	0.777
4	.	0.2000	0.9218	0.0000	0.0000	1.032	0.3540	1.032
5	.	0.2000	0.9955	0.0000	0.0000	1.357	0.4420	1.357
6	.	0.2000	0.9982	0.0000	0.0000	1.692	0.5520	1.692
7	.	0.2000	1.0000	0.0000	0.0000	1.982	0.5810	1.982
8	.	0.2000	1.0000	0.0000	0.0000	2.177	0.6510	2.177
9	.	0.2000	1.0000	0.0000	0.0000	2.435	0.6500	2.435
10+	.	0.2000	1.0000	0.0000	0.0000	2.821	0.6500	2.821
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : EYKA5.VPA
Date and time: 10MAY93:11:21

Table 2.3.21

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	5.517	8480	4.136	7627	4.136	7627
0.1000	0.0426	0.155	282	4.746	6546	3.368	5696	3.368	5696
0.2000	0.0852	0.252	427	4.264	5395	2.889	4548	2.889	4548
0.3000	0.1279	0.320	507	3.928	4636	2.556	3792	2.556	3792
0.4000	0.1705	0.370	555	3.679	4100	2.310	3259	2.310	3259
0.5000	0.2131	0.409	584	3.484	3701	2.118	2862	2.118	2862
0.6000	0.2557	0.441	602	3.326	3393	1.964	2557	1.964	2557
0.7000	0.2983	0.468	614	3.196	3147	1.836	2314	1.836	2314
0.8000	0.3410	0.490	621	3.085	2947	1.728	2116	1.728	2116
0.9000	0.3836	0.510	625	2.989	2780	1.635	1952	1.635	1952
1.0000	0.4262	0.527	628	2.906	2639	1.554	1814	1.554	1814
1.1000	0.4688	0.542	629	2.832	2518	1.483	1695	1.483	1695
1.2000	0.5114	0.556	629	2.765	2413	1.420	1592	1.420	1592
1.3000	0.5541	0.568	629	2.706	2320	1.363	1502	1.363	1502
1.4000	0.5967	0.579	628	2.652	2238	1.311	1422	1.311	1422
1.5000	0.6393	0.589	627	2.602	2165	1.264	1351	1.264	1351
1.6000	0.6819	0.599	626	2.557	2099	1.222	1288	1.222	1288
1.7000	0.7245	0.608	624	2.515	2040	1.182	1231	1.182	1231
1.8000	0.7672	0.616	623	2.476	1985	1.146	1179	1.146	1179
1.9000	0.8098	0.623	621	2.440	1936	1.113	1131	1.113	1131
2.0000	0.8524	0.630	620	2.407	1890	1.081	1088	1.081	1088
2.1000	0.8950	0.637	618	2.375	1848	1.052	1048	1.052	1048
2.2000	0.9376	0.643	617	2.345	1810	1.025	1011	1.025	1011
2.3000	0.9803	0.649	615	2.318	1773	0.999	977	0.999	977
2.4000	1.0229	0.654	614	2.291	1740	0.975	945	0.975	945
2.5000	1.0655	0.659	612	2.266	1708	0.953	916	0.953	916
2.6000	1.1081	0.664	611	2.243	1679	0.931	889	0.931	889
2.7000	1.1507	0.669	609	2.220	1651	0.911	863	0.911	863
2.8000	1.1934	0.674	608	2.199	1625	0.892	839	0.892	839
2.9000	1.2360	0.678	606	2.178	1601	0.874	816	0.874	816
3.0000	1.2786	0.682	605	2.159	1577	0.856	795	0.856	795
3.1000	1.3212	0.686	604	2.140	1555	0.840	774	0.840	774
3.2000	1.3638	0.690	602	2.122	1534	0.824	755	0.824	755
3.3000	1.4065	0.693	601	2.105	1515	0.809	737	0.809	737
3.4000	1.4491	0.697	600	2.089	1496	0.795	720	0.795	720
3.5000	1.4917	0.700	599	2.073	1478	0.781	704	0.781	704
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : EYKA5.VPA
Date and time : 10MAY93:11:21
Computation of ref. F: Simple mean, age 3 - 7
F-0.1 factor : 0.3819
F-max factor : 1.1936
F-0.1 reference F : 0.1628
F-max reference F : 0.5087
Recruitment : Single recruit

Table 2.4.1 Nominal catch (t) of SAITHE in Division Vb, 1979-1992 as officially 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 [1]
Denmark	21	255	94	-	2	-	-
Faroe Islands	40139	39301	44402	43624	59821	53321	35980
France	87	153	313				
German Dem.Rep.	-	-	-	9	-		
Germany Fed.Rep	105	49	74	20	15	32	3
Netherlands	-	-	-	22	-	65 [1]	
Norway	24	14	52	51	46	101 [1]	34
UK (Eng. & W.)	-	108	-	-	-	5	74
UK (Scotland)	1340	140	92	9	33	79	98
USSR/Russia [2]	-	-	-	-	30	-	
Total	41716	40020	45027	43735	59947	53603	36189

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

Table 2.4.2 Nominal catch (t) of SAITHE in Division Vb, 1979-1992 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 [1]
Belgia	-	-	-	-	-	5	-
Denmark	21	255	94	-	2	-	-
Faroe Islands							
Vb	40139	39301	44402	43624	59821	53321	35980
IIa_4	-	-	258	269	988	963	519
France	87	153	313	473	626	267	123
German Dem.Rep.	-	-	-	9	-		
Germany Fed.Rep	105	49	74	20	15	32	3
Netherlands	-	-	-	22	-	65 [1]	
Norway	24	14	52	51	46	101 [1]	34
UK (Eng. & W.)	-	108	-	-	-	5	74
UK (Scotland)	1340	140	92	9	33	79	98
USSR/Russia [2]	-	-	-	-	30	7	47
Total	41716	40020	45285	44477	61561	54845	36878

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

Table 2.4.3

Traditional vpa Terminal populations from weighted Separable populations

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
3,	2483,	368,	1224,	1167,	1581,	866,	451,	294,	1030,	526,
4,	1103,	11067,	3990,	1997,	5793,	2950,	5981,	3833,	5123,	4115,
5,	5052,	2359,	5583,	4473,	3827,	9555,	5300,	10120,	7450,	3711,
6,	1343,	4093,	1182,	3730,	2785,	2784,	7136,	9219,	5542,	2710,
7,	575,	875,	1898,	953,	990,	1300,	793,	5070,	3486,	1389,
8,	339,	273,	273,	1077,	532,	621,	546,	477,	1629,	904,
9,	273,	161,	103,	245,	333,	363,	185,	123,	405,	620,
10,	98,	52,	38,	104,	81,	159,	83,	61,	238,	124,
11,	98,	65,	26,	67,	43,	27,	55,	60,	128,	64,
12,	99,	59,	72,	33,	5,	43,	10,	18,	77,	37,
13,	25,	18,	41,	56,	11,	15,	2,	19,	22,	52,
14,	127,	25,	8,	7,	15,	1,	11,	9,	8,	8,
+gp,	289,	151,	154,	62,	66,	1,	16,	33,	11,	12,
TOTALNUM,	11904,	19566,	14592,	13971,	16062,	18685,	20569,	29336,	25149,	14272,
TONSLAND,	39176,	54665,	44605,	41716,	40020,	45285,	44477,	61561,	54845,	36878,
SOPCOF %,	100,	100,	94,	95,	96,	99,	97,	98,	99,	105,

Table 2.4.4

Traditional vpa Terminal populations from weighted Separable populations

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
3,	1.2080,	1.4310,	1.4010,	1.7180,	1.6090,	1.5000,	1.3090,	1.2230,	1.2400,	1.2640,
4,	2.0290,	1.9530,	2.0320,	1.9860,	1.8350,	1.9750,	1.7350,	1.6330,	1.5860,	1.6020,
5,	2.9650,	2.4700,	2.9650,	2.6180,	2.3950,	1.9780,	1.9070,	1.8300,	1.8640,	2.0690,
6,	4.1430,	3.8500,	3.5960,	3.2770,	3.1820,	2.9370,	2.3730,	2.0520,	2.2110,	2.5540,
7,	4.7240,	5.1770,	5.3360,	4.1860,	4.0670,	3.7980,	3.8100,	2.8660,	2.6480,	3.0570,
8,	5.9010,	6.3470,	7.2020,	5.2890,	5.1490,	4.4190,	4.5670,	4.4740,	3.3800,	4.0780,
9,	6.8110,	7.8250,	6.9660,	6.0500,	5.5010,	5.1150,	5.5090,	5.4240,	4.8160,	5.0120,
10,	7.0510,	6.7460,	9.8620,	6.1500,	6.6260,	6.7120,	5.9720,	6.4690,	5.5160,	6.7680,
11,	7.2480,	8.6360,	10.6700,	9.5360,	6.3430,	8.0400,	6.9390,	6.3430,	6.4070,	7.7540,
12,	8.2920,	8.4670,	10.4610,	9.8230,	10.2450,	9.3640,	8.5430,	8.4180,	7.3950,	8.3030,
13,	9.4780,	8.5560,	10.2020,	7.3030,	8.4910,	9.1420,	9.5140,	7.3830,	8.0790,	7.7860,
14,	10.8930,	11.1270,	9.6440,	11.8690,	11.6340,	.0000,	11.7300,	5.8220,	7.1870,	9.5750,
+gp,	10.3400,	10.7480,	13.2320,	12.8750,	10.2200,	.0000,	9.6270,	9.4080,	9.7560,	9.1020,
SOPCOFAC,	.9997,	.9991,	.9415,	.9488,	.9620,	.9939,	.9710,	.9800,	.9922,	1.0498,

Table 2.4.5

Proportion Mature at Year Start

(MATPROP)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
1960	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1961	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1962	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1964	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1965	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1966	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1967	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1968	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1969	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1970	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1971	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1972	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1973	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1974	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1975	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1976	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1977	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1978	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1979	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1980	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1981	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1982	0.00	0.00	0.04	0.24	0.55	0.81	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1983	0.00	0.00	0.00	0.13	0.42	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1984	0.00	0.00	0.00	0.43	0.84	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1985	0.00	0.00	0.09	0.19	0.41	0.85	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1986	0.00	0.00	0.04	0.50	0.88	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1987	0.00	0.00	0.20	0.25	0.36	0.79	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1988	0.00	0.00	0.10	0.22	0.52	0.75	0.91	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1989	0.00	0.00	0.00	0.18	0.67	0.71	0.82	0.83	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1990	0.00	0.00	0.00	0.20	0.53	0.56	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1991	0.00	0.00	0.00	0.21	0.46	0.77	0.82	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1992	0.00	0.00	0.00	0.06	0.33	0.77	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1993	0.00	0.00	0.00	0.23	0.62	0.82	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 2.4.6.A

Cuba Pair Trawlers (code: C2CAN) (Catch: Thousands) (Effort: Days)

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
1982	1805	0	984	275	516	107	47	37	34	14	12
1983	1792	225	231	1052	312	116	85	73	15	31	32
1984	1714	77	1780	328	762	182	49	19	3	8	17
1985	1224	93	518	1196	249	313	41	16	3	6	12
1986	1341	170	324	891	638	177	188	45	17	9	6
1987	1762	239	943	798	633	237	125	65	15	10	1
1988	1705	129	539	1706	599	244	102	67	16	2	2
1989	1473	96	1096	931	1178	133	79	26	15	10	2
1990	1820	44	477	1442	1395	768	71	19	8	8	3
1991	1985	72	994	1035	837	528	258	31	29	21	11
1992	1932	19	464	488	413	207	120	104	20	10	4

Table 2.4.6.B

7 pair trawlers (code: PT7CA) (Catch: Thousands) (Effort: Days)

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
1985	624	14	78	181	38	47	6	2	1	1	7
1986	2447	67	128	352	252	70	74	18	7	4	2
1987	2299	90	356	301	239	89	47	25	6	4	0
1988	4156	79	329	1042	366	149	62	41	10	1	1
1989	3381	60	690	586	741	84	50	16	9	7	1
1990	4962	28	305	922	892	491	45	12	5	5	2
1991	3705	39	502	717	489	366	197	18	16	9	5
1992	2917	12	288	303	256	128	75	64	12	6	2

Table 2.4.7

Extended Survivors Analysis

Saithe in the Faroes Grounds (Fishing Area Vb) (run name: SAIFR865)

CPUE data from file /users/ifad/ifapwork/wg_109/sai_faro/FLEET.865

Data for 1 fleets over 10 years
Age range from 4 to 10

Fleet,	Alpha,	Beta
C2: Cuba Pair Trawle ,	.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 >= 7

Terminal population estimation :

Final estimates shrunk towards mean of the last 5 years and 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 44 iterations

Total absolute residual between iterations
43 and 44 = .000

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

Fishing mortalities

Age,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992
4,	.098,	.462,	.214,	.130,	.132,	.088,	.203,	.202,	.359,	.262
5,	.332,	.315,	.449,	.395,	.391,	.335,	.227,	.624,	.756,	.481
6,	.338,	.495,	.257,	.620,	.460,	.554,	.451,	.777,	.865,	.697
7,	.270,	.385,	.450,	.340,	.327,	.405,	.298,	.682,	.782,	.546
8,	.130,	.198,	.198,	.501,	.324,	.351,	.296,	.294,	.484,	.472
9,	.090,	.084,	.106,	.274,	.282,	.383,	.166,	.099,	.437,	.342
10,	.118,	.170,	.255,	.576,	.426,	.347,	.326,	.272,	.698,	.676

(cont'd)

Table 2.4.7 (cont'd)

Log catchability residuals.

Fleet : C2: Cuba Pair Trawle

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
4	-.44	.88	.24	-.13	-.38	-.63	.35	-.26	.67	-.15
5	-.08	-.49	.63	.34	.10	-.18	-.43	.15	.23	-.25
6	-.31	-.10	-.30	.28	.00	.16	-.17	.08	.09	-.09
7	-.43	.00	.26	.01	-.05	-.05	-.32	.19	.24	-.10
8	-.94	-.81	-.65	.33	-.08	-.32	-.47	-.66	-.19	-.37
9	-1.24	-2.08	-1.24	-.22	-.40	-.12	-1.08	-1.70	-1.02	-.45

Mean catchability and Standard error.

Age	4	5	6	7	8	9	10
Mean Q	-10.94	-10.09	-9.74	-9.98	-9.98	-9.98	-9.98
S.E	.40	.28	.14	.18	.46	1.05	1.89

Extended survivors analysis.

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
4,	.0984,	.4617,	.2139,	.1295,	.1322,	.0884,	.2025,	.2016,	.3587,	.2623,
5,	.3324,	.3150,	.4488,	.3953,	.3911,	.3350,	.2266,	.6236,	.7558,	.4808,
6,	.3379,	.4946,	.2569,	.6202,	.4599,	.5537,	.4509,	.7771,	.8650,	.6966,
7,	.2698,	.3855,	.4500,	.3404,	.3265,	.4048,	.2975,	.6821,	.7825,	.5463,
8,	.1299,	.1980,	.1975,	.5006,	.3236,	.3507,	.2957,	.2938,	.4842,	.4715,
9,	.0901,	.0839,	.1063,	.2736,	.2816,	.3834,	.1659,	.0995,	.4373,	.3419,
10,	.1175,	.1697,	.2548,	.5758,	.4257,	.3473,	.3261,	.2722,	.6985,	.6760,
FBAR 4- 8,	.2337,	.3709,	.3134,	.3972,	.3267,	.3465,	.2947,	.5156,	.6492,	.4915,

Table 2.4.8

Separable analysis
from 1983 to 1992 on ages 3 to 14
with Terminal F of .719 on age 6 and Terminal S of 1.000

Initial sum of squared residuals was 131.233 and
final sum of squared residuals is 42.744 after 62 iterations

Matrix of Residuals

Years,	1983/84,	1984/85,	1985/86,	1986/87,	1987/88,	1988/89,	1989/90,	1990/91,	1991/92,		,,WTS
Ages											
3/ 4,	.355,	-.782,	1.585,	-.070,	1.193,	-.467,	-.109,	-.660,	.041,	.000,	.333,
4/ 5,	-.302,	.906,	.558,	-.522,	-.070,	-.479,	.146,	.095,	.307,	.000,	.565,
5/ 6,	-.047,	.199,	.359,	-.142,	.038,	-.295,	-.553,	.613,	.196,	.000,	.767,
6/ 7,	-.428,	-.339,	-.414,	.074,	-.119,	.055,	-.229,	.398,	-.105,	.000,	1.000,
7/ 8,	-.037,	.132,	.012,	-.586,	-.341,	-.264,	.000,	.644,	-.039,	.000,	.785,
8/ 9,	-.017,	-.039,	-.424,	.032,	-.405,	.093,	.992,	-.296,	-.383,	.000,	.611,
9/10,	.967,	.499,	-.471,	.044,	.020,	.421,	.668,	-1.040,	-.071,	.000,	.439,
10/11,	-.125,	-.092,	-.875,	-.015,	.536,	.164,	.031,	-.965,	.235,	.000,	.544,
11/12,	-.037,	-.898,	-.555,	1.688,	-.573,	.084,	.813,	-.480,	.155,	.000,	.333,
12/13,	1.475,	-.104,	.239,	.515,	-1.353,	2.497,	-.625,	-.145,	-.376,	.000,	.233,
13/14,	-.535,	.036,	1.450,	.407,	1.840,	-.557,	-1.766,	.600,	-.118,	.000,	.246,
,	.001,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	3.671,	
WTS ,	.001,	.001,	.001,	.001,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
F-values	.6387,	.6956,	.5831,	.8061,	.6360,	.6681,	.4823,	.6222,	.9980,	.7190,

Selection-at-age (S)

	3,	4,								
S-values	.0351,	.2771,								
	5,	6,	7,	8,	9,	10,	11,	12,	13,	14,
S-values	.6689,	1.0000,	.8958,	.8118,	.7053,	.6154,	.6065,	.5866,	.8331,	1.0000,

Table 2.4.9

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
3,	.0698,	.0158,	.0634,	.0211,	.0377,	.0218,	.0172,	.0140,	.0359,	.0252,
4,	.1053,	.4960,	.2366,	.1395,	.1384,	.0914,	.2046,	.1985,	.3556,	.1959,
5,	.3669,	.3409,	.5035,	.4528,	.4289,	.3539,	.2352,	.6272,	.7273,	.4735,
6,	.4520,	.5746,	.2861,	.7589,	.5703,	.6427,	.4885,	.8164,	.8703,	.6458,
7,	.4664,	.6044,	.5793,	.3939,	.4621,	.5768,	.3784,	.7851,	.8735,	.5568,
8,	.5214,	.4229,	.3820,	.7813,	.3991,	.5962,	.5120,	.4121,	.6334,	.5870,
9,	.8742,	.5061,	.2785,	.7077,	.5953,	.5242,	.3535,	.2044,	.7466,	.5304,
10,	.2418,	.3968,	.2117,	.5020,	.5392,	.6426,	.2150,	.1878,	.7577,	.5386,
11,	.4433,	.2505,	.3534,	.7008,	.4002,	.3452,	.4810,	.2379,	.7440,	.4684,
12,	.9635,	.5271,	.4840,	1.0490,	.0981,	.9067,	.2069,	.2847,	.5427,	.4967,
13,	.3805,	.4509,	.8810,	.8856,	1.3912,	.4708,	.0888,	.7523,	.6704,	.8941,
14,	.6336,	.8243,	.3706,	.3528,	.6311,	.4163,	.7679,	.7040,	.8580,	.5533,
+gp,	.6336,	.8243,	.3706,	.3528,	.6311,	.4162,	.7679,	.7040,	.8580,	.5533,
FBAR 4- 8,	.3824,	.4877,	.3975,	.5053,	.3998,	.4522,	.3637,	.5679,	.6920,	.4918,

Table 2.4.10

Traditional vpa Terminal populations from weighted Separable populations

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE											
3,	40567,	25830,	21968,	61536,	47175,	44373,	29093,	23257,	32211,	23307,	0,
4,	12159,	30973,	20816,	16882,	49327,	37197,	35547,	23412,	18775,	25442,	18607,
5,	18041,	8960,	15443,	13452,	12022,	35165,	27793,	23719,	15717,	10771,	17125,
6,	4045,	10235,	5217,	7642,	7003,	6410,	20210,	17986,	10372,	6218,	5493,
7,	1689,	2107,	4717,	3209,	2929,	3242,	2760,	10152,	6509,	3556,	2669,
8,	913,	867,	943,	2164,	1772,	1511,	1491,	1548,	3791,	2225,	1669,
9,	509,	444,	465,	527,	811,	973,	681,	732,	839,	1647,	1013,
10,	501,	174,	219,	288,	213,	366,	472,	392,	488,	326,	793,
11,	300,	322,	96,	145,	143,	101,	158,	311,	266,	187,	156,
12,	174,	158,	205,	55,	59,	78,	59,	80,	201,	103,	96,
13,	87,	54,	76,	104,	16,	44,	26,	39,	49,	96,	52,
14,	295,	48,	28,	26,	35,	3,	22,	19,	15,	21,	32,
+gp,	672,	293,	545,	229,	154,	3,	33,	71,	21,	31,	24,
TOTAL,	79951,	80465,	70739,	106258,	121659,	129466,	118344,	101718,	89253,	73930,	47728,

Table 2.4.11

Traditional vpa Terminal populations from weighted Separable populations

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
3,	0,	0,	2770,	4229,	15181,	6656,	0,	0,	0,	0,
4,	3207,	26011,	8036,	16764,	22629,	16162,	11101,	7646,	6253,	2445,
5,	22466,	18591,	18773,	30992,	10365,	36169,	35511,	23005,	13476,	7354,
6,	16756,	38221,	15946,	23541,	17605,	14120,	34050,	20668,	17658,	12228,
7,	7979,	10909,	23408,	13432,	11913,	11204,	8622,	21822,	14133,	10002,
8,	5385,	5505,	6789,	11444,	9123,	6142,	5651,	6924,	12812,	9072,
9,	3470,	3471,	3241,	3187,	4461,	4978,	3754,	3968,	4041,	8256,
10,	3535,	1174,	2159,	1773,	1408,	2458,	2817,	2535,	2693,	2204,
11,	2172,	2783,	1022,	1383,	906,	816,	1094,	1976,	1703,	1453,
12,	1442,	1334,	2149,	541,	604,	734,	503,	672,	1487,	859,
13,	821,	465,	777,	757,	134,	400,	247,	289,	397,	745,
14,	3218,	539,	273,	307,	407,	0,	262,	113,	109,	197,
+gp,	6952,	3147,	7215,	2945,	1574,	0,	313,	670,	203,	281,
TOTSPBIO,	77404,	112150,	92559,	111294,	96311,	99838,	103925,	90288,	74965,	55097,

Table 2.4.12

Table 16 Summary (without SOP correction)

Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	FBAR 4- 8,
1983,	40567,	178897,	77404,	39176,	.3824,
1984,	25830,	188315,	112150,	54665,	.4877,
1985,	21968,	186419,	92559,	44605,	.3975,
1986,	61536,	235276,	111293,	41716,	.5053,
1987,	47175,	248028,	96311,	40020,	.3998,
1988,	44373,	256778,	99838,	45285,	.4522,
1989,	29093,	227029,	103925,	44477,	.3637,
1990,	23257,	193230,	90288,	61561,	.5679,
1991,	32210,	162628,	74965,	54845,	.6920,
1992,	23307,	142324,	55097,	36878,	.4918,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),	

Table 2.4.13

Prediction with management option table: Input data

Year: 1993								
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	29000.000	0.2000	0.0000	0.0000	0.0000	1.242	0.0255	1.242
4	23000.000	0.2000	0.2300	0.0000	0.0000	1.607	0.1953	1.607
5	17171.000	0.2000	0.6200	0.0000	0.0000	1.921	0.4654	1.921
6	5606.000	0.2000	0.8200	0.0000	0.0000	2.272	0.6371	2.272
7	2713.000	0.2000	0.9200	0.0000	0.0000	2.857	0.5565	2.857
8	1666.000	0.2000	1.0000	0.0000	0.0000	3.977	0.5683	3.977
9	1056.000	0.2000	1.0000	0.0000	0.0000	5.084	0.5181	5.084
10	819.000	0.2000	1.0000	0.0000	0.0000	6.251	0.5250	6.251
11	161.000	0.2000	1.0000	0.0000	0.0000	6.835	0.4679	6.835
12	96.000	0.2000	1.0000	0.0000	0.0000	8.039	0.4912	8.039
13	52.000	0.2000	1.0000	0.0000	0.0000	7.749	0.8891	7.749
14	32.000	0.2000	1.0000	0.0000	0.0000	7.528	0.5493	7.528
15+	24.000	0.2000	1.0000	0.0000	0.0000	9.422	0.5493	9.422
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
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	29000.000	0.2000	0.0000	0.0000	0.0000	1.242	0.0255	1.242
4	.	0.2000	0.1567	0.0000	0.0000	1.607	0.1953	1.607
5	.	0.2000	0.4400	0.0000	0.0000	1.921	0.4654	1.921
6	.	0.2000	0.7000	0.0000	0.0000	2.272	0.6371	2.272
7	.	0.2000	0.8300	0.0000	0.0000	2.857	0.5565	2.857
8	.	0.2000	1.0000	0.0000	0.0000	3.977	0.5683	3.977
9	.	0.2000	1.0000	0.0000	0.0000	5.084	0.5181	5.084
10	.	0.2000	1.0000	0.0000	0.0000	6.251	0.5250	6.251
11	.	0.2000	1.0000	0.0000	0.0000	6.835	0.4679	6.835
12	.	0.2000	1.0000	0.0000	0.0000	8.039	0.4912	8.039
13	.	0.2000	1.0000	0.0000	0.0000	7.749	0.8891	7.749
14	.	0.2000	1.0000	0.0000	0.0000	7.528	0.5493	7.528
15+	.	0.2000	1.0000	0.0000	0.0000	9.422	0.5493	9.422
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	29000.000	0.2000	0.0000	0.0000	0.0000	1.242	0.0255	1.242
4	.	0.2000	0.1567	0.0000	0.0000	1.607	0.1953	1.607
5	.	0.2000	0.4400	0.0000	0.0000	1.921	0.4654	1.921
6	.	0.2000	0.7000	0.0000	0.0000	2.272	0.6371	2.272
7	.	0.2000	0.8300	0.0000	0.0000	2.857	0.5565	2.857
8	.	0.2000	1.0000	0.0000	0.0000	3.977	0.5683	3.977
9	.	0.2000	1.0000	0.0000	0.0000	5.084	0.5181	5.084
10	.	0.2000	1.0000	0.0000	0.0000	6.251	0.5250	6.251
11	.	0.2000	1.0000	0.0000	0.0000	6.835	0.4679	6.835
12	.	0.2000	1.0000	0.0000	0.0000	8.039	0.4912	8.039
13	.	0.2000	1.0000	0.0000	0.0000	7.749	0.8891	7.749
14	.	0.2000	1.0000	0.0000	0.0000	7.528	0.5493	7.528
15+	.	0.2000	1.0000	0.0000	0.0000	9.422	0.5493	9.422
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SAIFR817
Date and time: 11MAY93:13:55

Table 2.4.14

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
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	0.4845	146320	66385	34092	0.0000	0.0000	146311	55056	0	183861	83115
.	.	.	.	.	0.1000	0.0485	.	55056	4198	179219	79559
.	.	.	.	.	0.2000	0.0969	.	55056	8206	174797	76183
.	.	.	.	.	0.3000	0.1454	.	55056	12033	170581	72978
.	.	.	.	.	0.4000	0.1938	.	55056	15688	166563	69933
.	.	.	.	.	0.5000	0.2423	.	55056	19180	162731	67041
.	.	.	.	.	0.6000	0.2907	.	55056	22518	159075	64293
.	.	.	.	.	0.7000	0.3392	.	55056	25709	155587	61682
.	.	.	.	.	0.8000	0.3876	.	55056	28760	152259	59200
.	.	.	.	.	0.9000	0.4361	.	55056	31679	149081	56841
.	.	.	.	.	1.0000	0.4845	.	55056	34472	146046	54598
.	.	.	.	.	1.1000	0.5330	.	55056	37146	143147	52465
.	.	.	.	.	1.2000	0.5814	.	55056	39706	140378	50436
.	.	.	.	.	1.3000	0.6299	.	55056	42158	137730	48505
.	.	.	.	.	1.4000	0.6783	.	55056	44507	135199	46669
.	.	.	.	.	1.5000	0.7268	.	55056	46758	132778	44920
.	.	.	.	.	1.6000	0.7752	.	55056	48917	130462	43256
.	.	.	.	.	1.7000	0.8237	.	55056	50987	128246	41672
.	.	.	.	.	1.8000	0.8721	.	55056	52974	126124	40163
.	.	.	.	.	1.9000	0.9206	.	55056	54880	124092	38726
.	.	.	.	.	2.0000	0.9690	.	55056	56710	122146	37356
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : SAIFR817
Date and time : 11MAY93:10:17
Computation of ref. F: Simple mean, age 4 - 8
Basis for 1993 : F factors

Table 2.4.15

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	0.0000	0.0000	0.0000	1.242	0.0255	1.242
4	.	0.2000	0.1567	0.0000	0.0000	1.607	0.1953	1.607
5	.	0.2000	0.4400	0.0000	0.0000	1.921	0.4654	1.921
6	.	0.2000	0.7000	0.0000	0.0000	2.272	0.6371	2.272
7	.	0.2000	0.8300	0.0000	0.0000	2.857	0.5565	2.857
8	.	0.2000	1.0000	0.0000	0.0000	3.977	0.5683	3.977
9	.	0.2000	1.0000	0.0000	0.0000	5.084	0.5181	5.084
10	.	0.2000	1.0000	0.0000	0.0000	6.251	0.5250	6.251
11	.	0.2000	1.0000	0.0000	0.0000	6.835	0.4679	6.835
12	.	0.2000	1.0000	0.0000	0.0000	8.039	0.4912	8.039
13	.	0.2000	1.0000	0.0000	0.0000	7.749	0.8891	7.749
14	.	0.2000	1.0000	0.0000	0.0000	7.528	0.5493	7.528
15+	.	0.2000	1.0000	0.0000	0.0000	9.422	0.5493	9.422
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SAIFR816
Date and time: 11MAY93:10:47

Table 2.4.16

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	5.517	20219	3.210	16554	3.210	16554
0.1000	0.0485	0.158	624	4.731	14797	2.455	11202	2.455	11202
0.2000	0.0969	0.259	913	4.226	11644	1.978	8114	1.978	8114
0.3000	0.1454	0.331	1054	3.874	9643	1.652	6173	1.652	6173
0.4000	0.1938	0.383	1126	3.613	8289	1.415	4875	1.415	4875
0.5000	0.2423	0.424	1162	3.411	7328	1.237	3966	1.237	3966
0.6000	0.2907	0.457	1180	3.251	6619	1.098	3306	1.098	3306
0.7000	0.3392	0.484	1188	3.120	6080	0.988	2812	0.988	2812
0.8000	0.3876	0.506	1191	3.011	5659	0.898	2434	0.898	2434
0.9000	0.4361	0.525	1192	2.918	5324	0.823	2138	0.823	2138
1.0000	0.4845	0.541	1191	2.838	5050	0.761	1902	0.761	1902
1.1000	0.5330	0.556	1190	2.769	4824	0.708	1711	0.708	1711
1.2000	0.5814	0.568	1189	2.708	4634	0.663	1554	0.663	1554
1.3000	0.6299	0.580	1187	2.654	4473	0.623	1423	0.623	1423
1.4000	0.6783	0.590	1187	2.605	4333	0.588	1314	0.588	1314
1.5000	0.7268	0.599	1186	2.561	4212	0.558	1220	0.558	1220
1.6000	0.7752	0.607	1185	2.521	4105	0.531	1140	0.531	1140
1.7000	0.8237	0.615	1185	2.485	4010	0.507	1071	0.507	1071
1.8000	0.8721	0.622	1185	2.451	3925	0.485	1010	0.485	1010
1.9000	0.9206	0.628	1185	2.421	3849	0.465	956	0.465	956
2.0000	0.9690	0.635	1185	2.392	3779	0.447	909	0.447	909
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : SAIFR816
Date and time : 11MAY93:10:47
Computation of ref. F: Simple mean, age 4 - 8
F-0.1 factor : 0.3103
F-max factor : 0.8832
F-0.1 reference F : 0.1504
F-max reference F : 0.4279
Recruitment : Single recruit

Table 3.2.1 Nominal catch (tonnes) of SAITHE in Division Va, 1978-1992 as officially reported to ICES.

Country	1978	1979	1980	1981	1982	1983	1984	1985
Belgium	1,092	980	980	532	201	224	269	158
Faroe Islands	4,250	5,457	4,930	3,545	3,582	2,138	2,044	1,778
France	-	-	-	-	23	-	-	-
Iceland	44,327	57,066	52,436	54,921	65,124	55,904	60,406	55,135
Norway	3	1	1	3	1	+	-	1
UK (Engl. & Wales)	-	-	-	-	-	-	-	29
Total	49,672	63,504	58,347	59,001	68,933	58,266	62,719	57,101

Country	1986	1987	1988	1989	1990	1991	1992[1]
Belgium	218	217	268	369		190 236	195
Faroe Islands	783	2,139	2,596	2,246	2,905	2,690	1,570
France	-	-	-	-	-	-	-
Iceland	63,867	78,175	74,383	79,796	95,032	99,390	74,846
Norway	-	-	-	-	-	-	-
UK (Engl. & Wales)	-	-	-	-	-	-	-
Total	64,868	80,531	77,247	82,411	98,127	102,316	76,611
Total used in the assessment	66,376[2]	-	-	82,425[3]	-	102,737[4]	79,426[5]

[1]Preliminary.
[2]Additional catch by Faroe Islands of 1,508 t included.
[3]Additional catch by Iceland of 14 t included.
[4]Additional catch by Iceland of 451 t included.
[5]Additional catch by Iceland of 2,815 t included.

Table 3.2.2. Catch numbers at age Numbers*10**-3

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: STVPA9)

At 5-May-93 11:49

Traditional vpa using file input for terminal F

age/ year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	4271	1534	6134	3041	2003	940	1116	836	1572	287	476
4	3936	4999	2314	11712	4825	2090	3400	2605	4395	5622	3031
5	4879	3861	2518	3586	7589	3283	5591	3563	5706	4999	10221
6	1961	3744	2902	2301	2158	4117	4326	6318	6518	6126	6736
7	588	1019	1869	1185	1324	1285	4931	3207	9136	6178	6694
8	311	419	797	559	642	739	1200	3008	2796	5934	5045
9	240	280	329	237	353	390	550	621	1843	1689	4272
10	246	245	271	145	164	235	330	343	461	1191	959
11	130	143	254	107	102	133	169	215	100	299	887
12	116	83	193	92	85	69	73	103	110	171	349
13	24	28	75	59	81	102	104	79	32	92	96
14	20	15	22	33	52	73	65	41	44	70	63
+gp	156	120	189	73	54	93	126	95	32	86	131
TotN	16878	16490	17867	23130	19432	13549	21981	21034	32745	32744	38960
TotL	50826	50514	48011	60257	60177	52003	75712	77549	115853	116601	136764
SOPF	102	90	80	94	95	95	83	82	80	75	71

age/ year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	565	219	1269	526	329	59	548	480	275	203	508
4	3786	1768	3404	2997	3234	2099	1145	3764	2540	1325	1092
5	6524	5155	2348	2479	3045	2858	2435	1991	5214	3503	2804
6	8646	7077	3164	1829	2530	1801	1556	3616	2596	5404	4845
7	4178	7372	3452	3496	2154	1036	1275	1566	2169	1457	4293
8	3320	2616	3384	2994	2367	1068	961	718	1341	1415	1215
9	2098	1635	1303	1434	1530	1528	537	292	387	578	975
10	1421	871	824	710	1064	958	575	669	262	242	306
11	361	412	351	325	295	538	476	589	155	61	59
12	328	231	141	176	191	166	279	489	112	154	35
13	79	80	43	100	94	71	139	150	64	135	48
14	68	22	13	36	68	12	91	72	33	128	46
+gp	73	23	20	61	18	49	55	0	0	0	0
TotN	31447	27481	19716	17163	16919	12243	10072	14396	15148	14605	16226
TotL	111301	110888	97568	87954	82003	62026	49672	63504	58347	58986	68615
SOPF	76	82	102	100	97	98	97	98	101	102	101

(cont'd)

Table 3.2.2. Continued. Catch numbers at age Numbers*10**-3

age/ year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	107	53	376	3108	956	1318	315	143	198	241
4	1750	657	4014	1400	5135	5067	4313	1692	874	2921
5	1065	800	3366	4170	4428	6619	8471	5471	3613	3834
6	2455	1825	1958	2665	5409	3678	7309	10112	6844	4345
7	4454	2184	1536	1550	2915	2859	1794	6174	10772	3876
8	2311	3610	1172	1116	1348	1775	1928	1816	3223	4038
9	501	844	747	628	661	845	848	1087	858	1287
10	251	376	479	1549	496	226	270	380	838	349
11	38	291	74	216	498	270	191	151	228	196
12	12	135	23	51	58	107	135	55	40	56
13	2	185	72	30	27	24	76	76	6	53
14	4	226	71	14	48	1	10	37	5	15
+gp	0	0	0	0	0	0	0	0	0	0
TotN	12950	11186	13888	16497	21979	22789	25660	27194	27499	21211
TotL	58266	62719	57101	66376	80559	77247	82425	98130	102737	79426
SOPF	103	104	106	102	100	100	100	101	101	100

Table 3.2.3. Catch weights at age (kg)

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: STVPA9)

At 5-May-93ï 11:49

Traditional vpa using file input for terminal F

age/ year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
4	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96
5	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05	3.05
6	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34
7	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38
8	6.55	6.55	6.55	6.55	6.55	6.55	6.55	6.55	6.55	6.55	6.55
9	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64
10	8.63	8.63	8.63	8.63	8.63	8.63	8.63	8.63	8.63	8.63	8.63
11	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52
12	10.29	10.29	10.29	10.29	10.29	10.29	10.29	10.29	10.29	10.29	10.29
13	10.97	10.97	10.97	10.97	10.97	10.97	10.97	10.97	10.97	10.97	10.97
14	11.55	11.55	11.55	11.55	11.55	11.55	11.55	11.55	11.55	11.55	11.55
+gp	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8
SOPF	1.0171	0.898	0.8041	0.9369	0.945	0.9469	0.8316	0.8193	0.7993	0.7475	0.711

(cont'd)

Table 3.2.3. Continued. Catch weights at age (kg)

1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.428	1.585	1.547
1.96	1.96	1.76	1.76	1.76	1.76	1.76	1.76	1.983	2.037	2.194
3.05	3.05	2.73	2.73	2.73	2.73	2.73	2.73	2.667	2.696	3.015
4.34	4.34	4.29	4.29	4.29	4.29	4.29	4.29	3.689	3.525	3.183
5.38	5.38	5.54	5.54	5.54	5.54	5.54	5.54	5.409	4.541	5.114
6.55	6.55	7.27	7.27	7.27	7.27	7.27	7.27	6.321	6.247	6.202
7.64	7.64	8.42	8.42	8.42	8.42	8.42	8.42	7.213	6.991	7.256
8.63	8.63	9.41	9.41	9.41	9.41	9.41	9.41	8.565	8.202	7.922
9.52	9.52	10	10	10	10	10	10	9.147	9.537	8.924
10.29	10.29	10.56	10.56	10.56	10.56	10.56	10.56	9.617	9.089	10.134
10.97	10.97	11.87	11.87	11.87	11.87	11.87	11.87	10.066	9.351	9.447
11.55	11.55	13.12	13.12	13.12	13.12	13.12	13.12	11.041	10.225	10.535
12.8	12.8	14	14	14	14	14	13.12	0	0	0
0.7552	0.8234	1.0184	0.9996	0.9706	0.9769	0.9691	0.984	1.0119	1.025	1.011

age/ year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	1.53	1.653	1.609	1.45	1.516	1.261	1.403	1.647	1.224	1.269
4	2.221	2.432	2.172	2.19	1.715	2.017	2.021	1.983	1.939	1.909
5	3.171	3.33	3.169	2.959	2.67	2.513	2.194	2.566	2.432	2.579
6	4.27	4.681	3.922	4.402	3.839	3.476	3.047	3.021	3.16	3.287
7	4.107	5.466	4.697	5.488	5.081	4.719	4.505	4.077	3.634	4.143
8	5.984	4.973	6.411	6.406	6.185	5.932	5.889	5.744	4.967	4.849
9	7.565	7.407	6.492	7.57	7.33	7.523	7.172	7.038	6.629	6.158
10	8.673	8.179	8.346	6.487	8.025	8.439	8.852	7.564	7.704	7.936
11	8.801	8.77	9.401	9.616	7.974	8.748	10.17	8.854	9.061	8.34
12	9.039	8.831	10.335	10.462	9.615	9.559	10.392	10.645	9.117	8.986
13	11.138	11.01	11.027	11.747	12.246	10.824	12.522	11.674	10.922	11.576
14	9.818	11.127	10.644	11.902	11.656	14.099	11.923	11.431	11.342	9.417
+gp	0	0	0	0	0	0	0	0	0	0
SOPF	1.0312	1.0383	1.0628	1.0176	1.004	1	1.001	1.0061	1.0052	1.0019

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

Fitted:

Year	a3	a4	a5	a6	a7	a8	a9
1980	0.0732	0.1121	0.2718	0.6202	0.785	0.9138	0.9661
1981	0.0855	0.1728	0.2502	0.4967	0.8119	0.9061	0.9655
1982	0.0798	0.1981	0.3558	0.4688	0.7229	0.9195	0.9623
1983	0.0695	0.1865	0.3515	0.5935	0.7	0.8734	0.9679
1984	0.0534	0.1649	0.3818	0.6333	0.7943	0.8605	0.948
1985	0.066	0.1299	0.343	0.6202	0.8203	0.9108	0.9422
1986	0.033	0.1574	0.283	0.5799	0.8119	0.9235	0.9643
1987	0.0195	0.0828	0.3305	0.5107	0.785	0.9195	0.9696
1988	0.0409	0.0499	0.1926	0.5663	0.734	0.9061	0.9679
1989	0.0574	0.1014	0.122	0.3868	0.7754	0.8795	0.9623
1990	0.0594	0.1386	0.2298	0.2686	0.6251	0.9012	0.9507
1991	0.0594	0.1431	0.2984	0.441	0.4926	0.8151	0.9602
1992	0.0594	0.1431	0.3063	0.5293	0.676	0.7197	0.921
av.90-92	**0.06**	**0.14**	**0.28**	**0.41**	**0.60**	**0.81**	**0.94**

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	0.16	0.44	0.6	0.73	0.78	0.95

Table 3.2.5. Proportion mature at age

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: STVPA9)

At 5-May-93ï 11:49 Traditional vpa using file input for terminal F

age/ year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	0	0	0	0	0	0	0	0	0	0	0
4	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
5	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
6	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
7	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
8	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
9	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1	1	1	1
+gp	1	1	1	1	1	1	1	1	1	1	1

age/ year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	0	0	0	0	0	0	0	0	0.0732	0.0855	0.0798
4	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.1121	0.1728	0.1981
5	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.2718	0.2502	0.3558
6	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.6202	0.4967	0.4688
7	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.785	0.8119	0.7229
8	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.9138	0.9061	0.9195
9	1	1	1	1	1	1	1	1	0.9661	0.9655	0.9623
10	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1	1	1	1
+gp	1	1	1	1	1	1	1	1	1	1	1

age/ year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	0.0695	0.0534	0.066	0.033	0.0195	0.0409	0.0574	0.0594	0.0594	0.0594
4	0.1865	0.1649	0.1299	0.1574	0.0828	0.0499	0.1014	0.1386	0.1431	0.1431
5	0.3515	0.3818	0.343	0.283	0.3305	0.1926	0.122	0.2298	0.2984	0.3063
6	0.5935	0.6333	0.6202	0.5799	0.5107	0.5663	0.3868	0.2686	0.441	0.5293
7	0.7	0.7943	0.8203	0.8119	0.785	0.734	0.7754	0.6251	0.4926	0.676
8	0.8734	0.8605	0.9108	0.9235	0.9195	0.9061	0.8795	0.9012	0.8151	0.7197
9	0.9679	0.948	0.9422	0.9643	0.9696	0.9679	0.9623	0.9507	0.9602	0.921
10	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1	1	1
+gp	1	1	1	1	1	1	1	1	1	1

Table 3.2.6

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	0.0233	0.0479	0.0707	0.0731	0.0728	0.0184	0.0036	.0016

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	0.0497	0.0692	0.0677	0.0542	0.0522	0.0139	0.0022	.0011	.0002

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	46	241	2925	3708	4163	3476	3181	894	230	96	24	49

Table 3.2.7. Icelandic Saithe. Retrospective analysis, F(4-9).

A.XSA1. XSA with shrinkage.
Tuning data: TRW cpue Jan.-May and Jun.-Des. 1980-1992.
First age at which q is considered constant = 11
Tapered weighting applied, power = 3 over 20 years
Number of years for shrinking = 5, ages =4
log(S.E.) used in shrinkage = 0.5

YEAR	run87	run88	run89	run90	run91	run92
1976	0.37	0.37	0.37	0.37	0.37	0.37
1977	0.33	0.33	0.33	0.33	0.33	0.33
1978	0.31	0.31	0.31	0.31	0.31	0.31
1979	0.33	0.33	0.33	0.33	0.33	0.33
1980	0.37	0.37	0.37	0.37	0.37	0.37
1981	0.33	0.33	0.32	0.32	0.32	0.32
1982	0.41	0.41	0.40	0.40	0.40	0.40
1983	0.35	0.35	0.34	0.34	0.34	0.34
1984	0.32	0.33	0.31	0.32	0.32	0.32
1985	0.27	0.27	0.25	0.26	0.26	0.26
1986	0.30	0.30	0.27	0.28	0.28	0.28
1987	0.40	0.43	0.39	0.40	0.39	0.40
1988		0.38	0.39	0.40	0.39	0.40
1989			0.37	0.37	0.32	0.34
1990				0.47	0.36	0.39
1991					0.46	0.46
1992						0.40

B.XSA2 XSA with shrinkage.
Tuning data: TRW effort Jan.-Des. 1980-1992.
First age at which q is considered constant = 11
Tapered weighting applied, power = 3 over 20 years
Number of years for shrinking = 5, ages =4
log(S.E.) used in shrinkage = 0.5

YEAR	run87	run88	run89	run90	run91	run92
1976	0.37	0.37	0.37	0.37	0.37	0.37
1977	0.33	0.33	0.33	0.33	0.33	0.33
1978	0.31	0.31	0.31	0.31	0.31	0.31
1979	0.33	0.33	0.33	0.33	0.33	0.33
1980	0.37	0.38	0.37	0.37	0.37	0.38
1981	0.33	0.33	0.33	0.33	0.33	0.33
1982	0.41	0.41	0.40	0.40	0.40	0.40
1983	0.34	0.35	0.34	0.34	0.34	0.34
1984	0.32	0.33	0.32	0.32	0.32	0.32
1985	0.28	0.28	0.26	0.26	0.26	0.26
1986	0.31	0.31	0.29	0.28	0.28	0.28
1987	0.41	0.45	0.42	0.41	0.40	0.40
1988		0.43	0.45	0.42	0.40	0.40
1989			0.44	0.39	0.33	0.34
1990				0.50	0.38	0.39
1991					0.46	0.44
1992						0.37

(cont'd)

Table 3.2.7 (cont'd)

C.L/S1 **Laurec -Shepherd with shrinkage.**
Tuning data: TRW cpue Jan.-May and Jun.-Des. 1980-1992.
Oldest age F = 1.0 * average of 4 younger ages.
Shrinking: Numer of years = 5, log(S.E.) = 0.5.
Tapered weighting applied, power = 3 over 20 years.

YEAR	run87	run88	run89	run90	run91	run92
1976	0.36	0.36	0.36	0.36	0.36	0.36
1977	0.33	0.33	0.33	0.33	0.33	0.33
1978	0.31	0.31	0.31	0.31	0.31	0.31
1979	0.33	0.33	0.33	0.33	0.33	0.33
1980	0.37	0.38	0.37	0.37	0.37	0.37
1981	0.32	0.32	0.32	0.32	0.32	0.32
1982	0.40	0.41	0.40	0.40	0.40	0.40
1983	0.33	0.34	0.33	0.34	0.34	0.34
1984	0.30	0.32	0.31	0.32	0.31	0.31
1985	0.24	0.26	0.25	0.26	0.25	0.26
1986	0.25	0.29	0.26	0.28	0.27	0.28
1987	0.30	0.41	0.38	0.41	0.39	0.40
1988		0.35	0.39	0.42	0.38	0.40
1989			0.38	0.40	0.30	0.34
1990				0.52	0.32	0.38
1991					0.38	0.42
1992						0.33

D.L/S2 **Laurec -Shepherd with shrinkage.**
Tuning data: TRW effort Jan.-Des. 1980-1992.
Oldest age F = 1.0 * average of 4 younger ages.
Shrinking: Numer of years = 5, log(S.E.) = 0.5.
Tapered weighting applied, power = 3 over 20 years.

YEAR	run87	run88	run89	run90	run91	run92
1976	0.36	0.36	0.36	0.36	0.36	0.36
1977	0.33	0.33	0.33	0.33	0.33	0.33
1978	0.31	0.31	0.31	0.31	0.31	0.31
1979	0.33	0.33	0.33	0.33	0.33	0.33
1980	0.37	0.38	0.37	0.37	0.37	0.37
1981	0.32	0.32	0.32	0.32	0.32	0.32
1982	0.40	0.41	0.40	0.40	0.40	0.40
1983	0.34	0.34	0.34	0.34	0.34	0.34
1984	0.32	0.33	0.31	0.32	0.31	0.31
1985	0.27	0.27	0.26	0.26	0.25	0.26
1986	0.29	0.31	0.28	0.28	0.27	0.28
1987	0.37	0.45	0.43	0.41	0.39	0.40
1988		0.40	0.47	0.41	0.38	0.40
1989			0.48	0.38	0.31	0.33
1990				0.48	0.33	0.37
1991					0.39	0.41
1992						0.32

(cont'd)

Tale 3.2.7 (cont'd)

E.L/S3 Laurec -Shepherd WITHOUT shrinkage.
Tuning data: TRW cpue Jan.-May and Jun.-Des. 1980-1992.
Oldest age F = 1.0 * average of 4 younger ages.
Tapered weighting applied, power = 3 over 20 years.

YEAR	run87	run88	run89	run90	run91	run92
1976	0.36	0.36	0.36	0.36	0.36	0.36
1977	0.33	0.33	0.33	0.33	0.33	0.33
1978	0.31	0.31	0.31	0.31	0.31	0.31
1979	0.33	0.33	0.33	0.33	0.33	0.33
1980	0.37	0.37	0.37	0.37	0.37	0.37
1981	0.32	0.32	0.32	0.32	0.32	0.32
1982	0.39	0.40	0.39	0.40	0.40	0.40
1983	0.31	0.33	0.32	0.34	0.34	0.34
1984	0.28	0.30	0.28	0.31	0.31	0.31
1985	0.22	0.24	0.21	0.26	0.25	0.26
1986	0.22	0.25	0.21	0.28	0.27	0.28
1987	0.27	0.39	0.30	0.41	0.39	0.40
1988		0.36	0.33	0.40	0.38	0.39
1989			0.42	0.45	0.30	0.32
1990				0.74	0.33	0.35
1991					0.40	0.37
1992						0.28

F.TSA Time series analysis.

Only catch in numbers.

YEAR	run87	run88	run89	run90	run91	run92
1980	0.33	0.32	0.32	0.33	0.32	0.32
1981	0.30	0.29	0.29	0.29	0.29	0.29
1982	0.35	0.33	0.34	0.34	0.34	0.34
1983	0.30	0.29	0.29	0.30	0.29	0.29
1984	0.30	0.29	0.30	0.30	0.30	0.30
1985	0.28	0.27	0.28	0.28	0.28	0.28
1986	0.28	0.27	0.28	0.28	0.28	0.28
1987	0.37	0.34	0.37	0.37	0.36	0.37
1988		0.32	0.34	0.34	0.33	0.34
1989			0.30	0.30	0.28	0.30
1990				0.33	0.30	0.33
1991					0.32	0.35
1992						0.29

Table 3.2.8. Icelandic Saithe. F(4-9) from different runs.

Year	XSA1	XSA2	L/S1	L/S2	L/S3	TSA
1980	0.37	0.38	0.37	0.37	0.37	0.32
1981	0.32	0.33	0.32	0.32	0.32	0.29
1982	0.40	0.40	0.40	0.40	0.40	0.34
1983	0.34	0.34	0.34	0.34	0.34	0.29
1984	0.32	0.32	0.31	0.31	0.31	0.3
1985	0.26	0.26	0.26	0.26	0.26	0.28
1986	0.28	0.28	0.28	0.28	0.28	0.28
1987	0.40	0.40	0.40	0.40	0.40	0.36
1988	0.40	0.40	0.40	0.40	0.39	0.34
1989	0.34	0.34	0.34	0.33	0.32	0.3
1990	0.39	0.39	0.38	0.37	0.35	0.33
1991	0.46	0.44	0.42	0.41	0.37	0.35
1992	0.40	0.37	0.33	0.32	0.28	0.29

Table 3.2.9. Extended Survivors analysis

VPA Version 3.0 (MSDOS)

5-May-93î 12:25

Extended Survivors Analysis

Saithe in the Iceland Grounds (Fishing Area Va) (run name: XSA1)

CPUE data from file /users/ifad/ifapwork/wg_109/sai_icel/FLEET.X1

Data for 2 fleets over 13 years
Age range from 3 to 12

		Beta
FLT	0	0.42
FLT	0.42	1

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 : Final estimates shrunk towards mean of the last 5 years and the 4 oldest ages.
S.E. of the mean to which the estimates are shrunk = .500
Prior weighting not applied

Tuning converged after 26 iterations

Total absolute residual between iterations
25 and 26 = .000

Regression weights

0.482	0.579	0.67	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

year/age

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	0.011	0.012	0.026	0.004	0.001	0.013	0.049	0.011	0.026	0.01	0.006	0.005	0.013
4	0.065	0.066	0.08	0.119	0.029	0.127	0.06	0.107	0.076	0.113	0.066	0.044	0.097
5	0.216	0.12	0.195	0.104	0.073	0.203	0.189	0.271	0.197	0.175	0.206	0.197	0.278
6	0.367	0.365	0.242	0.262	0.262	0.257	0.246	0.399	0.38	0.347	0.326	0.43	0.387
7	0.397	0.362	0.558	0.368	0.394	0.367	0.333	0.466	0.38	0.322	0.557	0.696	0.465
8	0.584	0.492	0.587	0.676	0.58	0.381	0.5	0.545	0.582	0.48	0.634	0.646	0.617
9	0.608	0.541	0.766	0.515	0.564	0.222	0.362	0.635	0.808	0.617	0.551	0.715	0.584
10	0.889	1.019	0.623	0.449	0.96	0.744	0.989	0.546	0.462	0.664	0.629	1.179	0.731
11	0.354	0.523	0.749	0.141	1.624	0.49	0.936	1.088	0.658	0.933	1.032	1.026	1.029
12	0.61	0.723	0.658	0.324	1.063	0.499	0.759	0.71	0.726	0.842	0.782	0.879	0.77

(cont'd)

Table 3.2.9. Continued. Extended Survivors analysis

XSA population numbers

Age / YEAR	3	4	5	6	7	8	9	10	11	12	Plus GP
1980	28100	44700	29600	9350	7310	3350	939	492	575	271	232
1981	19400	22800	34300	19500	5300	4020	1530	419	165	331	557
1982	21600	15700	17500	24900	11100	3020	2010	730	124	80	213
1983	31200	17300	11900	11800	16000	5200	1380	767	320	48	24
1984	45500	25400	12500	8760	7410	9060	2170	673	401	228	681
1985	33000	37200	20200	9550	5520	4090	4150	1010	211	65	398
1986	71500	26700	26800	13500	6050	3130	2290	2730	393	106	90
1987	95100	55800	20600	18200	8650	3550	1550	1300	830	126	161
1988	55700	77000	41000	12900	9990	4450	1680	675	619	229	53
1989	35900	44400	58400	27600	7200	5590	2040	615	348	262	164
1990	27400	29100	32500	40200	16000	4280	2840	900	259	112	227
1991	42900	22300	22300	21600	23700	7490	1860	1340	393	76	21
1992	20900	35000	17500	15000	11500	9690	3210	744	337	115	138

Terminal population estimates.

	3	4	5	6	7	8	9	10	11	12	Plus GP
	0	16900	26000	10800	8330	5930	4280	1470	293	99	96

Fleet : FLT06: TRW CPUE JAN.-JUN. Log catchability residuals.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	No data for this fleet at this age												
4	0.61	0.65	0.73	-0.09	0.86	-0.86	0.49	1.26	-0.96	-1.04	0.11	-0.88	0.03
5	0.31	0.04	1.03	-0.19	0.37	0.04	1.19	0.42	-0.13	-1.34	-0.64	-0.47	0
6	0.17	0.88	-0.74	0.26	0.09	-0.22	0.09	0.3	0.26	-0.01	-0.59	-0.23	0.03
7	-0.44	0.39	0	0.35	-0.39	0.45	-0.6	-0.15	0.16	0.19	-0.03	-0.04	0.07
8	0.1	-0.41	0.52	0.37	0.59	0.47	-2.1	-0.2	0.2	0.26	-0.13	0.08	0.39
9	-0.14	-0.65	0.51	-0.55	-0.77	-0.21	0	-0.64	0.97	0.59	-0.16	0.45	0.12
10	1.24	-0.52	-0.06	-1.24	0.09	-0.07	-1.71	-0.65	0.5	0.81	0.43	0.91	0.23
11	0.02	0	0.72	0	0	-0.56	0	-1.12	0.34	-0.28	0.95	0.31	-0.23

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10	11	12
Mean Q		-18.81	-17.31	-16.78	-16.51	-16.63	-16.66	-16.78	-16.16	
S.E		0.74	0.63	0.35	0.29	0.66	0.53	0.77	0.62	

Fleet : FLT08: TRW CPU JUNE Log catchability residuals.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	-1.62	1.15	0.96	-0.12	-1.41	0.62	1.75	0.34	0.54	-1.17	0.02	-0.94	-0.22
4	-1.11	0.52	0.13	1.72	-0.93	1.13	-0.26	-0.02	0.05	-0.04	-0.24	-0.94	0.07
5	-0.02	0.24	0.31	0.2	-1.75	0.57	0.07	0.32	0.01	-0.34	0.14	-0.24	0.51
6	0.08	0.46	0.37	-0.29	-0.03	0.3	-0.39	-0.21	0.14	-0.17	-0.16	0.05	0.13
7	0.56	0.2	0.38	0.34	-0.7	-0.14	-0.03	0.2	-0.19	-0.66	-0.28	0.56	0.19
8	0.71	-0.41	-0.06	0.1	0.89	-1.02	0.18	0.54	0.02	-0.57	-0.89	0.33	0.44
9	1.47	-0.36	-0.48	-1.37	0	-0.28	0.5	0.99	0.24	0.51	-1.37	-0.15	0.47
10	1.79	0.43	-0.39	-1.26	1.3	0.46	0.62	0.22	-1.12	0.5	-1.29	0.07	-0.34
11	0.11	0	0	0	1.62	0	1.18	-0.16	-1.55	0.31	-0.42	0	-0.69

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10	11	12
Mean Q	-19.99	-17.93	-17.22	-16.63	-16.6	-16.61	-16.87	-16.44	-15.79	-15.79
S.E	0.92	0.7	0.54	0.23	0.38	0.55	0.73	0.83	0.97	1.32

Table 3.2.10. Extended Survivors Analysis.

5-May-93î 12:48

Extended Survivors An VPA Version 3.0 (MSDOS)

Saithe in the Iceland Grounds (Fishing Area Va) (run name: XSA3)

CPUE data from file /users/ifad/ifapwork/wg_109/sai_icel/FLEET.X3

Data for 1 fleets over 13 years
Age range from 3 to 12

Fleet	Alpha	Beta
04: TRW EFFORT	0	1

Time series weights : Tapered time weighting applied
Power = 3 over 20 years

Catchability a Catchability independent of stock size for all ages
Catchability independent of age for ages >= 11

Terminal population estimation :

Final estimates shrunk towards mean of the last 5 years and the 4 oldest ages.
S.E. of the mean to which the estimates are shrunk = .500
Prior weighting not applied

Tuning converged after 24 iterations

Total absolute residual between iterations
23 and 24 = .000

Regression weights

0.482	0.579	0.67	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	0.011	0.012	0.026	0.004	0.001	0.013	0.048	0.011	0.026	0.01	0.006	0.005	0.012
4	0.065	0.066	0.08	0.119	0.029	0.127	0.06	0.105	0.073	0.111	0.07	0.047	0.095
5	0.216	0.12	0.195	0.104	0.073	0.203	0.189	0.272	0.191	0.167	0.201	0.209	0.298
6	0.365	0.365	0.242	0.262	0.261	0.257	0.246	0.399	0.381	0.334	0.308	0.416	0.418
7	0.398	0.359	0.558	0.367	0.394	0.367	0.334	0.466	0.38	0.324	0.527	0.633	0.442
8	0.591	0.494	0.581	0.675	0.578	0.38	0.5	0.546	0.583	0.48	0.64	0.584	0.518
9	0.615	0.553	0.771	0.505	0.562	0.22	0.361	0.634	0.813	0.62	0.551	0.728	0.489
10	0.911	1.046	0.648	0.455	0.921	0.74	0.98	0.544	0.461	0.672	0.634	1.179	0.76
11	0.359	0.549	0.798	0.149	1.691	0.452	0.925	1.061	0.654	0.928	1.064	1.047	1.03
12	0.626	0.742	0.72	0.361	1.193	0.557	0.656	0.692	0.684	0.831	0.773	0.953	0.809
												F(4-9) =	0.3767

(cont'd)

Table 3.2.10. Continued. Extended Survivors Analysis.
XSA population numbers

	AGE										
YEAR	3	4	5	6	7	8	9	10	11	12	Plus GP
1980	28200	44700	29600	9380	7300	3320	931	484	568	266	228
1981	19400	22800	34300	19500	5330	4010	1500	412	159	325	547
1982	21600	15700	17500	24900	11100	3050	2000	709	119	75	200
1983	31200	17200	11900	11800	16000	5200	1400	759	304	44	22
1984	45500	25400	12500	8770	7410	9090	2170	690	394	214	638
1985	33000	37200	20200	9540	5530	4090	4170	1010	225	60	366
1986	73100	26700	26800	13500	6040	3130	2290	2740	396	117	100
1987	98700	57000	20600	18200	8650	3540	1560	1310	842	128	164
1988	56800	80000	42000	12800	9990	4440	1680	676	621	239	55
1989	34200	45300	60900	28400	7170	5590	2030	610	349	264	166
1990	25900	27700	33200	42200	16700	4250	2840	894	255	113	229
1991	43700	21100	21200	22200	25400	8050	1830	1340	388	72	20
1992	22700	35600	16400	14100	12000	11000	3680	725	337	112	133

Terminal population estimates.

0	18400	26500	10000	7570	6310	5390	1850	277	99	89

Log catchability residuals.

Fleet : FLT04: TRW EFFORT

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	0.5	0.69	1.39	-0.69	-1.92	0.39	1.78	-0.01	0.81	-0.21	-0.94	-1.12	0.02
4	0.28	0.43	0.49	0.68	-0.82	0.66	-0.03	0.25	-0.18	0.16	-0.52	-0.89	0.09
5	0.63	0.17	0.42	-0.26	-0.9	0.24	0.26	0.34	-0.05	-0.29	-0.32	-0.23	0.36
6	0.53	0.74	0.14	0	-0.2	-0.07	-0.26	0.11	0.08	-0.15	-0.44	-0.07	0.17
7	0.32	0.43	0.17	0.26	-0.43	0.08	-0.03	-0.05	-0.13	-0.52	-0.05	0.25	0.1
8	0.47	-0.25	-0.02	0.4	0.5	-0.15	0.03	0.06	-0.09	-0.66	-0.18	0.02	0.17
9	0.51	-0.2	-0.17	0.05	-0.03	-0.42	-0.05	0.15	0.36	-0.02	-0.33	0.09	0.13
10	0.8	0.69	-0.2	-0.88	1.01	0.27	0.14	-0.41	-0.83	-0.08	-0.45	0.39	0.17
11	0.15	-1.2	0.55	-4.04	1.77	-0.72	0.91	-0.11	-0.15	0.53	0.61	0.41	0.34

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10	11	12
Mean Q	-8.29	-6.28	-5.44	-4.92	-4.86	-4.91	-5.05	-4.7	-4.87	-4.87
S.E	0.96	0.48	0.37	0.26	0.25	0.29	0.22	0.53	1.23	1.6

Table 3.2.11 The results from the TSA

FINAL ESTIMATES

STOCK

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
4	44114.	22626.	16237.	18788.	27090.	39370.	28542.	58585.	81983.	50304.	33222.	33345.	43428.
5	31210.	33743.	17358.	12281.	13954.	21237.	28615.	21986.	42981.	62300.	37704.	25545.	26037.
6	10012.	21020.	23662.	11746.	8664.	9970.	14469.	19748.	14050.	29218.	42981.	25884.	17515.
7	7664.	5966.	12753.	14586.	7347.	5460.	6245.	9195.	11238.	8287.	17871.	26110.	15029.
8	3638.	4249.	3429.	6682.	8230.	4051.	3140.	3678.	4873.	6288.	4861.	9387.	12873.
9	1196.	1813.	2236.	1676.	3397.	3961.	2203.	1647.	1809.	2387.	3347.	2386.	4495.
10	748.	607.	944.	1045.	898.	1788.	2233.	1171.	767.	838.	1225.	1721.	1153.

STANDARD DEVIATION OF STOCK ESTIMATES

4	2714.	1357.	985.	1136.	1461.	2628.	1652.	4171.	6067.	4931.	3917.	4205.	13293.
5	1809.	2168.	1070.	782.	891.	1161.	1940.	1306.	3086.	4616.	3838.	3125.	3358.
6	791.	1362.	1608.	806.	572.	660.	872.	1465.	984.	2308.	3404.	2906.	2394.
7	573.	485.	947.	1114.	559.	392.	438.	633.	1011.	703.	1618.	2416.	2141.
8	344.	367.	329.	666.	737.	386.	256.	298.	441.	693.	487.	1126.	1768.
9	196.	235.	261.	236.	473.	544.	261.	189.	213.	324.	471.	343.	818.
10	129.	118.	165.	192.	159.	336.	363.	186.	138.	155.	229.	315.	245.

FISHING MORTALITY RATES

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
4	0.068	0.062	0.068	0.082	0.043	0.113	0.061	0.110	0.069	0.089	0.063	0.045	0.074
5	0.195	0.152	0.188	0.145	0.134	0.183	0.169	0.237	0.186	0.168	0.176	0.177	0.177
6	0.316	0.300	0.283	0.269	0.261	0.261	0.253	0.355	0.316	0.292	0.297	0.342	0.297
7	0.389	0.354	0.437	0.371	0.393	0.347	0.325	0.433	0.377	0.333	0.441	0.505	0.358
8	0.497	0.441	0.513	0.474	0.530	0.404	0.445	0.509	0.510	0.430	0.511	0.531	0.432
9	0.475	0.453	0.556	0.423	0.441	0.361	0.431	0.563	0.566	0.467	0.464	0.524	0.427
10	0.484	0.465	0.504	0.420	0.465	0.406	0.472	0.556	0.496	0.456	0.467	0.540	0.441

STANDARD DEVIATIONS OF LOG(F)

4	0.17	0.17	0.13	0.14	0.17	0.24	0.18	0.29	0.33	0.27	0.21	0.18	0.34
5	0.08	0.09	0.08	0.07	0.06	0.09	0.08	0.09	0.10	0.12	0.11	0.13	0.16
6	0.12	0.09	0.11	0.09	0.11	0.11	0.09	0.10	0.08	0.11	0.12	0.13	0.15
7	0.11	0.10	0.10	0.11	0.10	0.10	0.11	0.09	0.10	0.09	0.11	0.13	0.14
8	0.12	0.12	0.12	0.11	0.13	0.12	0.13	0.12	0.11	0.12	0.12	0.14	0.16
9	0.15	0.14	0.14	0.14	0.14	0.15	0.15	0.14	0.14	0.14	0.15	0.15	0.17
10	0.16	0.17	0.16	0.16	0.16	0.16	0.17	0.16	0.16	0.16	0.17	0.17	0.18

STATE VECTORS

15	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21	-1.21
16	-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
17	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
18	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
19	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
20	-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 3.2.12. Fishing mortality (F) at age

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: STVPA9)

At 5-May-93ï 11:49 Traditional vpa using file input for terminal F

year/ age	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	0.155	0.0561	0.0838	0.0626	0.0238	0.0149	0.0182	0.0156	0.0197	0.0048	0.0104
4	0.2023	0.2733	0.1123	0.2273	0.1337	0.0311	0.0684	0.0537	0.1061	0.0909	0.0638
5	0.3397	0.3121	0.2152	0.2541	0.2256	0.1266	0.1089	0.095	0.1593	0.1688	0.2369
6	0.3216	0.4754	0.4091	0.3113	0.2391	0.1837	0.2443	0.1727	0.2512	0.2564	0.359
7	0.2017	0.2757	0.4639	0.2911	0.2967	0.2188	0.3483	0.2882	0.403	0.4001	0.4919
8	0.1312	0.2163	0.3607	0.2439	0.2533	0.2686	0.3264	0.3716	0.4382	0.4994	0.6704
9	0.1143	0.1674	0.2631	0.1722	0.2395	0.2407	0.3283	0.2799	0.4103	0.5195	0.8357
10	0.1731	0.1636	0.2422	0.1771	0.173	0.2485	0.3297	0.3509	0.3462	0.5104	0.6377
11	0.1822	0.1441	0.2545	0.142	0.182	0.207	0.2846	0.3718	0.1627	0.3966	0.9208
12	0.4958	0.1694	0.2942	0.1375	0.1602	0.1803	0.1675	0.2812	0.3308	0.4576	1.1569
13	0.1881	0.2108	0.2276	0.137	0.1725	0.2932	0.4495	0.2753	0.1318	0.5097	0.5068
14	0.26	0.172	0.255	0.148	0.172	0.232	0.308	0.32	0.243	0.469	0.806
+gp	0.26	0.172	0.255	0.148	0.172	0.232	0.308	0.32	0.243	0.469	0.806
F (4- 9)	0.2185	0.2867	0.304	0.25	0.2313	0.1783	0.2375	0.2102	0.2947	0.3225	0.4429

year/ age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	0.0238	0.0093	0.0573	0.0226	0.0117	0.003	0.0123	0.0096	0.0109	0.0116	0.0252
4	0.1072	0.0966	0.1946	0.186	0.188	0.0959	0.074	0.1095	0.0646	0.0666	0.0796
5	0.1898	0.208	0.1795	0.212	0.2919	0.2524	0.1538	0.1777	0.2174	0.1191	0.1955
6	0.3226	0.3233	0.1905	0.207	0.3476	0.281	0.212	0.3574	0.3693	0.3662	0.2397
7	0.396	0.5031	0.2583	0.3319	0.4	0.2336	0.3289	0.342	0.3778	0.3657	0.5581
8	0.4861	0.4638	0.4571	0.3735	0.3934	0.354	0.3531	0.312	0.5534	0.4546	0.5941
9	0.6638	0.4725	0.4449	0.3573	0.3324	0.4772	0.3025	0.1715	0.276	0.4935	0.6592
10	0.7581	0.6498	0.465	0.4665	0.4916	0.3587	0.331	0.7625	0.2293	0.278	0.5315
11	0.5292	0.5162	0.5993	0.3366	0.3598	0.4977	0.3039	0.6698	0.3939	0.0763	0.1006
12	1.1404	0.7828	0.3331	0.6969	0.3386	0.3534	0.5249	0.5861	0.2524	0.8706	0.0572
13	0.9287	1.0084	0.3176	0.4184	1.0598	0.2025	0.5657	0.6027	0.1374	0.5457	0.7539
14	0.839	0.739	0.429	0.48	0.563	0.353	0.431	0.655	0.253	0.443	0.361
+gp	0.839	0.739	0.429	0.48	0.563	0.353	0.431	0.655	0.253	0.443	0.361
F (4- 9)	0.3609	0.3446	0.2875	0.2779	0.3256	0.2823	0.2374	0.245	0.3097	0.3109	0.3877

year/ age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	FBAR 90-92
3	0.0038	0.0013	0.0122	0.0476	0.0103	0.024	0.0082	0.0039	0.004	0.007	0.005
4	0.1134	0.0288	0.1236	0.0574	0.1034	0.0696	0.1019	0.0557	0.0299	0.074	0.0532
5	0.1039	0.0695	0.2013	0.1824	0.258	0.1879	0.1591	0.1815	0.1615	0.177	0.1733
6	0.2622	0.2594	0.2413	0.2427	0.3797	0.354	0.3259	0.2888	0.3612	0.297	0.3157
7	0.3618	0.3931	0.3623	0.3059	0.4552	0.3542	0.2921	0.5047	0.5686	0.358	0.4771
8	0.6742	0.5624	0.3794	0.4889	0.4766	0.5587	0.4303	0.5407	0.5419	0.433	0.5052
9	0.5262	0.5624	0.213	0.3596	0.6074	0.628	0.5737	0.4621	0.5343	0.433	0.4765
10	0.3495	0.9941	0.7376	0.903	0.5383	0.4308	0.4189	0.5521	0.7988	0.433	0.5946
11	0.1133	0.8849	0.5315	0.9141	0.8592	0.6412	0.804	0.4389	0.7724	0.433	0.5481
12	0.0267	0.7246	0.1497	0.8847	0.6774	0.4457	0.793	0.5724	0.1972	0.433	0.4009
13	0.0041	0.7003	1.1654	0.2965	2.3112	0.6727	0.6644	1.7174	0.1095	0.433	0.7533
14	0.123	0.826	0.646	0.75	1.096	0.548	0.67	0.82	0.469	0.433	0.574
+gp	0.123	0.826	0.646	0.75	1.096	0.548	0.67	0.82	0.469	0.433	
F (4- 9)	0.3403	0.3126	0.2535	0.2728	0.38	0.3587	0.3138	0.3389	0.3662	0.2953	

Table 3.2.13. Stock number at age (start of year) Numbers*10**-3

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: STVPA9)

At 5-May-93ï 11:49 Traditional vpa using file input for terminal F

year / age	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	32739	30999	84106	55195	94062	70223	68332	59672	88751	66328	50638
4	23635	22957	23995	63327	42446	75203	56645	54937	48100	71243	54046
5	18584	15807	14300	17559	41308	30403	59684	43309	42628	35418	53258
6	7826	10833	9472	9441	11151	26990	21932	43823	32245	29760	24495
7	3540	4645	5513	5152	5662	7188	18390	14065	30189	20537	18855
8	2784	2369	2887	2839	3152	3446	4728	10628	8632	16519	11270
9	2446	1999	1562	1648	1821	2003	2156	2793	6001	4560	8208
10	1703	1786	1384	983	1136	1173	1289	1271	1728	3260	2221
11	859	1173	1242	890	674	782	749	759	733	1001	1602
12	325	586	831	788	632	460	521	462	429	510	551
13	154	162	405	507	562	441	315	361	285	252	264
14	96	104	107	264	362	387	269	164	224	205	124
+gp	749	835	923	584	376	494	522	381	163	251	258
TOT	95439	94255	146729	159177	203344	219194	235532	232626	260108	249844	225790

year / age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	26456	26103	25125	25927	31235	21672	49438	55214	27993	19432	22517
4	41029	21150	21173	19425	20752	25276	17690	39981	44772	22670	15726
5	41514	30178	15722	14270	13205	14078	18801	13451	29340	34364	17365
6	34407	28114	20067	10757	9452	8074	8955	13199	9219	19329	24977
7	14006	20402	16659	13580	7161	5466	4991	5931	7559	5217	10973
8	9439	7718	10100	10534	7978	3930	3543	2941	3450	4242	2963
9	4720	4753	3974	5235	5937	4407	2258	2038	1763	1624	2204
10	2914	1990	2426	2085	2998	3486	2239	1366	1405	1095	812
11	961	1118	851	1248	1071	1501	1994	1317	522	915	679
12	522	463	546	383	730	612	747	1205	552	288	694
13	142	137	173	320	156	426	352	362	549	351	99
14	130	46	41	103	173	44	285	164	162	392	166
+gp	140	48	63	175	46	181	172	0	0	0	0
TOT	176380	142219	116919	104043	100892	89154	111466	137168	127286	109919	99176

year / age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	31288	46504	34216	73743	102430	61351	42384	40123	55337	38115	0
4	17977	25520	38027	27675	57571	82999	49040	34417	32720	45127	30988
5	11890	13140	20301	27515	21395	42504	63382	36261	26651	26000	34312
6	11693	8774	10036	13590	18772	13534	28839	44261	24761	18565	17834
7	16090	7365	5542	6456	8729	10514	7777	17045	27147	14127	11294
8	5141	9174	4070	3159	3892	4533	6040	4755	8424	12587	8086
9	1339	2145	4280	2280	1586	1979	2123	3216	2267	4012	6683
10	934	648	1001	2832	1303	707	864	979	1659	1088	2130
11	391	539	196	392	940	623	376	466	462	611	578
12	503	286	182	94	129	326	269	138	246	175	324
13	537	401	113	128	32	53	171	99	64	165	93
14	38	438	163	29	78	3	22	72	15	47	88
+gp	0	0	0	0	0	0	0	0	0	0	25
TOT	97820	114933	118128	157893	216856	219126	201289	181831	179752	160618	112434

Table 3.2.14. Summary (without SOP correction)

Run title : Saithe in the Iceland Grounds (Fishing Area Va) (run name: STVPA9)

At 5-May-93 11:49 Traditional vpa using file input for terminal F

year	recruits	total bio	total spbio	land-ings	Fbar age4-9
1961	32739	268195	129872	50826	0.2185
1962	30999	277003	142184	50514	0.2867
1963	84106	336274	144613	48011	0.304
1964	55195	380521	141947	60257	0.25
1965	94062	465836	165999	60177	0.2313
1966	70223	550397	214136	52003	0.1783
1967	68332	648019	279292	75712	0.2375
1968	59672	697092	345778	77549	0.2102
1969	88751	762546	395280	115853	0.2947
1970	66328	755885	399454	116601	0.3225
1971	50638	717074	381384	136764	0.4429
1972	26456	603752	334676	111301	0.3609
1973	26103	516600	313690	110888	0.3446
1974	25125	434163	288072	97568	0.2875
1975	25927	387979	264698	87954	0.2779
1976	31235	347146	227234	82003	0.3256
1977	21672	300237	186664	62026	0.2823
1978	49438	307896	165549	49672	0.2374
1979	55214	342138	159512	63504	0.245
1980	27993	345856	148978	58347	0.3097
1981	19432	326915	149456	58986	0.3109
1982	22517	313893	160580	68615	0.3877
1983	31288	304838	159023	58266	0.3403
1984	46504	347361	165182	62719	0.3126
1985	34216	336319	147205	57101	0.2535
1986	73743	406678	159875	66376	0.2728
1987	102430	483747	155600	80559	0.38
1988	61351	505167	149068	77247	0.3587
1989	42384	488019	154199	82425	0.3138
1990	40123	495508	175235	98130	0.3389
1991	55337	449824	184145	102737	0.3662
1992	38115	424506	191930	79426	0.2953
Units	(Thousan	(Tonnes)	(Tonnes)	(Tonnes)	

Table 3.2.15

Prediction with management option table: Input data

Year: 1993								
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	0.0600	0.0000	0.0000	1.380	0.0044	1.380
4	32.532	0.2000	0.1400	0.0000	0.0000	1.987	0.0464	1.987
5	24.802	0.2000	0.3100	0.0000	0.0000	2.725	0.1523	2.725
6	17.834	0.2000	0.5400	0.0000	0.0000	3.463	0.2775	3.463
7	11.294	0.2000	0.7500	0.0000	0.0000	4.522	0.4219	4.522
8	8.086	0.2000	0.8500	0.0000	0.0000	5.338	0.4473	5.338
9	6.683	0.2000	0.8700	0.0000	0.0000	6.231	0.4228	6.231
10	2.130	0.2000	1.0000	0.0000	0.0000	7.735	0.5304	7.735
11	0.578	0.2000	1.0000	0.0000	0.0000	8.752	0.4867	8.752
12	0.324	0.2000	1.0000	0.0000	0.0000	9.583	0.3519	9.583
13	0.093	0.2000	1.0000	0.0000	0.0000	11.391	0.6644	11.391
14	0.088	0.2000	1.0000	0.0000	0.0000	10.730	0.5086	10.730
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
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	0.0600	0.0000	0.0000	1.380	0.0044	1.380
4	.	0.2000	0.1400	0.0000	0.0000	2.037	0.0464	2.037
5	.	0.2000	0.3100	0.0000	0.0000	2.775	0.1523	2.775
6	.	0.2000	0.5400	0.0000	0.0000	3.624	0.2775	3.624
7	.	0.2000	0.7600	0.0000	0.0000	4.618	0.4219	4.618
8	.	0.2000	0.8900	0.0000	0.0000	5.728	0.4473	5.728
9	.	0.2000	0.9400	0.0000	0.0000	6.617	0.4228	6.617
10	.	0.2000	1.0000	0.0000	0.0000	7.735	0.5304	7.735
11	.	0.2000	1.0000	0.0000	0.0000	8.752	0.4867	8.752
12	.	0.2000	1.0000	0.0000	0.0000	9.583	0.3519	9.583
13	.	0.2000	1.0000	0.0000	0.0000	11.391	0.6644	11.391
14	.	0.2000	1.0000	0.0000	0.0000	10.730	0.5086	10.730
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	0.0600	0.0000	0.0000	1.380	0.0044	1.380
4	.	0.2000	0.1400	0.0000	0.0000	2.037	0.0464	2.037
5	.	0.2000	0.3100	0.0000	0.0000	2.807	0.1523	2.807
6	.	0.2000	0.5400	0.0000	0.0000	3.680	0.2775	3.680
7	.	0.2000	0.7600	0.0000	0.0000	4.674	0.4219	4.674
8	.	0.2000	0.8900	0.0000	0.0000	5.806	0.4473	5.806
9	.	0.2000	0.9500	0.0000	0.0000	6.927	0.4228	6.927
10	.	0.2000	1.0000	0.0000	0.0000	7.735	0.5304	7.735
11	.	0.2000	1.0000	0.0000	0.0000	8.752	0.4867	8.752
12	.	0.2000	1.0000	0.0000	0.0000	9.583	0.3519	9.583
13	.	0.2000	1.0000	0.0000	0.0000	11.391	0.6644	11.391
14	.	0.2000	1.0000	0.0000	0.0000	10.730	0.5086	10.730
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PRED1
Date and time: 05MAY93:14:02

Table 3.2.16

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
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
1.1871	0.3499	411705	204526	90000	0.6000	0.1768	397949	195754	47259	426707	216815
.	.	.	.	.	0.7000	0.2063	.	195754	54197	419048	210486
.	.	.	.	.	0.8000	0.2358	.	195754	60894	411658	204398
.	.	.	.	.	0.9000	0.2652	.	195754	67361	404526	198540
.	.	.	.	.	1.0000	0.2947	.	195754	73607	397642	192905
.	.	.	.	.	1.1000	0.3242	.	195754	79640	390996	187482
.	.	.	.	.	1.2000	0.3536	.	195754	85470	384579	182262
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED1
Date and time : 05MAY93:14:02
Computation of ref. F: Simple mean, age 4 - 9
Basis for 1993 : TAC constraints

Table 3.2.17

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	0.0600	0.0000	0.0000	1.471	0.0300	1.471
4	.	0.2000	0.1400	0.0000	0.0000	2.063	0.2200	2.063
5	.	0.2000	0.2900	0.0000	0.0000	2.766	0.5200	2.766
6	.	0.2000	0.5200	0.0000	0.0000	3.654	0.9500	3.654
7	.	0.2000	0.7300	0.0000	0.0000	4.691	1.2300	4.691
8	.	0.2000	0.8800	0.0000	0.0000	5.855	1.7000	5.855
9	.	0.2000	0.9600	0.0000	0.0000	7.103	1.7000	7.103
10	.	0.2000	1.0000	0.0000	0.0000	8.069	1.7000	8.069
11	.	0.2000	1.0000	0.0000	0.0000	9.026	1.7000	9.026
12	.	0.2000	1.0000	0.0000	0.0000	9.679	1.7000	9.679
13	.	0.2000	1.0000	0.0000	0.0000	11.042	1.7000	11.042
14	.	0.2000	1.0000	0.0000	0.0000	11.166	1.7000	11.166
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YIELD3
Date and time: 06MAY93:10:02

Table 3.3.1 Nominal catch (tonnes) of COD in Division Va, 1978-1992, as officially reported to ICES.

Country	1978	1979	1980	1981	1982	1983	1984
Belgium	1,314	1,485	840	1,321	236	188	254
Faroe Is.	7,069	6,163	4,802	6,183	5,297	5,626	2,041
Iceland	319,648	360,077	429,044	461,038	382,297	293,890	281,481
Norway	189	288	358	559	557	109	90
UK (Engl. & Wales)	-	-	-	-	-	-	2
Total	328,220	368,013	435,044	469,101	388,387	299,813	283,868

Country	1985	1986	1987	1988	1989	1990	1991	1992[1]
Belgium	207	226	597	365	309	260	548	222
Faroe Islands	2,203	2,554	1,848	1,966	2,012	1,782	1,323	883
Iceland	322,810	365,852	389,808	375,741	353,985	333,348	306,697	255,844
Norway	46	1	4	4	3	-	-	-
UK (Engl. & Wales)	1	-	-	-	-	-	-	-
Total	325,267	368,633	392,257	378,076	356,309	335,390	308,568	256,949
Working Group estimate							310,499[2]	265,300[3]

[1]Preliminary.
[2]Additional catch by Iceland of 1,931 t included.
[3]Additional catch by Iceland of 8,350 t included.

Table 3.3.2

Virtual Population Analysis : Catch in numbers, millions
Run 3. 1993.

Age	1973	1974	1975	1976	1977	1978	1979
3	36.538	14.846	29.301	23.578	2.614	5.999	7.136
4	25.542	61.826	29.489	39.790	42.659	16.287	28.427
5	27.391	21.824	44.138	21.092	32.465	43.931	13.772
6	17.045	14.413	12.088	24.395	12.162	17.626	34.443
7	12.721	8.974	9.628	5.803	13.017	8.729	14.130
8	3.685	6.216	3.691	5.343	2.809	4.119	4.426
9	4.718	1.647	2.051	1.297	1.773	0.978	1.432
10	5.809	2.530	0.752	0.633	0.421	0.348	0.350
11	1.134	1.765	0.891	0.205	0.086	0.119	0.168
12	0.282	0.334	0.416	0.155	0.024	0.048	0.043
13	0.007	0.062	0.060	0.065	0.006	0.015	0.024
14	0.001	0.028	0.046	0.029	0.002	0.027	0.004

Age	1980	1981	1982	1983	1984	1985	1986
3	4.348	2.118	3.285	3.554	6.750	6.457	20.642
4	28.530	13.297	20.812	10.910	31.553	24.552	20.330
5	32.500	39.195	24.462	24.305	19.420	35.392	26.644
6	15.119	23.247	28.351	18.944	15.326	18.267	30.839
7	27.090	12.710	14.012	17.382	8.082	8.711	11.413
8	7.847	26.455	7.666	8.381	7.336	4.201	4.441
9	2.228	4.804	11.517	2.054	2.680	2.264	1.771
10	0.646	1.677	1.912	2.733	0.512	1.063	0.305
11	0.246	0.582	0.327	0.514	0.538	0.217	0.392
12	0.099	0.228	0.094	0.215	0.195	0.233	0.173
13	0.025	0.053	0.043	0.064	0.090	0.102	0.076
14	0.004	0.068	0.011	0.037	0.036	0.038	0.040

Age	1987	1988	1989	1990	1991	1992
3	11.002	6.713	2.605	5.785	8.608	11.643
4	62.130	39.323	27.983	12.313	25.290	21.257
5	27.192	55.895	50.059	27.179	15.589	25.174
6	15.127	18.663	31.455	44.534	21.650	11.021
7	15.695	6.399	6.010	17.037	25.197	9.676
8	4.159	5.877	1.915	2.573	6.404	8.202
9	1.463	1.345	0.881	0.609	0.909	2.026
10	0.592	0.455	0.225	0.322	0.245	0.268
11	0.253	0.305	0.107	0.118	0.126	0.049
12	0.142	0.157	0.086	0.050	0.063	0.034
13	0.046	0.114	0.038	0.015	0.011	0.009
14	0.058	0.025	0.005	0.020	0.012	0.006

Table 3.3.3

Proportion of F and M before spawning:

Age	PropF	PropM
3	0.085	0.250
4	0.180	0.250
5	0.248	0.250
6	0.296	0.250
7	0.382	0.250
8	0.437	0.250
9	0.477	0.250
10	0.477	0.250
11	0.477	0.250
12	0.477	0.250
13	0.477	0.250
14	0.477	0.250

Table 3.3.4

Virtual Population Analysis : Weight at age in the catches, in grams
Run 3. 1993.

Age	1973	1974	1975	1976	1977	1978	1979
3	1030	1050	1100	1350	1259	1289	1408
4	1420	1710	1770	1780	1911	1833	1956
5	2470	2430	2780	2650	2856	2929	2642
6	3600	3820	3760	4100	4069	3955	3999
7	4900	5240	5450	5070	5777	5726	5548
8	6110	6660	6690	6730	6636	6806	6754
9	6670	7150	7570	8250	7685	9041	8299
10	6750	7760	8580	9610	9730	10865	9312
11	7430	8190	8810	11540	11703	13068	13130
12	7950	9780	9780	11430	14394	11982	13418
13	10170	12380	10090	14060	17456	19062	13540
14	17000	14700	11000	16180	24116	21284	20072

Age	1980	1981	1982	1983	1984	1985	1986
3	1392	1180	1006	1095	1288	1407	1459
4	1862	1651	1550	1599	1725	1971	1961
5	2733	2260	2246	2275	2596	2576	2844
6	3768	3293	3104	3021	3581	3650	3593
7	5259	4483	4258	4096	4371	4976	4635
8	6981	5821	5386	5481	5798	6372	6155
9	8037	7739	6682	7049	7456	8207	7503
10	10731	9422	9141	8128	9851	10320	9084
11	12301	11374	11963	11009	11052	12197	10356
12	17281	12784	14226	13972	14338	14683	15283
13	14893	12514	17287	15882	15273	16175	14540
14	19069	19069	16590	18498	16660	19050	15017

Age	1987	1988	1989	1990	1991	1992	1993
3	1316	1438	1186	1290	1309	1303	1272
4	1956	1805	1813	1704	1899	1782	1884
5	2686	2576	2590	2383	2475	2503	2628
6	3894	3519	3915	3034	3159	3320	3618
7	4716	4930	5210	4624	3792	4488	4651
8	6257	6001	6892	6521	5680	5690	6135
9	7368	7144	8035	8888	7242	6950	7779
10	9243	8822	9831	10592	9804	8208	9609
11	10697	9977	11986	10993	9754	12747	11370
12	10622	11732	10003	14570	14344	13448	13091
13	15894	14156	12611	15732	14172	15881	14599
14	12592	13042	16045	17290	20200	11757	16323

Table 3.3.5

Virtual Population Analysis : Weight at age in the SSB, in grams
Run 3. 1993.

Age	1973	1974	1975	1976	1977	1978	1979
3	999	1046	978	1217	960	1031	1141
4	1580	1850	1855	1604	1723	1671	1647
5	3488	2772	3292	2516	2729	2863	2532
6	4441	4596	4165	4380	4108	3920	4027
7	5585	5859	5893	5407	5957	5976	5664
8	6844	7209	7153	6985	6696	6946	6951
9	7002	7820	7905	8752	7618	9204	8234
10	6917	7874	8753	10143	9669	10833	9500
11	7632	8301	8745	11829	12578	12920	12921
12	7899	9886	9788	11518	13884	12863	13028
13	13982	11221	10081	13916	17026	19104	13308
14	14000	14363	9876	15367	24652	21183	18930

Age	1980	1981	1982	1983	1984	1985	1986
3	1333	967	996	891	1002	1131	1182
4	1680	1513	1626	1472	1479	1597	1762
5	2708	2101	2095	2139	2257	2285	2681
6	3875	3225	3006	2918	3476	3524	3562
7	5446	4520	4339	4130	4480	5010	4824
8	7106	5851	5571	5553	5887	6195	6457
9	8120	7661	6801	7007	7660	7800	7843
10	10737	9084	9259	7770	9920	9225	9419
11	12628	10833	11550	10817	11035	11336	10674
12	17528	12401	13445	13176	14531	13277	13660
13	15939	11724	17138	14175	15378	15325	13812
14	25212	14326	16554	18543	16394	18932	18479

Age	1987	1988	1989	1990	1991	1992	1993
3	1289	1218	1012	813	1122	866	953
4	1811	1604	1542	1330	1776	1400	1512
5	2735	2499	2423	2132	2233	2223	2416
6	4202	3566	3743	3187	3044	3215	3494
7	5110	5161	5298	4691	3891	4567	4771
8	6497	6238	6910	6627	5897	5682	6197
9	7802	7302	7725	8915	7657	6878	7793
10	10220	8647	9397	10362	10573	8269	9650
11	11197	10184	11953	12093	11230	11601	11719
12	10620	11504	9529	15453	14340	13639	13240
13	15893	14159	12195	15337	14172	15434	14285
14	16514	10952	14270	17257	20200	11757	15871

Table 3.3.6

Virtual Population Analysis : Sexual maturity at age in the stock
Run 3. 1993.

Age	1973	1974	1975	1976	1977	1978	1979
3	0.026	0.014	0.007	0.049	0.000	0.049	0.000
4	0.069	0.090	0.112	0.058	0.047	0.050	0.019
5	0.408	0.277	0.342	0.281	0.213	0.185	0.139
6	0.611	0.584	0.536	0.505	0.611	0.443	0.531
7	0.842	0.794	0.857	0.629	0.881	0.877	0.793
8	0.941	0.929	0.950	0.936	0.960	0.962	0.929
9	0.980	0.961	0.986	0.988	0.990	0.982	0.982
10	0.996	0.989	1.000	1.000	1.000	1.000	0.919
11	0.996	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age	1980	1981	1982	1983	1984	1985	1986
3	0.056	0.000	0.023	0.000	0.000	0.027	0.005
4	0.023	0.029	0.051	0.087	0.043	0.058	0.054
5	0.165	0.085	0.129	0.167	0.189	0.202	0.244
6	0.478	0.289	0.226	0.338	0.416	0.548	0.543
7	0.807	0.659	0.544	0.515	0.656	0.774	0.762
8	0.915	0.890	0.849	0.717	0.782	0.903	0.891
9	0.979	0.952	0.956	0.857	0.858	0.938	0.981
10	0.977	0.962	0.967	0.979	0.949	1.000	0.962
11	1.000	0.988	1.000	0.985	0.969	1.000	0.988
12	0.964	1.000	1.000	1.000	0.948	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age	1987	1988	1989	1990	1991	1992	1993
3	0.020	0.039	0.000	0.000	0.000	0.070	0.036
4	0.046	0.020	0.048	0.075	0.063	0.236	0.158
5	0.238	0.206	0.226	0.303	0.214	0.568	0.394
6	0.585	0.477	0.550	0.633	0.543	0.707	0.624
7	0.808	0.690	0.820	0.819	0.781	0.907	0.929
8	0.942	0.831	0.858	0.912	0.887	0.962	0.971
9	0.952	0.929	0.887	0.953	0.945	0.977	0.952
10	1.000	0.946	0.991	0.986	0.842	1.000	1.000
11	0.979	0.974	1.000	1.000	1.000	1.000	1.000
12	1.000	0.821	0.903	1.000	1.000	1.000	1.000
13	1.000	1.000	0.859	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 3.3.7 Cpue data.

FLEET: SUR.N

	85	86	87	88	89	90	91	92	93
3	628.91	2176.69	2630.80	1704.59	490.23	633.58	548.94	825.28	652.57
4	906.14	347.02	1628.86	2104.16	1444.27	319.75	638.93	470.11	656.03
5	1302.26	375.68	438.26	1477.87	1069.33	450.77	274.91	367.24	195.98
6	331.92	515.43	210.85	118.97	412.32	394.70	258.20	136.17	155.87
7	267.34	83.67	196.80	119.78	31.65	163.16	193.32	63.03	19.64
8	68.69	31.45	24.75	149.94	13.89	9.26	31.01	27.21	14.59
9	57.46	6.90	12.57	5.56	14.80	4.45	9.33	7.10	13.77
10	26.82	10.36	3.44	3.09	1.30	5.48	1.90	0.92	3.64
11	0.50	3.19	4.27	1.55	1.50	1.41	1.41	NA	1.29
12	0.71	0.52	1.21	5.44	0.94	0.10	NA	1.82	0.71
13	0.17	0.26	0.62	0.47	NA	0.29	0.34	0.62	NA
14	0.17	0.13	0.67	0.46	0.48	0.84	0.41	NA	NA

FLEET: SUR.SW

	85	86	87	88	89	90	91	92	93
3	26.45	59.83	66.00	29.80	14.26	28.71	18.11	44.30	80.06
4	55.04	28.16	92.69	95.03	100.32	27.90	72.20	46.65	88.80
5	80.26	43.52	25.04	116.41	175.55	145.50	52.73	43.80	44.41
6	66.85	57.20	28.96	28.28	140.65	234.80	105.40	23.37	32.35
7	31.95	35.54	28.96	19.03	24.37	70.74	179.74	44.12	9.58
8	22.29	11.19	11.75	16.60	7.05	9.10	25.17	47.71	10.58
9	7.13	6.18	2.24	4.36	3.23	3.88	3.73	8.88	6.36
10	4.08	3.64	1.20	1.67	1.71	1.87	1.62	1.68	2.36
11	0.49	1.38	0.98	0.59	0.84	0.53	0.39	0.31	0.47
12	0.95	0.57	1.17	0.71	0.57	NA	NA	NA	NA
13	0.34	0.43	0.61	0.18	0.27	0.18	0.41	0.12	0.49
14	0.09	0.59	0.27	0.18	NA	NA	NA	NA	0.12

FLEET: SUR.SE

	85	86	87	88	89	90	91	92	93
3	3.00	26.20	21.69	50.42	2.72	4.88	2.13	23.78	33.77
4	9.48	22.31	21.20	190.39	36.86	2.07	6.26	16.26	36.82
5	22.55	37.24	8.38	107.02	148.73	15.81	6.36	16.50	21.75
6	30.06	46.07	15.01	31.91	138.34	60.11	19.03	15.27	22.42
7	21.29	22.34	24.05	12.14	24.20	70.57	54.53	25.26	12.18
8	16.66	10.66	10.76	9.95	6.48	11.61	29.59	37.84	8.31
9	10.66	6.40	4.10	3.38	2.73	1.87	3.75	11.64	6.93
10	10.73	7.20	4.71	1.50	2.92	1.42	0.49	1.67	3.09
11	3.14	3.24	4.08	0.39	2.85	0.26	0.53	0.01	1.81
12	2.23	0.65	0.92	1.49	NA	NA	NA	NA	0.49
13	0.61	1.22	0.71	1.19	NA	0.27	0.40	0.42	NA
14	0.75	0.15	1.26	1.06	NA	NA	0.62	NA	NA

Continued..

Table 3.3.7 Cpue data (Cont'd)

FLEET: TRWL.JUN.DEC.N

	89	90	91	92	93
4	0.0141	0.0108	0.0330	0.0274	0.0449
5	0.0941	0.1281	0.0537	0.1049	0.0644
6	0.1538	0.1988	0.0875	0.0621	0.0776
7	0.0680	0.0588	0.1406	0.0693	0.0281
8	0.0108	0.0067	0.0200	0.0415	0.0198
9	0.0037	0.0006	0.0012	0.0070	0.0078
10	0.0003	0.0003	NA	0.0013	0.0005
11	0.0002	NA	0.0001	0.0002	NA

FLEET: TRWL.JUN.DEC.SW

	89	90	91	92	93
4	0.0198	0.0060	0.0077	0.0062	0.0314
5	0.0893	0.0751	0.0203	0.0613	0.0706
6	0.1270	0.1172	0.0705	0.0487	0.0603
7	0.0520	0.0481	0.1233	0.0696	0.0352
8	0.0143	0.0087	0.0305	0.0778	0.0289
9	0.0018	0.0014	0.0028	0.0146	0.0106
10	0.0005	0.0014	0.0013	0.0032	0.0011
11	NA	0.0009	0.0018	0.0007	NA

FLEET: TRWL.JUN.DEC.SE

	89	90	91	92	93
4	0.0093	0.0027	0.0032	0.0202	0.0240
5	0.0526	0.0161	0.0082	0.0087	0.0161
6	0.0914	0.0680	0.0317	0.0123	0.0203
7	0.0443	0.0751	0.0631	0.0245	0.0142
8	0.0129	0.0165	0.0387	0.0300	0.0203
9	0.0089	0.0037	0.0054	0.0160	0.0207
10	0.0026	0.0025	0.0019	0.0045	0.0049
11	0.0012	0.0009	0.0012	0.0009	0.0009

Table 3.3.8 Standardized catchabilities (residuals), mean catchabilities, var (q) and weights used in final fit by fleet, age and year.

Standardized catchabilities. Fleet:
TRWL.JUN.DEC.N

	1989	1990	1991	1992	1993	Mean	Var	c/Var	Wts
4	-1.47	-0.59	0.82	0.77	0.47	-15.39	0.21	0.24	0.80
5	-1.63	0.78	0.09	0.85	-0.09	-13.66	0.12	0.42	1.00
6	-0.36	-0.90	-0.76	1.48	0.54	-13.03	0.02	2.33	1.40
7	1.24	-1.48	-0.14	0.48	-0.10	-12.61	0.17	0.30	0.60
8	0.61	-1.33	-0.78	0.47	1.02	-12.92	0.16	0.30	0.40
9	0.83	-1.35	-0.79	0.71	0.59	-13.57	0.41	0.12	0.00
10	-0.39	-0.54	NA	1.50	-0.56	-14.05	0.73	0.07	0.00
11	-0.14	NA	-0.93	1.06	NA	-13.80	0.65	0.08	0.00

Standardized catchabilities. Fleet:
TRWL.JUN.DEC.SE

	1989	1990	1991	1992	1993	Mean	Var	c/Var	Wts
4	-0.09	-0.77	-1.13	1.27	0.72	-16.41	0.70	0.07	0.00
5	1.32	-0.30	-0.41	-1.26	0.65	-15.35	0.17	0.30	0.10
6	1.70	-0.28	-0.04	-0.91	-0.46	-14.14	0.10	0.49	0.20
7	1.55	0.45	-0.79	-0.76	-0.45	-13.15	0.16	0.31	0.30
8	0.58	0.32	0.24	-1.76	0.62	-12.63	0.06	0.88	0.50
9	0.99	-1.18	-0.95	0.40	0.74	-12.36	0.04	1.15	0.50
10	-0.34	-0.83	-0.17	1.74	-0.41	-12.11	0.11	0.44	0.15
11	-0.31	-1.25	-0.16	1.51	0.21	-12.00	0.14	0.36	0.00

Standardized catchabilities. Fleet:
TRWL.JUN.DEC.SW

	1989	1990	1991	1992	1993	Mean	Var	c/Var	Wts
4	0.85	-0.33	-0.83	-0.95	1.26	-16.10	0.20	0.25	0.40
5	-0.56	0.36	-1.40	0.41	1.20	-14.07	0.15	0.34	0.40
6	0.17	-1.58	-0.18	1.10	0.48	-13.31	0.06	0.90	1.00
7	0.70	-1.65	-0.25	0.62	0.58	-12.68	0.20	0.25	0.50
8	0.29	-1.42	-0.61	0.90	0.84	-12.53	0.22	0.23	0.20
9	-1.07	-0.76	-0.10	1.42	0.51	-13.16	0.31	0.16	0.00
10	-1.04	0.03	0.54	1.35	-0.89	-13.00	0.70	0.07	0.00
11	NA	-1.15	0.61	0.54	NA	-11.94	0.21	0.24	0.00

Continued...

Table 3.3.8 (Cont'd)

Standardized catchabilities. Fleet:
SUR.N

	1985	1986	1987	1988	1989	1990	1991	1992	1993	Mean	Var	c/Var	Wts
3	-0.70	0.37	1.35	1.49	-0.01	-0.63	-0.66	-1.21	NA	-5.16	0.14	0.36	0.00
4	0.83	-1.52	0.19	1.16	1.41	-0.56	-0.05	-0.38	-1.09	-5.13	0.18	0.28	0.80
5	1.55	-0.31	-0.16	1.26	0.49	-0.49	-0.10	-0.44	-1.79	-5.06	0.12	0.42	1.20
6	0.97	1.17	0.84	-1.73	0.05	-1.28	0.18	0.29	-0.50	-5.20	0.08	0.62	0.80
7	1.67	-0.38	0.59	1.24	-1.08	0.02	-0.23	-0.50	-1.31	-5.29	0.38	0.13	0.10
8	0.97	0.02	-0.17	2.14	0.04	-0.98	-0.49	-1.00	-0.52	-5.54	0.50	0.10	0.00
9	1.72	-1.20	0.24	-0.75	1.11	-0.10	0.54	-1.14	-0.40	-5.45	0.41	0.12	0.00
10	1.67	0.57	-0.81	-0.16	-0.99	1.15	0.24	-1.30	-0.38	-5.41	0.38	0.13	0.00
11	-2.16	-0.23	0.55	-0.57	0.53	0.36	0.53	NA	0.99	-5.37	0.53	0.09	0.00
12	-1.11	-0.72	-0.33	0.88	0.07	-1.20	NA	1.24	1.17	-5.12	1.80	0.03	0.00
13	-1.37	-1.06	0.19	-0.26	NA	0.26	0.74	1.51	NA	-5.29	1.90	0.03	0.00
14	-1.12	-1.42	-0.34	0.26	1.29	0.68	0.65	NA	NA	-4.71	1.71	0.03	0.00

Standardized catchabilities. Fleet:
SUR.SE

	1985	1986	1987	1988	1989	1990	1991	1992	1993	Mean	Var	c/Var	Wts
3	-1.00	0.40	0.38	1.79	-0.57	-0.47	-1.21	0.69	NA	-9.82	0.90	0.06	0.00
4	-0.48	0.35	-0.53	1.85	0.68	-1.56	-0.92	0.21	0.40	-8.86	0.97	0.05	0.00
5	-0.64	0.81	-1.27	1.10	1.61	-0.63	-0.99	-0.28	0.29	-8.10	0.59	0.08	0.00
6	-0.17	-0.07	-0.83	0.58	2.31	-0.45	-1.19	-0.12	-0.06	-7.25	0.18	0.28	0.10
7	-0.58	-0.74	-1.36	-0.65	1.33	1.69	-0.25	0.38	0.17	-6.63	0.09	0.56	0.20
8	0.09	-1.02	-0.63	-1.46	0.09	0.99	1.21	1.28	-0.56	-6.30	0.09	0.55	0.20
9	0.76	-0.23	-0.71	-0.76	-0.75	-0.58	0.82	2.08	-0.62	-6.23	0.07	0.73	0.30
10	0.98	0.73	0.36	-1.01	1.19	-0.63	-1.85	0.32	-0.10	-5.76	0.22	0.23	0.10
11	0.54	0.26	0.59	-0.82	1.03	-0.58	-0.03	-2.03	1.05	-5.92	2.34	0.02	0.00
12	-0.25	-0.75	-0.73	0.04	NA	NA	NA	NA	1.69	-5.27	0.63	0.08	0.00
13	-1.50	-0.58	-0.15	0.08	NA	-0.30	0.89	1.58	NA	-4.78	0.56	0.09	0.00
14	-0.14	-1.58	0.00	0.82	NA	NA	0.89	NA	NA	-4.52	1.43	0.03	0.00

Standardized catchabilities. Fleet:
SUR.SW

	1985	1986	1987	1988	1989	1990	1991	1992	1993	Mean	Var	c/Var	Wts
3	0.01	-0.15	1.77	-0.37	-0.76	0.70	-1.58	0.38	NA	-8.60	0.02	2.41	0.00
4	0.29	-1.92	-0.76	-0.20	1.49	-0.42	1.06	0.22	0.25	-7.67	0.10	0.49	0.20
5	-0.42	-0.43	-1.82	-0.10	0.90	1.62	0.80	-0.46	-0.08	-7.12	0.22	0.23	0.20
6	0.29	-0.97	-0.69	-1.12	0.91	1.32	1.42	-0.53	-0.62	-6.65	0.18	0.27	0.30
7	-0.25	-0.22	-1.35	-0.20	0.17	0.42	1.89	0.81	-1.27	-6.29	0.17	0.29	0.50
8	0.79	-1.53	-0.90	-0.20	-0.04	-0.26	0.33	2.00	-0.19	-6.18	0.06	0.80	1.00
9	-0.45	-0.18	-1.98	0.22	0.00	1.58	0.62	0.78	-0.57	-6.26	0.15	0.34	0.50
10	-0.58	-0.21	-2.11	-0.25	0.59	0.51	1.30	0.89	-0.15	-6.01	0.20	0.25	0.00
11	-1.52	-0.37	-0.50	-1.11	1.24	0.20	-0.17	1.18	1.04	-6.19	0.26	0.20	0.00
12	-1.35	-0.34	0.86	-0.28	1.11	NA	NA	NA	NA	-5.88	0.11	0.48	0.00
13	-1.08	-0.86	0.28	-1.19	-0.42	-0.06	1.18	0.47	1.68	-5.34	1.13	0.04	0.00
14	-1.21	0.27	-0.58	0.05	NA	NA	NA	NA	1.46	-5.37	1.41	0.04	0.00

Table 3.3.9

Virtual Population Analysis : Fishing mortality
Run 3. 1993.

Age	1973	1974	1975	1976	1977	1978	1979
3	0.144	0.102	0.131	0.083	0.020	0.030	0.033
4	0.319	0.383	0.299	0.263	0.212	0.169	0.195
5	0.453	0.496	0.521	0.363	0.355	0.351	0.211
6	0.598	0.459	0.569	0.617	0.368	0.333	0.513
7	0.715	0.744	0.643	0.596	0.810	0.494	0.487
8	0.702	0.968	0.808	0.938	0.657	0.660	0.503
9	0.679	0.810	1.069	0.764	0.995	0.505	0.507
10	1.102	1.004	1.176	1.270	0.608	0.530	0.339
11	1.098	1.360	1.348	1.363	0.562	0.343	0.531
12	0.969	1.262	1.767	0.940	0.547	0.719	0.200
13	0.124	0.583	0.821	2.490	0.078	0.806	1.020
14	0.794	1.004	1.236	1.365	0.558	0.580	0.519
W.Av 5-10	0.585	0.577	0.569	0.521	0.438	0.372	0.403
Ave 5-10	0.708	0.747	0.798	0.758	0.632	0.479	0.427

Age	1980	1981	1982	1983	1984	1985	1986
3	0.034	0.016	0.028	0.017	0.055	0.051	0.071
4	0.176	0.137	0.221	0.120	0.211	0.289	0.224
5	0.358	0.388	0.400	0.434	0.323	0.388	0.583
6	0.378	0.470	0.541	0.623	0.540	0.574	0.697
7	0.442	0.635	0.581	0.768	0.599	0.686	0.890
8	0.554	0.839	1.046	0.852	0.902	0.733	0.943
9	0.514	0.803	1.187	0.931	0.747	0.805	0.812
10	0.453	0.951	0.910	1.083	0.635	0.771	0.772
11	0.425	0.982	0.480	0.672	0.641	0.615	0.742
12	0.700	0.904	0.404	0.679	0.588	0.644	0.677
13	0.171	1.076	0.417	0.533	0.686	0.713	0.449
14	0.453	0.943	0.680	0.779	0.659	0.710	0.690
W.Av 5-10	0.404	0.529	0.583	0.610	0.480	0.487	0.691
Ave 5-10	0.450	0.681	0.778	0.782	0.624	0.660	0.783

Age	1987	1988	1989	1990	1991	1992	1989-1992
3	0.045	0.044	0.034	0.046	0.080	0.058	0.055
4	0.314	0.222	0.262	0.221	0.291	0.289	0.266
5	0.525	0.519	0.485	0.438	0.480	0.526	0.482
6	0.793	0.857	0.628	0.640	0.758	0.754	0.695
7	0.978	0.977	0.763	0.858	0.957	0.959	0.884
8	1.013	1.401	0.930	0.910	0.975	1.014	0.957
9	0.996	1.176	0.833	0.907	1.019	1.014	0.943
10	0.717	1.044	0.620	0.868	1.280	1.014	0.946
11	0.594	1.066	0.758	0.795	1.075	1.014	0.911
12	0.668	0.945	1.067	1.035	1.531	1.014	1.162
13	0.749	2.388	0.630	0.527	0.674	1.014	0.711
14	0.745	1.324	0.782	0.827	1.116	1.014	0.934
W.Av 5-10	0.704	0.644	0.554	0.603	0.754	0.696	0.616
Ave 5-10	0.837	0.996	0.710	0.770	0.911	0.880	0.818

Table 3.3.10

Virtual Population Analysis : Stock in numbers, millions
Run 3. 1993.

Age	1973	1974	1975	1976	1977	1978	1979
3	300.418	169.263	263.221	326.284	143.285	221.651	245.472
4	102.627	213.034	125.192	189.096	245.869	114.952	176.056
5	82.328	61.073	118.922	75.993	119.032	162.901	79.443
6	41.384	42.846	30.449	57.836	43.279	68.301	93.913
7	27.168	18.637	22.158	14.113	25.539	24.514	40.086
8	7.966	10.886	7.250	9.536	6.364	9.306	12.250
9	10.441	3.231	3.386	2.646	3.054	2.700	3.938
10	9.426	4.334	1.177	0.951	1.009	0.925	1.335
11	1.844	2.563	1.300	0.297	0.219	0.450	0.446
12	0.494	0.504	0.538	0.276	0.062	0.102	0.261
13	0.066	0.153	0.117	0.075	0.088	0.030	0.041
14	0.002	0.048	0.070	0.042	0.005	0.067	0.011

Age	1980	1981	1982	1983	1984	1985	1986
3	143.982	143.163	133.346	226.258	138.628	143.084	331.452
4	194.488	113.957	115.299	106.209	182.035	107.407	111.319
5	118.547	133.536	81.316	75.668	77.121	120.635	65.865
6	52.646	67.873	74.151	44.625	40.153	45.692	67.002
7	83.043	29.531	34.733	35.328	19.598	19.153	21.064
8	20.158	50.697	12.816	15.900	13.419	8.817	7.901
9	6.064	9.480	17.936	3.685	5.552	4.457	3.469
10	1.942	2.969	3.479	4.479	1.189	2.155	1.631
11	0.778	1.010	0.939	1.147	1.242	0.516	0.316
12	0.214	0.416	0.310	0.476	0.480	0.536	0.223
13	0.175	0.087	0.138	0.169	0.198	0.218	0.230
14	0.012	0.121	0.024	0.074	0.081	0.082	0.088

Age	1987	1988	1989	1990	1991	1992	1993
3	277.658	170.280	86.206	140.657	135.000	155.000	137.000
4	252.745	217.396	133.354	68.227	109.939	102.005	119.743
5	72.844	151.099	142.598	84.013	44.778	67.275	62.537
6	30.088	35.289	73.649	102.891	44.409	22.690	32.537
7	27.317	11.146	12.268	32.177	44.433	17.044	8.744
8	7.085	8.412	3.437	4.683	11.169	13.970	5.350
9	2.518	2.106	1.696	1.110	1.544	3.451	4.150
10	1.262	0.761	0.532	0.604	0.367	0.456	1.025
11	0.617	0.504	0.219	0.234	0.207	0.083	0.136
12	0.318	0.279	0.142	0.084	0.087	0.058	0.025
13	0.095	0.134	0.089	0.040	0.024	0.015	0.017
14	0.120	0.037	0.010	0.039	0.019	0.010	0.005

Table 3.3.11

Virtual Population Analysis : SSB in 1000 x tons
Run 3. 1993.

Age	1973	1974	1975	1976	1977	1978	1979
3	7.361	2.304	1.744	18.341	0.000	10.689	0.000
4	10.078	31.423	23.444	16.043	18.154	8.826	5.033
5	99.602	39.501	111.992	46.707	60.347	75.074	34.383
6	89.539	95.517	54.649	101.362	92.716	102.237	164.282
7	92.510	62.097	83.232	36.342	93.536	101.227	142.170
8	35.883	45.423	32.934	39.358	29.196	44.331	60.419
9	49.282	15.690	15.076	15.110	13.639	18.243	23.791
10	36.519	19.881	5.594	5.008	6.945	7.402	9.431
11	7.897	10.577	5.684	1.747	2.002	4.694	4.251
12	2.337	2.593	2.158	1.935	0.634	0.887	2.945
13	0.831	1.240	0.756	0.304	1.380	0.365	0.317
14	0.018	0.406	0.365	0.320	0.092	1.024	0.152
Total	431.856	326.652	337.628	282.578	318.643	374.998	447.179

Age	1980	1981	1982	1983	1984	1985	1986
3	10.267	0.000	2.912	0.000	0.000	4.138	1.352
4	6.865	4.672	8.740	12.647	10.552	8.984	9.677
5	46.053	20.602	18.915	23.076	28.927	48.106	35.464
6	82.987	52.342	40.877	34.807	47.102	70.813	100.285
7	293.368	65.626	62.433	53.272	43.559	54.372	52.434
8	97.892	174.020	36.489	41.474	39.633	34.060	28.630
9	35.891	44.865	62.967	13.503	24.317	21.124	17.239
10	15.612	15.687	19.188	19.342	7.865	13.087	9.728
11	7.632	6.443	8.211	8.431	9.301	4.151	5.745
12	2.468	3.192	3.269	4.318	4.746	4.975	2.150
13	2.450	0.582	1.844	1.771	2.086	2.263	2.442
14	0.233	1.052	0.277	0.905	0.927	1.047	1.107
Total	601.718	389.082	266.122	213.546	219.014	267.120	266.754

Age	1987	1988	1989	1990	1991	1992
3	6.783	7.665	0.000	0.000	0.000	8.894
4	18.926	6.374	8.956	6.221	11.104	30.432
5	39.600	65.061	65.862	46.317	18.071	70.914
6	55.635	44.310	119.756	163.386	55.797	39.252
7	73.844	26.000	37.878	84.727	89.111	46.563
8	26.489	22.483	12.908	18.092	36.300	46.642
9	11.063	7.753	7.429	5.819	6.537	13.601
10	8.712	3.600	3.505	3.876	1.686	2.214
11	4.848	2.861	1.737	1.844	1.326	0.568
12	2.337	1.597	0.699	0.755	0.569	0.463
13	1.005	0.576	0.655	0.454	0.239	0.139
14	1.325	0.204	0.094	0.428	0.218	0.070
Total	250.569	188.486	259.479	331.919	220.958	259.751

Table 3.3.12 Spawning stock biomass and recruitment in year of spawning along with average fishing mortality

Year	Rec	SSB	F(5-10,u)
1955	258	1383	0.30
1956	305	1317	0.25
1957	152	1235	0.31
1958	189	1102	0.32
1959	142	979	0.32
1960	162	854	0.37
1961	289	786	0.33
1962	253	751	0.39
1963	271	701	0.45
1964	326	579	0.54
1965	172	456	0.61
1966	252	412	0.54
1967	185	474	0.49
1968	177	592	0.67
1969	135	688	0.53
1970	300	679	0.56
1971	169	609	0.62
1972	263	472	0.71
1973		432	0.71
1974	143	327	0.75
1975	222	338	0.80
1976	245	283	0.76
1977	144	319	0.63
1978	143	375	0.48
1979	133	447	0.43
1980	226	602	0.45
1981	139	389	0.68
1982	143	266	0.78
1983	331	214	0.78
1984		219	0.62
1985	170	267	0.66
1986	86	267	0.78
1987	141	251	0.84
1988	135	188	1.00
1989	155	259	0.71
1990	137	332	0.77
1991	73	221	0.91
1992	130	260	0.88

Table 3.3.13

Year	Capelin
1979	2386
1980	1487
1981	988
1982	1049
1983	1000
1984	1950
1985	2380
1986	2479
1987	2358
1988	2076
1989	1732
1990	1159
1991	1045
1992	1819
1993	2214

Table 3.3.14 Icelandic COD. Predicting 3-group (GB-index N. and CN3 (c-no of 3-group); VPA skv. ADAPT) 5 18 2

'Ycl '	'VPA'	'CN3'	'SUR4'	'SUR3'	'SUR2'	'SUR1'
75	222	6.0	-11	-11	-11	-11
76	245	7.2	-11	-11	-11	-11
77	144	4.3	-11	-11	-11	-11
78	143	2.1	-11	-11	-11	-11
79	133	3.3	-11	-11	-11	-11
80	226	3.6	-11	-11	-11	-11
81	139	6.8	906	-11	-11	-11
82	143	6.5	347	629	-11	-11
83	331	20.6	1629	2177	1529	-11
84	277	11.0	2104	2631	1813	369
85	170	6.7	1444	1705	780	290
86	86	2.6	320	490	212	62
87	141	5.8	639	634	643	55
88	123	8.7	470	549	415	83
89	-11	11.6	656	825	540	117
90	-11	-11	-11	653	577	73
91	-11	-11	-11	-11	108	11
92	-11	-11	-11	-11	-11	50

Table 3.3.15

Icelandic COD. Predicting 3-group (GB-index N. og CN3; VPA skv. ADAPT)

Data for 5 surveys over 18 years : 75 - 92

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

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as 0.30
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 86

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
CN3	0.85	3.57	0.34	0.517	11	1.28	4.66	0.427	0.290
SUR4	0.76	-0.05	0.43	0.531	5	5.77	4.36	0.778	0.087
SUR3	0.75	-0.16	0.33	0.680	4	6.20	4.51	0.725	0.101
SUR2	0.86	-0.62	0.24	0.808	3	5.36	3.98	1.269	0.033
SUR1									
					VPA Mean =		5.24	0.329	0.489

Yearclass = 87

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
CN3	0.92	3.40	0.35	0.582	12	1.92	5.17	0.411	0.166
SUR4	0.72	0.27	0.35	0.711	6	6.46	4.92	0.474	0.125
SUR3	0.77	-0.32	0.28	0.832	5	6.45	4.68	0.427	0.154
SUR2	0.63	1.03	0.16	0.955	4	6.47	5.10	0.256	0.311
SUR1	0.64	1.74	0.26	0.910	3	4.03	4.30	0.657	0.065
					VPA Mean =		5.17	0.395	0.180

Yearclass = 88

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
CN3	0.94	3.33	0.35	0.575	13	2.27	5.48	0.411	0.151
SUR4	0.72	0.30	0.31	0.721	7	6.15	4.71	0.415	0.148
SUR3	0.74	-0.02	0.26	0.818	6	6.31	4.64	0.371	0.185
SUR2	0.65	0.87	0.16	0.941	5	6.03	4.79	0.233	0.284
SUR1	0.59	2.15	0.40	0.681	4	4.43	4.75	0.660	0.059
					VPA Mean =		5.15	0.386	0.172

Yearclass = 89

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
CN3	1.07	3.01	0.44	0.462	14	2.53	5.73	0.527	0.079
SUR4	0.70	0.43	0.28	0.742	8	6.49	4.96	0.347	0.182
SUR3	0.71	0.21	0.23	0.827	7	6.72	4.97	0.299	0.244
SUR2	0.64	0.91	0.13	0.947	6	6.29	4.96	0.179	0.244
SUR1	0.58	2.22	0.33	0.697	5	4.77	4.96	0.463	0.103
					VPA Mean =		5.12	0.384	0.149

cont'd.

Table 3.3.15 (cont'd.)

Yearclass = 90

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
CN3									
SUR4									
SUR3	0.71	0.21	0.23	0.827	7	6.48	4.80	0.308	0.325
SUR2	0.64	0.92	0.13	0.947	6	6.36	5.01	0.179	0.341
SUR1	0.58	2.22	0.33	0.695	5	4.30	4.70	0.483	0.132
					VPA Mean =		5.11	0.390	0.202

Yearclass = 91

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
CN3									
SUR4									
SUR3									
SUR2	0.64	0.93	0.13	0.947	6	4.69	3.94	0.250	0.576
SUR1	0.58	2.22	0.33	0.692	5	2.48	3.65	0.747	0.093
					VPA Mean =		5.10	0.396	0.331

Yearclass = 92

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
CN3									
SUR4									
SUR3									
SUR2									
SUR1	0.58	2.22	0.33	0.689	5	3.93	4.48	0.533	0.364
					VPA Mean =		5.10	0.403	0.636

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
86	131	4.88	0.23	0.19	0.67	86	4.47
87	146	4.99	0.17	0.11	0.44	142	4.96
88	135	4.91	0.16	0.13	0.66	123	4.82
89	155	5.05	0.15	0.09	0.39		
90	137	4.92	0.18	0.08	0.23		
91	73	4.30	0.23	0.41	3.18		
92	130	4.87	0.32	0.29	0.84		

Table 3.3.16

Cod in the Iceland Grounds (Fishing Area Va)

Cod in the Iceland Grounds (Fishing Area Va)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.2000	0.0200	0.0850	0.2500	1.054	0.0660	1.255
4	.	0.2000	0.0680	0.1800	0.2500	1.620	0.3280	1.783
5	.	0.2000	0.2490	0.2480	0.2500	2.529	0.5990	2.579
6	.	0.2000	0.5130	0.2960	0.2500	3.698	0.8560	3.623
7	.	0.2000	0.7690	0.3820	0.2500	5.075	1.0890	4.898
8	.	0.2000	0.9010	0.4370	0.2500	6.450	1.1520	6.302
9	.	0.2000	0.9520	0.4770	0.2500	7.785	1.1520	7.685
10	.	0.2000	0.9750	0.4770	0.2500	9.343	1.1520	9.346
11	.	0.2000	0.9940	0.4770	0.2500	11.132	1.1520	10.923
12	.	0.2000	0.9830	0.4770	0.2500	12.629	1.1520	12.767
13	.	0.2000	0.9930	0.4770	0.2500	14.457	1.1520	14.520
14	.	0.2000	1.0000	0.4770	0.2500	16.839	1.1520	17.235
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YIELD1
Date and time: 10MAY93:11:22

Table 3.3.17

Cod in the Iceland Grounds (Fishing Area Va)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0	5.016	23564	2.337	18039	2.223	17160
0.0500	0.0500	0.131	805	4.573	19252	1.939	13936	1.805	12935
0.1000	0.1000	0.225	1265	4.231	16109	1.638	10978	1.495	9954
0.1500	0.1500	0.294	1524	3.961	13779	1.406	8813	1.261	7816
0.2000	0.2000	0.346	1666	3.744	12021	1.225	7203	1.080	6258
0.2500	0.2500	0.386	1739	3.566	10670	1.080	5986	0.939	5102
0.3000	0.3000	0.419	1773	3.418	9613	0.964	5052	0.826	4229
0.3500	0.3500	0.446	1783	3.293	8772	0.868	4324	0.735	3560
0.4000	0.4000	0.469	1781	3.186	8092	0.788	3747	0.660	3039
0.4500	0.4500	0.488	1771	3.093	7532	0.722	3283	0.598	2626
0.5000	0.5000	0.505	1758	3.011	7065	0.665	2906	0.546	2294
0.5500	0.5500	0.520	1743	2.939	6670	0.616	2594	0.501	2024
0.6000	0.6000	0.534	1727	2.874	6332	0.573	2334	0.463	1801
0.6500	0.6500	0.546	1711	2.815	6039	0.536	2115	0.430	1615
0.7000	0.7000	0.557	1696	2.762	5783	0.503	1928	0.401	1459
0.7500	0.7500	0.567	1681	2.713	5558	0.474	1767	0.375	1325
0.8000	0.8000	0.576	1667	2.668	5357	0.448	1628	0.352	1211
0.8500	0.8500	0.585	1653	2.627	5176	0.425	1506	0.332	1111
0.9000	0.9000	0.593	1640	2.588	5014	0.404	1399	0.314	1025
0.9500	0.9500	0.600	1628	2.552	4867	0.385	1304	0.298	949
1.0000	1.0000	0.607	1616	2.519	4732	0.367	1220	0.283	882
1.0500	1.0500	0.614	1605	2.487	4609	0.352	1144	0.269	823
1.1000	1.1000	0.620	1595	2.458	4495	0.337	1076	0.257	769
1.1500	1.1500	0.626	1585	2.430	4390	0.323	1015	0.246	722
1.2000	1.2000	0.631	1576	2.403	4293	0.311	959	0.235	679
1.2500	1.2500	0.636	1567	2.378	4203	0.299	909	0.226	640
1.3000	1.3000	0.641	1558	2.354	4118	0.289	863	0.217	605
1.3500	1.3500	0.646	1550	2.332	4039	0.279	820	0.209	573
1.4000	1.4000	0.651	1542	2.310	3965	0.270	782	0.201	543
1.4500	1.4500	0.655	1535	2.290	3895	0.261	746	0.194	516
1.5000	1.5000	0.659	1528	2.270	3829	0.253	713	0.188	492
1.5500	1.5500	0.663	1521	2.251	3767	0.245	682	0.181	469
1.6000	1.6000	0.667	1515	2.233	3708	0.238	654	0.176	448
1.6500	1.6500	0.671	1509	2.215	3652	0.231	627	0.170	428
1.7000	1.7000	0.674	1503	2.199	3599	0.225	603	0.165	410
1.7500	1.7500	0.678	1497	2.182	3549	0.219	580	0.160	393
1.8000	1.8000	0.681	1492	2.167	3501	0.213	558	0.156	378
1.8500	1.8500	0.684	1486	2.152	3455	0.208	538	0.151	363
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

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
1.9000	1.9000	0.687	1481	2.137	3412	0.202	519	0.147	349
1.9500	1.9500	0.690	1476	2.123	3370	0.198	502	0.143	337
2.0000	2.0000	0.693	1472	2.110	3330	0.193	485	0.140	324
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YIELD1
Date and time : 10MAY93:11:22
Computation of ref. F: Simple mean, age 5 - 10
F-0.1 factor : 0.1974
F-max factor : 0.3621
F-0.1 reference F : 0.1974
F-max reference F : 0.3621
Recruitment : Single recruit

Table 3.3.18

Cod in the Iceland Grounds (Fishing Area Va)

Prediction with management option table: Input data

Year: 1993								
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	137.000	0.2000	0.0360	0.0850	0.2500	0.953	0.0580	1.272
4	119.752	0.2000	0.1580	0.1800	0.2500	1.512	0.2890	1.884
5	62.569	0.2000	0.3940	0.2480	0.2500	2.416	0.5270	2.628
6	32.532	0.2000	0.6240	0.2960	0.2500	3.494	0.7530	3.618
7	8.747	0.2000	0.9290	0.3820	0.2500	4.771	0.9580	4.651
8	5.354	0.2000	0.9710	0.4370	0.2500	6.197	1.0140	6.135
9	4.155	0.2000	0.9520	0.4770	0.2500	7.794	1.0140	7.779
10	1.026	0.2000	1.0000	0.4770	0.2500	9.650	1.0140	9.609
11	0.136	0.2000	1.0000	0.4770	0.2500	11.719	1.0140	11.370
12	0.025	0.2000	1.0000	0.4770	0.2500	13.240	1.0140	13.091
13	0.017	0.2000	1.0000	0.4770	0.2500	14.285	1.0140	14.599
14	0.005	0.2000	1.0000	0.4770	0.2500	15.871	1.0140	16.323
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
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	73.000	0.2000	0.0300	0.0850	0.2500	0.953	0.0580	1.272
4	.	0.2000	0.1250	0.1800	0.2500	1.512	0.2890	1.801
5	.	0.2000	0.3460	0.2480	0.2500	2.318	0.5270	2.563
6	.	0.2000	0.6040	0.2960	0.2500	3.494	0.7530	3.571
7	.	0.2000	0.8730	0.3820	0.2500	4.741	0.9580	4.755
8	.	0.2000	0.9400	0.4370	0.2500	6.214	1.0140	6.071
9	.	0.2000	0.9500	0.4770	0.2500	7.794	1.0140	7.779
10	.	0.2000	0.9840	0.4770	0.2500	9.650	1.0140	9.609
11	.	0.2000	0.9970	0.4770	0.2500	11.719	1.0140	11.370
12	.	0.2000	0.9860	0.4770	0.2500	13.240	1.0140	13.091
13	.	0.2000	0.9930	0.4770	0.2500	14.285	1.0140	14.599
14	.	0.2000	1.0000	0.4770	0.2500	15.871	1.0140	16.323
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Prediction with management option table: Input data

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	130.000	0.2000	0.0230	0.0850	0.2500	0.953	0.0580	1.272
4	.	0.2000	0.0910	0.1800	0.2500	1.512	0.2890	1.801
5	.	0.2000	0.2990	0.2480	0.2500	2.318	0.5270	2.533
6	.	0.2000	0.5830	0.2960	0.2500	3.411	0.7530	3.527
7	.	0.2000	0.8170	0.3820	0.2500	4.741	0.9580	4.714
8	.	0.2000	0.9100	0.4370	0.2500	6.190	1.0140	6.137
9	.	0.2000	0.9470	0.4770	0.2500	7.794	1.0140	7.779
10	.	0.2000	0.9670	0.4770	0.2500	9.650	1.0140	9.609
11	.	0.2000	0.9940	0.4770	0.2500	11.719	1.0140	11.370
12	.	0.2000	0.9724	0.4770	0.2500	13.240	1.0140	13.091
13	.	0.2000	0.9859	0.4770	0.2500	14.285	1.0140	14.599
14	.	0.2000	1.0000	0.4770	0.2500	15.871	1.0140	16.323
Unit	Millions	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : PRED1
Date and time: 07MAY93:17:16

Table 3.3.19

Cod in the Iceland Grounds (Fishing Area Va)

Cod in the Iceland Grounds (Fishing Area Va)

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.9051	0.7964	695902	209280	230000	0.3000	0.2640	630606	223211	88908	764697	291205
.	.	.	.	.	0.4000	0.3520	.	217547	114950	734266	265851
.	.	.	.	.	0.5000	0.4400	.	212067	139407	705754	243075
.	.	.	.	.	0.6000	0.5280	.	206764	162392	679022	222590
.	.	.	.	.	0.7000	0.6160	.	201632	184010	653941	204143
.	.	.	.	.	0.8000	0.7040	.	196664	204357	630395	187512
.	.	.	.	.	0.9000	0.7920	.	191854	223520	608275	172498
.	.	.	.	.	1.0000	0.8800	.	187196	241582	587481	158929
.	.	.	.	.	1.1000	0.9680	.	182685	258617	567920	146649
.	.	.	.	.	1.2000	1.0560	.	178315	274697	549506	135522
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : PRED1
Date and time : 07MAY93:18:26
Computation of ref. F: Simple mean, age 5 - 10
Basis for 1993 : TAC constraints

Table 4.1.1 Abundance indices of 0-group cod from the International and Icelandic 0-group Survey in the East Greenland/ Iceland area, 1971-1992 (except 19972).

Year Class	Dohrn Bank East Greenland	SE Iceland	SW Iceland	W Iceland	N Iceland	E Iceland	Total
1971	+	-	-	60	214	-	283
1973	135	10	107	96	757	86	1,191
1974	2	-	-	22	30	+	54
1975	+	-	2	50	73	5	130
1976	5	9	30	102	2,015	584	2,743
1977	7	2	+	26	305	94	435
1978	2	-	+	169	335	47	552
1979	2	+	1	22	345	+	370
1980	1	2	+	38	507	10	557
1981	19	-	-	41	19	-	78
1982	+	-	+	7	4	-	11
1983	+	-	+	85	66	2	153
1984	372	5	+	200	826	369	1,772
1985	32	+	+	581	197	2	812
1986	+	1	2	15	32	+	50
1987	7	-	1	2	61	10	81
1988	0	-	1	7	12	+	20
1989	1	-	3	7	30	+	41
1990	3	-	+	2	30	2	37
1991	+	-	-	+	5	+	6
1992	0	-	+	15	21	5	42

Table 5.1.1 Specification of the strata.

Stratum 1:	64°15'N - 67°00'N	50°00'W - 57°00'W		
Stratum 1.1	depth	1-200 m,	area	6,805 nm^2
Stratum 1.2	depth	201-400 m,	area	1,881 nm^2
Stratum 2:	62°30'N - 64°15'N	50°00'W - 55°00'W		
Stratum 2.1	depth	1-200 m,	area	2,350 nm^2
Stratum 2.2	depth	201-400 m,	area	1,018 nm^2
Stratum 3:	60°45'N - 62°30'N	48°00'W - 53°00'W		
Stratum 3.1	depth	1-200 m,	area	1,938 nm^2
Stratum 3.2	depth	201-400 m,	area	742 nm^2
Stratum 4:	59°00'N - 60°45'N	44°00'W - 50°00'W		
Stratum 4.1	depth	1-200 m,	area	2,568 nm^2
Stratum 4.2	depth	201-400 m,	area	971 nm^2
Stratum 5:	59°00'N - 63°00'N	40°00'W - 44°00'W		
Stratum 5.1	depth	1-200 m,	area	2,468 nm^2
Stratum 5.2	depth	201-400 m,	area	3,126 nm^2
Stratum 6:	63°00'N - 66°00'N	35°00'W - 41°00'W		
Stratum 6.1	depth	1-200 m,	area	1,120 nm^2
Stratum 6.2	depth	201-400 m,	area	7,795 nm^2
Stratum 7:	64°45'N - 67°00'N	29°00'W - 35°00'W		
Stratum 7.1	depth	1-200 m,	area	92 nm^2
Stratum 7.2	depth	201-400 m,	area	4,589 nm^2
Total				37,463 nm^2

Table 5.1.2 Trawl parameters of the survey.

Gear	140-feet bottom trawl
Horizontal net opening	22 m
Standard trawling speed	4.5 kn
Towing time	30 minutes
Coefficient of catchability	1.0

Table 5.1.3 Numbers of valid hauls per stratum and total, 1982-92.

STRATA: YEAR	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	SUM
1982	20	11	16	7	9	6	13	2	1	10	3	12	1	25	136
1983	26	11	25	11	17	5	18	4	3	19	10	36	0	18	203
1984	25	13	26	8	18	6	21	4	5	4	2	8	0	5	145
1985	10	8	26	10	17	5	21	4	5	21	14	50	0	28	219
1986	27	9	21	9	16	7	18	3	3	15	14	37	1	34	214
1987	25	11	21	4	18	3	21	3	19	16	13	40	0	18	212
1988	34	21	28	5	18	5	18	2	21	8	13	39	0	26	238
1989	26	14	30	9	8	3	25	3	17	18	12	29	0	11	205
1990	19	7	23	8	16	3	21	6	18	19	6	15	0	13	174
1991	19	11	23	7	12	6	14	5	8	11	10	28	0	16	170
1992	6	6	6	5	6	6	7	5	0	0	0	0	0	6	53

Table 5.1.4 Abundance indices (n*1,000) for West, East Greenland and total by stratum, 1982-92. Confidence intervals (CI) are given in per cent of the statified mean at 95% level of significance. () invalid due to incomplete sampling.

Year Strata:	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	West Greenland
1982	5,092.1	729.4	47,956.6	1,888.1	15,114.0	3,706.1	17,789.5	0.0	92,275.8
1983	430.9	467.0	16,012.6	5,169.5	14,881.3	2,326.4	10,915.7	0.0	50,203.4
1984	376.8	178.6	4,714.0	171.4	5,200.5	689.4	5,353.0	0.0	16,683.7
1985	19,629.9	2,428.0	13,222.3	4,395.3	10,530.8	1,637.9	7,498.8	0.0	59,343.0
1986	32,438.3	1,235.5	50,907.6	228.5	37,446.2	1,320.6	22,103.6	0.0	145,680.3
1987	330,943.5	1,650.6	248,002.1	0.0	154,681.0	0.0	51,114.3	0.0	786,391.5
1988	92,024.1	2,422.9	338,740.0	84,935.3	47,336.0	88.8	60,946.4	0.0	626,493.5
1989	2,497.1	919.9	27,930.3	672.9	261,502.3	0.0	65,203.4	0.0	358,725.9
1990	964.8	512.7	4,155.3	361.8	6,013.7	0.0	10,303.4	12,212.6	34,524.3
1991	268.0	204.7	179.7	152.4	1,027.2	610.7	1,839.2	523.1	4,805.0
1992	551.6	621.7	117.2	137.1	120.8	74.0	151.0	268.8	2,042.2

Year Strata:	5.1	5.2	6.1	6.2	7.1	7.2	East Greenland	Greenland	CI
1982	0.0	467.8	0.0	6,173.1	0.0	1,449.1	8,090.0	100,365.8	28.2
1983	0.0	2,228.3	1,273.9	2,276.4	0.0	2,212.9	7,991.5	58,194.9	25.2
1984	4,062.9	0.0	0.0	1,749.9	0.0	789.8	6,602.6	23,286.3	31.6
1985	3,564.3	373.1	3,977.9	3,348.1	0.0	1,140.5	12,403.9	71,746.9	32.5
1986	0.0	779.7	6,950.1	6,676.3	0.0	828.2	15,234.3	160,914.6	31.7
1987	18,317.0	9,831.7	6,527.3	6,080.8	0.0	877.5	41,634.3	828,025.8	58.9
1988	7,985.0	8,084.6	2,059.7	4,374.6	0.0	1,083.0	23,586.9	650,080.4	47.7
1989	30,906.1	38,407.2	11,600.4	9,382.9	0.0	1,436.0	91,732.6	450,458.5	58.9
1990	4,955.5	2,523.8	4,532.6	9,040.9	0.0	4,199.9	25,252.7	59,777.0	42.9
1991	2,343.1	1,786.2	779.4	1,958.2	0.0	3,541.2	10,408.1	15,213.1	28.5
1992	0.0	0.0	0.0	0.0	0.0	658.2	(658.2)	(2,700.4)	49.9

Table 5.1.5 Biomass indices (tonnes) for West, East Greenland and total by stratum, 1982-92. Confidence intervals (CI) are given in per cent of the stratified mean at 95% level of significance. () invalid due to incomplete sampling.

Year	Strata: 1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	West Greenland
1982	2,378.0	306.8	63,683.9	2,631.9	20,318.5	8,744.8	30,425.8	0.0	128,489.7
1983	353.4	205.4	20,215.0	7,827.3	22,806.1	9,594.3	21,373.6	0.0	82,375.1
1984	824.1	233.9	7,508.0	233.8	7,218.0	1,054.7	8,492.6	0.0	25,565.1
1985	2,528.2	250.7	12,869.4	2,351.0	10,730.5	989.7	5,952.1	0.0	35,671.6
1986	10,640.6	484.0	26,098.1	79.6	28,509.5	1,423.0	19,482.5	0.0	86,717.3
1987	283,591.2	544.9	200,632.4	0.0	116,610.0	0.0	37,210.2	0.0	638,588.7
1988	94,174.7	1,367.0	333,848.3	77,966.8	44,592.8	93.3	55,945.0	0.0	607,987.9
1989	727.4	227.5	25,829.2	440.5	231,239.0	0.0	75,386.3	0.0	333,849.9
1990	224.3	113.5	3,552.3	190.3	5,778.4	0.0	13,185.4	11,387.8	34,432.0
1991	90.8	71.6	72.9	45.4	1,208.3	589.3	2,620.8	451.0	5,150.1
1992	134.5	194.7	23.4	36.0	21.1	14.3	81.3	101.8	607.1

Year	Strata: 5.1	5.2	6.1	6.2	7.1	7.2	East Greenland	Greenland	CI
1982	0.0	1,927.4	0.0	14,562.7	0.0	7,127.3	23,617.4	152,107.1	24.8
1983	0.0	6,146.7	3,511.5	11,344.3	0.0	13,153.6	34,156.1	116,531.2	25.2
1984	10,397.3	0.0	0.0	4,109.6	0.0	5,236.7	19,743.6	45,308.7	33.7
1985	7,073.1	1,355.6	9,955.2	9,436.7	0.0	5,744.1	33,564.7	69,236.3	39.2
1986	0.0	2,645.2	18,630.9	16,542.8	0.0	3,365.7	41,184.6	127,901.9	26.1
1987	10,315.1	9,053.9	9,291.4	17,616.0	0.0	5,315.8	51,592.2	690,180.9	63.1
1988	8,750.1	18,204.3	6,162.4	16,258.0	0.0	3,571.9	52,946.7	660,934.6	46.0
1989	40,614.2	127,864.8	34,957.0	31,323.9	0.0	4,785.6	239,545.5	573,395.4	45.5
1990	9,229.2	6,812.7	12,953.7	24,407.6	0.0	12,560.0	65,963.2	100,395.2	33.7
1991	4,236.0	5,778.9	1,263.2	7,467.1	0.0	14,005.5	32,750.7	37,900.8	35.5
1992	0.0	0.0	0.0	0.0	0.0	1,215.8	(1,215.8)	(1,822.9)	68.7

Table 5.1.6 West Greenland. Age disaggregate abundance indices (n*1,000), 1982-92. *) calculated proportionally using age compositions reported by ICES Working Group on Cod Stocks off East Greenland (Anon. 1984, 1988).

AGE	1982*	1983*	1984	1985	1986	1987*	1988	1989	1990	1991	1992
0	0	0	186	890	0	65	434	12	158	0	0
1	136	0	5	39,277	10,575	521	254	204	47	245	189
2	612	1,469	38	1,531	114,823	50,817	3,290	2,583	1,014	208	1,473
3	31,089	2,815	2,094	898	4,374	692,832	101,820	7,618	2,900	435	227
4	9,168	26,619	1,541	5,958	1,033	17,176	511,473	170,469	1,272	1,260	48
5	32,867	4,960	9,648	2,616	7,837	5,673	5,435	174,532	22,120	160	89
6	11,539	10,969	850	7,184	2,250	12,653	616	2,868	6,964	2,102	0
7	4,031	1,882	1,983	375	4,167	1,655	1,134	0	47	356	28
8	886	992	90	600	107	4,543	662	259	0	6	0
9	1,699	317	201	18	449	0	1,310	40	0	0	0
10	107	168	29	19	23	426	34	141	0	0	0
11	72	0	0	0	24	31	39	0	5	0	0
12	59	0	0	0	0	0	0	5	0	0	0
13	0	13	0	0	11	0	0	0	0	0	0
14	11	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0
SUM	92,276	50,204	16,665	59,366	145,673	786,392	626,501	358,731	34,527	4,772	2,054

Table 5.1.7 East Greenland. Age disaggregate abundance indices (n*1,000), 1982-92. *) calculated proportionally using age compositions reported by ICES Working Group on Cod Stocks off East Greenland (Anon. 1984, 1988). () invalid due to incomplete sampling.

AGE	1982*	1983*	1984	1985	1986	1987*	1988	1989	1990	1991	(1992)
0	0	0	0	232	0	0	12	0	0	0	29
1	16	0	18	1,932	1,398	14	25	8	37	101	29
2	336	411	73	559	3,346	14,205	160	177	79	374	73
3	660	605	1,339	117	1,693	17,968	6,975	494	552	388	69
4	1,373	1,008	659	2,496	550	3,987	11,092	17,396	463	697	59
5	1,728	1,187	1,403	2,035	2,419	982	2,011	63,169	5,132	148	54
6	1,218	2,125	853	1,853	1,121	1,581	478	2,990	17,998	3,524	47
7	372	1,287	1,619	779	2,187	408	1,410	294	265	5,046	143
8	140	302	408	1,989	566	1,313	150	4,746	71	82	52
9	1,950	265	102	284	1,594	131	653	396	238	37	0
10	189	703	36	53	116	938	94	1,560	0	12	0
11	98	69	95	34	104	25	425	39	278	9	6
12	10	32	0	45	13	71	41	415	24	0	19
13	0	0	0	0	84	5	19	0	100	0	0
14	0	0	0	0	0	5	0	44	0	11	0
15	0	0	0	0	0	0	9	0	9	0	0
16	0	0	0	0	0	0	7	0	0	0	0
SUM	8,090	7,994	6,605	12,408	15,191	41,633	23,561	91,728	25,246	10,429	580

Table 5.1.8 Greenland (total). Age disaggregate abundance indices (n*1,000), 1982-92. *) calculated proportionally using age compositions reported by ICES Working Group on Cod Stocks off East Greenland (Anon. 1984, 1988). () invalid due to incomplete sampling.

AGE	1982*	1983*	1984	1985	1986	1987*	1988	1989	1990	1991	(1992)
0	0	0	186	1,122	0	65	446	12	158	0	29
1	152	0	23	41,209	11,973	535	279	212	84	346	218
2	948	1,880	111	2,090	118,169	65,022	3,450	2,760	1,093	582	1,546
3	31,749	3,420	3,433	1,015	6,067	710,800	108,795	8,112	3,452	823	296
4	10,541	27,627	2,200	8,454	1,583	21,163	522,565	187,865	1,735	1,957	107
5	34,595	6,147	11,051	4,651	10,256	6,655	7,446	237,701	27,252	308	143
6	12,757	13,094	1,703	9,037	3,371	14,234	1,094	5,858	24,962	5,626	47
7	4,403	3,169	3,602	1,154	6,354	2,063	2,544	294	312	5,402	171
8	1,026	1,294	498	2,589	673	5,856	812	5,005	71	88	52
9	3,649	582	303	302	2,043	131	1,963	436	238	37	0
10	296	871	65	72	139	1,364	128	1,701	0	12	0
11	170	69	95	34	128	56	464	39	283	9	6
12	69	32	0	45	13	71	41	420	24	0	19
13	0	13	0	0	95	5	19	0	100	0	0
14	11	0	0	0	0	5	0	44	0	11	0
15	0	0	0	0	0	0	9	0	9	0	0
16	0	0	0	0	0	0	7	0	0	0	0
SUM	100,366	58,198	23,270	71,774	160,864	828,025	650,062	450,459	59,773	15,201	2,634

Table 5.1.9 Swept area abundance ('000) and biomass (Tons) by stratum as observed from the Greenland trawl survey, 1992. Stations and strata are shown in Fig. 5.1.6. °) In these strata substratification on depth was impossible due to unreliable bathymetric maps.

	Abundance				Biomass			
Strata	0-200	201-400	401-600	Total	0-200	201-400	401-600	Total
NWGRL°	-	-	-	4.4	-	-	-	2.2
1AS°	-	-	-	0.0	-	-	-	0.0
DISKO°	-	-	-	0.0	-	-	-	0.0
1BN	0.0	14.0	0.0	14.0	0.0	18.9	0.0	18.9
1BS	0.0	0.0	28.0	28.0	0.0	0.0	26.2	26.2
1C	0.0	182.0	18.0	200.0	0.0	58.3	2.6	60.9
1D	0.0	245.0	11.0	256.0	0.0	81.5	6.6	88.1
1E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1F	6.0	0.0	0.0	6.0	1.3	0.0	0.0	1.3
EAST1	66.0	185.0	0.0	251.0	36.1	27.8	0.0	63.9
EAST2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EAST3	0.0	7.0	0.0	7.7	0.0	1.9	0.0	1.9
EAST4°	-	-	-	6.0	-	-	-	5.6

TOTAL	West Greenland	Abundance	: 507 +- 508
		Biomass	: 198 +- 188
	East Greenland	Abundance	: 264 +- 394
		Biomass	: 71 +- 92

Table 5.1.10 CPUE of age 2 cod by area as observed in the Greenland gill-net survey in inshore areas of West Greenland, 1985-1992

Year	Year-class	Area Sisimiut (Div. 1B)	Nuuk (Div. 1D)	Qaqortoq (Div 1F)	Average
1985	83	0.00	0.03	0.00	0.01
1986	84	5.37	2.01	2.30	3.24
1987	85	1.24	0.20	1.52	0.99
1988	86	0.38	0.19	0.01	0.20
1989	87	0.98	0.82	0.06	0.62
1990	88	1.11	0.16	0.01	0.42
1991	89	0.03	0.02	0.02	0.02
1992	90	0.43	0.57	0.03	0.34

Table 5.2.1 Nominal catches of NAFO Sub-area 1 cod by fleet ('000 t) for 1980-1992.

Category	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Trawlers	14	29	42	18	7	1	1	40	73	39	2	0
Other	39	26	16	12	8	4	12	22	39	29	18	6
Total	53	55	58	30	15	5	13	62	112	68	20	6
TAC	50[1]	62	62	68	28.5	12.5	12.5	53	90	110	90[1]	83[1]

[1]Combined TAC for East and West Greenland.

Table 5.2.2 Nominal catch of COD in NAFO Sub-area 1, 1981-1992 as officially reported to NAFO.

Country	1981	1982	1983	1984	1985	1986
Faroe Islands	-	-	1,339	-	-	-
Germany,Fed.Rep.	417	8,139	10,158	8,941	2,170	41
Greenland	53,039	47,693	44,970	24,457	12,651	6,549
Japan	-	-	-	13	54	11
Norway	-	-	-	5	1	2
United Kingdom	-	-	1,174	-	-	-
Total	53,456	55,832	57,641	33,416	14,876	6,603

Country	1987	1988	1989	1990[1]	1991[2]	1992[3]
Faroe Islands	-	-	-	-	-	-
Germany,Fed.Rep.	55	6,574	12,892	7,515	82	-
Greenland	12,283	52,166	92,152	59,043	20,238	5,665
Japan	33	10	-	-	-	-
Norway	1	7	2	57	-	-
United Kingdom	-	927	3,780	1,632	-	-
Total	12,372	59,684	108,826	68,247	20,320	
Working Group estimate[3]	-	62,684	111,642	-	-	5,665

[1]Provisional data (NAFO SCS 91/17 (except for Greenland)).
[2]Reported to Greenland authorities. (NAFO SCS 92/25).
[3]Only Greenland available.
[4]Includes 3,000 t in 1988 and 2,741 t in 1989 reported to be from ICES Sub-area XIV.

Table 5.2.3 Nominal catch (tonnes) of COD in ICES Sub-area XIV, 1981-1992 as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986
Faroe Islands	292	-	368	-	-	86
Germany,Fed.Rep.	7,367	8,940	8,238	7,035	2,006	4,063
Greenland	890	898	438	1,051	106	606
Iceland	1	-	-	-	-	-
Norway	-	-	-	794	-	-
UK(England & Wales)	-	-	-	-	-	-
UK(Scotland)	-	-	-	-	-	-
Total	8,550	9,838	9,044	8,880	2,112	4,755
Working Group estimate	16,000	27,000	13,377	8,914	2,112	4,755

Country	1987	1988	1989	1990	1991	1992[1]
Faroe Islands	-	12	40	-	-	-
Germany,Fed.Rep.	5,358	12,049	10,613	26,419	8,434	6100
Greenland	1,476	345	3,715	4,442	6,677	1,283
Iceland	1	9	-	-	-	-
Norway	-	-	-	17	836[1]	1,158
UK(England & Wales)	-	-	1,158	2,365	5,832	2,496
UK(Scotland)	-	-	135	93	29	463
Total	6,835	12,415	15,661	33,336	21,808	11,500
Working Group estimate	6,658	9,415[2]	14,504[3]	33,465[4]	22,227[4]	11,500

[1]Preliminary.
[2]Excluding 3,000 t assumed to be from NAFO Division 1F.
[3]Excluding 2,741 t assumed to be from NAFO Division 1F and including 1,500 t reported from other areas assumed to be from Sub-area XIV and including 94 tonnes by Japan.
[4]Includes additional catches by Japan.
[5]Includes additional catches reported to Greenland authorities.

Table 5.3.1 Cod off West Greenland, NAFO Sub-area 1. Catch-at-age and mean weight-at-age by division in 1992.

Catch at age by div.('000)

Div.	1A	1B	1C	1D	1E	1F
Age						
3	0	0	5	2	1	33
4	635	2239	457	402	6	22
5	159	654	139	434	85	223
6	10	56	13	40	23	55
7	2	17	3	15	30	49
8	0	1	0	3	3	5
9	0	0	0	0	0	1
10+	0	0	0	0	0	0
Sum	806	2968	617	897	149	387

Mean weight at age (Kg.), by Div.

Div.	1A	1B	1C	1D	1E	1F
Age						
3	-	-	0.55	0.49	0.70	0.65
4	0.79	0.81	0.81	0.95	0.78	0.79
5	1.04	1.11	1.14	1.31	1.09	1.13
6	1.96	2.14	1.63	1.71	1.32	1.41
7	1.98	2.18	2.50	2.57	1.53	1.52
8	4.83	4.83	2.97	2.74	1.59	1.55
9	-	-	-	9.26	1.99	2.00
10+	-	-	-	-	-	-

Table 5.3.2 Cod off West Greenland, NAFO Sub-area 1. Catch at age from 1966 to 1992.

Cod off West Greenland (Fishing Area XIV)

Catch in Numbers (Thousands)

(CANUM)

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
1966	1530	7872	62130	26941	5915	4955	6912	1289	283	130	981	139	247
1967	1727	15091	30457	61848	24562	2700	1996	5237	352	93	166	453	85
1968	3764	7976	36670	29824	34591	10005	1725	833	2348	187	37	42	303
1969	662	12399	8709	27433	14664	12411	4784	513	237	704	41	62	8
1970	49	2768	10342	6465	13985	4365	2810	1280	149	85	201	27	41
1971	272	2519	10172	9283	5237	9158	2077	1841	953	78	51	134	56
1972	51	10039	9786	12020	4081	2550	2660	624	954	709	130	57	122
1973	131	2302	16378	3065	2605	1406	1203	552	165	237	93	37	44
1974	343	1079	2384	6938	1135	1806	800	194	177	152	272	147	11
1975	275	3595	2677	1803	5855	1388	619	291	84	38	9	12	10
1976	10760	4026	2243	1216	302	1594	139	148	53	27	17	14	26
1977	634	46649	6053	1515	618	425	446	168	79	88	22	1	1
1978	287	5494	30039	1004	509	83	41	13	7	7	7	1	1
1979	286	10656	12505	18970	709	400	78	52	55	80	5	5	16
1980	2999	4513	4580	1978	8014	125	60	24	1	16	3	1	2
1981	12	16864	6374	2391	1053	3382	45	65	1	1	0	0	7
1982	1204	1210	17960	2965	2078	807	610	45	88	9	4	1	13
1983	77	12356	2011	17228	1581	995	344	343	3	22	0	2	19
1984	595	2018	10384	688	3656	106	365	97	69	0	3	0	0
1985	456	1266	1303	4915	161	750	42	140	15	8	0	0	14
1986	12	113	706	318	1193	12	332	80	13	35	0	0	0
1987	5705	1636	274	662	424	686	7	30	1	14	0	0	0
1988	839	50214	1070	501	652	524	751	21	85	0	0	0	0
1989	31	8300	74318	570	84	161	253	525	0	72	0	0	0
1990	77	3355	24493	30316	68	0	8	2	41	12	0	0	0
1991	101	5395	4744	7126	689	0	0	0	0	0	0	0	0
1992	40	3763	1694	196	116	13	1	0	0	0	0	0	0

Table 5.3.3 Cod off East Greenland, ICES Sub-area XIV. Catch at age from 1965 to 1992.

Cod off East Greenland (Fishing Area XIV)

Catch in Numbers (Thousands)

(CANUM)

Year	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1965	0	0	131	35	91	879	661	1484	59	27	139	29	178
1966	0	28	21	470	89	137	1071	359	418	23	3	27	36
1967	0	0	145	302	2346	564	210	1292	492	371	37	17	81
1968	0	0	104	630	502	2505	238	62	144	69	27	5	25
1969	0	0	31	252	849	770	2103	170	38	82	68	24	86
1970	0	0	66	76	500	1539	1060	1715	237	32	63	48	27
1971	0	0	25	171	159	1051	3785	1580	1326	171	19	4	14
1972	0	0	27	85	254	295	1299	3184	818	470	136	26	53
1973	0	4	25	197	126	250	82	710	959	222	72	19	7
1974	0	4	63	22	488	176	185	52	329	259	65	11	2
1975	0	57	57	339	86	783	155	82	21	66	52	16	4
1976	0	257	175	162	590	228	1546	158	116	53	13	30	2
1977	0	0	4635	1205	513	652	208	424	164	77	29	9	1
1978	0	0	427	6808	1828	188	205	111	278	130	93	56	19
1979	0	5	145	1184	4700	2755	797	121	51	18	11	1	1
1980	0	14	78	235	223	2330	695	77	9	2	5	1	6
1981	0	0	5	72	252	378	2898	231	22	9	5	5	3
1982	0	0	0	458	1335	2012	1605	2123	146	18	6	3	0
1983	0	0	104	593	2376	962	321	116	229	10	2	2	0
1984	0	14	107	368	481	1638	320	103	43	61	1	1	0
1985	0	0	34	111	242	105	196	19	12	4	4	0	0
1986	0	68	50	432	287	738	66	122	5	4	0	0	0
1987	32	737	145	59	303	148	651	56	294	12	26	0	0
1988	0	413	3851	173	41	387	50	233	10	117	23	0	0
1989	0	19	1851	6480	151	34	236	56	163	2	41	0	0
1990	0	6	32	2217	10827	121	9	106	3	42	11	0	0
1991	0	0	328	298	4545	5426	51	22	17	7	27	0	0
1992	0	2	124	258	158	2515	1188	28	4	0	1	0	0

Table 5.3.4 Cod off West Greenland, NAFO Sub-area 1. Mean weight at age in the catch from 1966 to 1992.

Cod off West Greenland (Fishing Area XIV)

Mean Weight of Catch (Kilograms)

(WECA)

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
1966	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1967	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1968	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1969	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1970	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1971	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1972	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1973	0.580	1.280	1.720	2.510	3.520	4.660	5.070	5.680	5.370	8.650	9.580	9.600	9.600
1974	0.650	0.990	1.680	2.770	3.840	4.720	5.340	5.340	5.480	5.390	8.700	10.190	10.740
1975	0.710	1.300	1.850	2.670	3.990	4.430	5.060	5.600	7.920	5.160	6.110	8.510	10.110
1976	0.850	1.210	2.030	2.710	3.420	4.580	4.490	5.880	7.020	6.460	5.140	9.030	12.870
1977	0.740	1.238	1.714	2.118	3.614	4.580	4.812	5.600	6.000	6.600	7.700	9.900	10.500
1978	0.650	1.150	2.180	2.890	3.690	4.580	5.060	5.600	6.000	6.600	7.700	9.000	10.500
1979	0.720	1.230	2.020	2.710	3.780	4.900	6.400	7.800	9.000	9.700	10.200	10.400	10.500
1980	0.870	1.330	2.060	3.000	4.280	5.840	6.400	7.800	9.000	9.700	10.200	10.400	10.500
1981	0.830	1.110	1.700	2.350	3.200	4.300	6.500	9.020	9.320	9.320	9.320	9.320	9.320
1982	0.830	1.110	1.700	2.350	3.200	4.300	6.500	9.020	9.320	9.320	9.320	9.320	9.320
1983	0.780	0.980	1.380	2.080	2.950	3.850	4.780	5.580	6.000	6.000	6.000	6.000	6.000
1984	0.780	0.980	1.380	2.080	2.950	3.850	4.780	5.580	6.000	6.000	6.000	6.000	6.000
1985	0.780	0.980	1.380	2.080	2.950	3.850	4.780	5.580	6.000	6.000	6.000	6.000	6.000
1986	0.660	0.980	1.790	2.240	2.430	3.080	3.620	3.170	3.170	3.170	3.170	3.170	3.170
1987	0.900	1.070	1.800	2.120	2.610	3.240	4.300	4.700	4.700	4.700	4.700	4.700	4.700
1988	0.550	1.080	1.370	2.000	2.750	3.500	3.940	4.920	4.920	4.920	-1.000	-1.000	-1.000
1989	0.520	0.720	1.270	1.670	2.310	3.710	4.210	4.670	4.070	3.120	-1.000	-1.000	-1.000
1990	0.860	0.910	1.020	1.360	2.040	2.120	2.200	2.890	3.790	7.950	-1.000	-1.000	-1.000
1991	0.780	1.030	1.120	1.160	1.610	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000
1992	0.630	0.820	1.160	1.710	1.790	2.260	3.500	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000

Table 5.3.5 Cod off East Greenland, ICES Sub-area XIV. Mean weight at age in the catch from 1965 to 1992.

Cod off East Greenland (Fishing Area XIV)

Mean Weight of Catch (Kilograms)

(WECA)

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1965	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1966	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1967	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1968	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1969	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1970	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1971	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1972	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1973	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1974	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1975	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1976	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1977	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1978	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1979	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1980	0.400	1.130	1.390	2.260	3.210	4.380	5.520	7.090	8.200	8.700	9.300	9.700
1981	0.316	0.776	1.455	1.823	2.890	4.246	5.948	8.698	9.787	12.483	13.426	13.728
1982	0.359	0.727	1.258	1.968	2.874	3.990	5.328	6.901	8.721	10.799	13.145	15.769
1983	0.352	0.700	1.273	2.158	3.071	3.713	4.680	6.234	5.350	6.806	7.555	8.304
1984	0.352	0.700	1.273	2.158	3.071	3.713	4.680	6.234	5.350	6.806	7.555	8.304
1985	0.290	0.810	1.520	2.330	3.150	3.940	4.670	5.330	5.890	6.380	6.790	-1.000
1986	0.250	0.780	1.580	2.600	3.730	4.910	6.090	7.210	8.270	9.230	10.110	11.000
1987	0.300	0.930	1.790	2.750	3.700	4.580	5.360	6.030	6.590	7.050	7.420	-1.000
1988	0.320	0.900	1.740	2.760	3.880	5.020	6.140	7.200	8.170	9.450	-1.000	-1.000
1989	0.240	0.780	1.730	3.030	3.580	4.970	5.240	6.590	7.080	9.480	-1.000	-1.000
1990	0.600	1.060	1.660	2.400	3.270	4.270	5.410	6.690	8.100	10.500	-1.000	-1.000
1991	-1.000	1.040	1.240	1.610	2.570	3.330	5.410	7.480	8.340	10.810	-1.000	-1.000
1992	1.326	1.770	1.807	2.071	2.217	3.586	4.143	7.660	-1.000	10.198	7.758	-1.000

Table 6.1.1 GREENLAND HALIBUT. Nominal catches (tonnes) in Sub-areas V and XIV, 1980-1991, as offically reported to ICES.

Country	1980	1981	1982	1983	1984	1985	1986
Denmark	-	-	-	-	-	-	-
Faroe Islands	1,042	767	1,532	1,146	2,502	1,052	853
France	51	8	27	236	489	845	52
Germany, Fed. Rep.	2,318	3,007	2,581	1,142	936	863	858
Greenland	-	+	1	5	15	81	177
Iceland	27,838	15,4552	28,300	28,360	30,080	29,231	31,044
Norway	3	-	+	2	2	3	+
UK (Engl. & Wales)	-		-	-	-	-	-
Total	31,252	19,239	32,441	30,888	34,024	32,075	32,984
Working Group estimate	-	-	-	-	-	-	-

Country	1987	1988	1989	1990	1991	1992[1]
Denmark	6	+	-	-	-	-
Faroe islands	1,096	1,378	2,319	1,803	1,566	2,092
France	19	25	-	-	-	-
Germany, Fed. Rep.	565	637	493	336	303	396
Greenland	154	37	11	40	66	437
Iceland	44,780	49,040	58,330	36,557	34,883	30,371
Norway	2	1	3	50	28	267
UK (Engl. & Wales)	-	-	-	27	38	127
Total	46,622	51,118	61,396	38,813	36,884	33,690
Working Group estimate	-	-	61,936	39,326	38,006	35,460

[1]Preliminary data.

Table 6.1.2 GREENLAND HALIBUT. Nominal catches (tonnes) in Division Vb, 1980-1992, as officially reported to ICES.

Country	1980	1981	1982	1983	1984	1985	1986
Denmark	-	-	-	-	-	-	-
Faroe Islands	951	442	863	1,112	2,456	1,052	775
France	51	8	27	236	489	845	52
Germany, Fed. Rep.	172	114	142	86	118	227	113
Norway	3	2	+	2	2	2	+
UK (Engl.& Wales)	-	-	-	-	-	-	-
Uk (Scotland)	-	-	-	-	-	-	-
Total	1,177	566	1,032	1,436	3,065	2,126	940
Working Group estimate	-	-	-	-	-	-	-

Country	1987	1988	1989	1990	1991	1992[1]
Denmark	6	+	-	-	-	-
Faroe Islands	907	901	1,513	1,064	1,293	2,069
France	19	25	-	-	-	-
Germany, Fed. Rep.	109	42	73	43	24	73
Norway	2	1	3	42	16[1]	25
UK (Engl.& Wales)	-	-	-	-	-	1
UK (Scotland)	-	-	-	-	-	1
Total	1,043	969	-	-	1,333	2,169
Working Group estimate	-	-	-	-	1,7313[4]	2,235[5]

[1]Preliminary.
[2]Includes 17 t taken by France.
[3]Includes 133 t taken in Division IIa (Faroes waters)
[4]Includes 317 t taken in Division IIa (Faroes waters) + France 12 t.
[5]Includes 63 t taken in Division IIa (Faroes waters) and France 3 t.

Table 6.1.3 GREENLAND HALIBUT. Nominal catches (tonnes) in Division Va, 1980-1992, as reported officially to ICES.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
Faroe Islands	91	325	669	33	46	-	-	15	379	719	739	273	23
Iceland	27,836	15,455	28,300	28,359	30,078	29,195	31,027	44,644	49,000	58,330	36,557	34,883	30,371
Norway	-	+	-	+	+	2	-	-	-	-	-	-	-
Total	27,927	15,780	28,969	28,392	30,124	29,196	31,027	44,659	49,379	59,049	37,296	35,156	30,394
Working Group estimate	-	-	-	-	-	-	-	-	-	59,272[2]	37,308[3]	35,413[4]	31,882[4]

[1]Preliminary.
[2]Includes 223 t by Norway.
[3]Includes 12 t by Norway.
[4]Includes additional catches by Iceland. 257 t in 1991 and 1,588 t in 1992.

Table 6.1.4 GREENLAND HALIBUT. Nominal catches (tonnes) in Sub-area XIV, 1980-1992, as reported officially to ICES.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
Faroe Islands	-	-	-	-	-	-	78	74	98	87	-	-	-
Germany, Fed. Rep.	2,146	2,893	2,439	1,054	818	636	745	456	595	420	293	279	323
Greenland	-	+	1	5	15	81	177	154	37	11	40	66	437
Iceland	2	-	-	1	2	36	17	136	40	+	-	-	-
Norway	-	-	-	-	+	-	-	-	-	-	8	12[1]	242
UK (Engl. &	-	-	-	-	-	-	-	-	-	+	27	38	107
Wales)	-	-	-	-	-	-	-	-	-	-	-	-	18
Total	2,148	2,893	2,440	1,060	835	753	1,017	820	770	518	368	395	1,127
Working Group estimate[2]	-	-	-	-	-	-	-	-	-	-	736[2]	860[3]	1,243[4]

[1]Preliminary.
[2]Includes 370 t catches by Japan.
[3]Includes 315 t catch by Japan and 159 t by other countries as reported to Greenland.
[4]Indicates additional catches taken by Germany (96 t) and UK (17 t) as reported to Greenland.

Table 6.2.1 Greenland Halibut. Cpue and effort data for Icelandic trawlers.

Year	Total Catch (t)	Cpue (t/hr)	Total Effort (hr)
1977	16,578	1.0000	16,578
1978	14,349	0.9317	15,401
1979	23,616	1.2144	19,446
1980	31,252	1.3953	22,398
1981	19,239	1.4251	13,249
1982	32,441	1.6211	20,012
1983	30,888	1.2187	25,345
1984	34,024	1.0661	31,914
1985	32,075	1.0543	30,423
1986	32,984	1.0342	31,893
1987	46,622	0.9522	48,962
1988	51,118	1.0846	47,130
1989	61,396	1.0338	59,388
1990	39,326	0.7647	51,426
1991	37,994	0.8263	45,980
1992	35,298	0.6909	51,089

Table 6.3.1

Run title : Greenland halibut in the Iceland and Faroes Grounds and East Green (run name: FI

At 9-May-93 15:08

Extended survivors analysis.

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,
AGE							
5,	43,	0,	23,	29,	47,	26,	8,
6,	296,	34,	91,	197,	502,	158,	300,
7,	584,	671,	347,	1605,	1536,	580,	1140,
8,	621,	1727,	1037,	2253,	2630,	1160,	2451,
9,	431,	2289,	1214,	3090,	3126,	1430,	2646,
10,	240,	834,	848,	1693,	2324,	1764,	2456,
11,	121,	420,	567,	880,	1739,	1299,	1803,
12,	86,	423,	312,	394,	849,	664,	963,
13,	37,	174,	232,	246,	578,	435,	609,
14,	32,	120,	218,	189,	306,	252,	331,
15,	14,	28,	114,	147,	143,	176,	195,
+gp,	9,	141,	204,	125,	116,	159,	132,
TOTALNUM,	2514,	6861,	5207,	10848,	13896,	8103,	13034,
TONSLAND,	6045,	16578,	14349,	23616,	31252,	19239,	32441,
SOPCOF %,	100,	100,	100,	101,	99,	100,	100,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
5,	10,	83,	125,	245,	182,	129,	499,	188,	289,	17,
6,	240,	277,	441,	612,	3123,	742,	1657,	463,	1225,	421,
7,	1611,	891,	1018,	1033,	4863,	2068,	4485,	1513,	1797,	2023,
8,	2651,	2139,	2295,	1942,	2586,	2985,	5961,	3515,	2866,	3262,
9,	3060,	3568,	3454,	2983,	2156,	3166,	5763,	4186,	2935,	2646,
10,	2443,	2800,	2749,	3097,	3476,	2966,	3246,	3143,	2074,	3019,
11,	1693,	1825,	1452,	1683,	1847,	1848,	1601,	1224,	1130,	1962,
12,	978,	1134,	627,	820,	1829,	1761,	1458,	959,	1072,	1278,
13,	424,	588,	423,	550,	886,	1851,	1237,	568,	924,	509,
14,	174,	363,	137,	202,	243,	701,	506,	358,	554,	144,
15,	37,	92,	36,	59,	31,	216,	362,	137,	342,	36,
+gp,	47,	20,	46,	34,	5,	246,	145,	61,	82,	56,
TOTALNUM,	13368,	13780,	12803,	13260,	21227,	18679,	26920,	16315,	15290,	15373,
TONSLAND,	30888,	34024,	32075,	32984,	46622,	51118,	61396,	39326,	37994,	35298,
SOPCOF %,	101,	99,	103,	101,	98,	101,	100,	100,	101,	100,

Table 6.4.1

Run title : Greenland halibut in the Iceland and Faroes Grounds and East Green (run name: FI

At 9-May-93n 15:08

Extended survivors analysis.

Table 2 Catch weights at age (kg)

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,
AGE							
5,	1.1570,	1.1570,	.9680,	.9110,	1.1250,	1.0710,	1.0100,
6,	1.5850,	1.0460,	1.1990,	.9420,	1.2830,	1.2570,	1.3680,
7,	1.7680,	1.4290,	1.4230,	1.2780,	1.4870,	1.4400,	1.6180,
8,	2.1800,	1.7940,	1.8540,	1.6760,	1.7560,	1.6600,	1.9050,
9,	2.5700,	2.2280,	2.2560,	2.0720,	2.1530,	1.9670,	2.1870,
10,	3.0180,	2.6870,	2.6070,	2.3330,	2.2790,	2.2580,	2.5160,
11,	3.7300,	3.0170,	3.0810,	2.7230,	2.4980,	2.5150,	2.7610,
12,	4.0520,	3.9140,	3.5910,	3.2970,	3.0590,	2.9500,	3.1290,
13,	4.8150,	4.0400,	4.6040,	3.9850,	3.7830,	3.4500,	3.7850,
14,	5.3480,	4.7140,	4.6950,	4.6680,	4.5070,	4.0330,	4.4750,
15,	5.7520,	5.4010,	5.1510,	4.7920,	5.1390,	4.6520,	4.9850,
+gp,	7.0940,	5.5970,	6.4500,	5.3870,	5.9830,	5.3300,	6.0880,
SOPCOFAC,	1.0024,	1.0008,	.9993,	1.0124,	.9902,	1.0024,	.9997,

Table 2 Catch weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
5,	.9840,	.9420,	.9950,	1.0300,	1.0300,	1.1290,	.8420,	1.0290,	1.0010,	1.0160,
6,	1.3380,	1.2750,	1.2300,	1.2380,	1.2180,	1.3040,	1.0470,	1.2100,	1.2470,	1.2560,
7,	1.5770,	1.5920,	1.6300,	1.4990,	1.5330,	1.5410,	1.4250,	1.5720,	1.4720,	1.4010,
8,	1.8480,	1.8170,	1.9510,	1.9370,	1.8240,	1.7700,	1.7270,	1.7900,	1.8100,	1.7180,
9,	2.1590,	2.2400,	2.3670,	2.3630,	2.1870,	2.2360,	2.1250,	2.1260,	2.0880,	2.0490,
10,	2.4340,	2.4610,	2.6370,	2.6310,	2.6660,	2.6830,	2.6370,	2.5360,	2.4400,	2.4360,
11,	2.6030,	2.8350,	2.8290,	2.8480,	2.9960,	3.0820,	3.2200,	3.2140,	2.9350,	2.8680,
12,	3.0340,	3.2620,	3.3530,	3.3350,	3.5950,	3.6240,	3.7330,	3.6930,	3.7370,	3.4780,
13,	3.7840,	3.9620,	4.0060,	4.0390,	4.4310,	4.3120,	4.1350,	4.4480,	4.4010,	4.5100,
14,	4.4460,	4.9360,	4.7920,	4.9250,	5.1400,	5.0980,	5.3800,	5.1970,	5.0220,	4.6810,
15,	4.7510,	5.2300,	5.2310,	5.4660,	5.7640,	5.2130,	6.5690,	5.8910,	5.9910,	6.0100,
+gp,	6.3850,	7.1920,	6.3230,	5.9850,	7.2670,	5.7640,	6.4970,	6.0490,	6.4120,	5.1280,
SOPCOFAC,	1.0110,	.9937,	1.0258,	1.0060,	.9785,	1.0063,	.9999,	.9998,	1.0109,	.9998,

Table 6.5.1

Run title : Greenland halibut in the Iceland and Faroes Grounds and East Green (run name: FI

At 9-May-93n 15:08

Extended survivors analysis.

Table 5 Proportion mature at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,
AGE							
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0500,
7,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.2000,
8,	.3500,	.3500,	.3500,	.3500,	.3500,	.3500,	.3300,
9,	.7700,	.7700,	.7700,	.7700,	.7700,	.7700,	.5000,
10,	.9600,	.9600,	.9600,	.9600,	.9600,	.9600,	.7000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.8500,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9400,
13,	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,
15,	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,

Table 5 Proportion mature at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
5,	.0400,	.0000,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0200,
6,	.0700,	.0800,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0400,
7,	.1500,	.1900,	.2100,	.2100,	.2100,	.2100,	.2100,	.2100,	.2900,	.1100,
8,	.2800,	.3200,	.3500,	.3500,	.3500,	.3500,	.3500,	.3500,	.4800,	.2500,
9,	.3800,	.4200,	.4600,	.4600,	.4600,	.4600,	.4600,	.4600,	.5600,	.4700,
10,	.6000,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.6400,	.6200,	.6800,
11,	.8500,	.7500,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.8500,	.8500,
12,	.9800,	.9300,	.9600,	.9600,	.9600,	.9600,	.9600,	.9600,	1.0000,	.9600,
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,
15,	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 6.6.1

```
VPA Version 3.0 (MSDOS)

9-May-93ε  15:08

Extended Survivors Analysis

Greenland halibut in the Iceland and Faroes Grounds and East Green (run name: FI

CPUE data from file /users/ifad/ifapwork/wg_109/ghl_grn/FLEET.SLU


Data for    1 fleets over   17 years
Age range from    5 to   15


     Fleet,                Alpha,    Beta
FLT01: Greenland hal     ,  .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 >=   12


Terminal population estimation :

     Final estimates shrunk towards mean of the last   5 years and 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   27 iterations


Total absolute residual between iterations
26 and  27 =    .000


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


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

    5,  .003,  .006,  .005,  .005,  .017,  .007,  .015,  .009
    6,  .019,  .018,  .092,  .025,  .079,  .019,  .052,  .025
    7,  .056,  .052,  .182,  .077,  .194,  .091,  .091,  .109
    8,  .130,  .136,  .170,  .154,  .311,  .217,  .236,  .224
    9,  .233,  .236,  .208,  .306,  .467,  .353,  .268,  .336
   10,  .266,  .320,  .446,  .462,  .556,  .473,  .280,  .457  -  F8-12 = 0.409
   11,  .278,  .245,  .303,  .427,  .460,  .395,  .291,  .438
   12,  .314,  .236,  .431,  .496,  .670,  .522,  .678,  .588
   13,  .755,  .471,  .406, 1.004,  .744,  .566, 1.456,  .765
   14,  .543,  .982,  .370,  .617,  .797,  .464, 1.984,  .904
   15,  .455,  .448,  .354,  .620,  .718,  .483, 1.065,  .642
```

....Continued

Table 6.6.1 (Cont'd)

XSA population numbers

YEAR	AGE 5	6	7	8	9	10	11	12	13	14	15	Plus GP
1985 ,	4.34E+04,	2.58E+04,	2.02E+04,	2.03E+04,	1.79E+04,	1.27E+04,	6.45E+03,	2.51E+03,	8.60E+02,	3.52E+02,	1.06E+02,	1.35E+02,
1986 ,	4.49E+04,	3.72E+04,	2.18E+04,	1.64E+04,	1.53E+04,	1.22E+04,	8.36E+03,	4.21E+03,	1.58E+03,	3.48E+02,	1.76E+02,	1.01E+02,
1987 ,	3.81E+04,	3.84E+04,	3.15E+04,	1.78E+04,	1.24E+04,	1.04E+04,	7.63E+03,	5.63E+03,	2.86E+03,	8.47E+02,	1.12E+02,	1.80E+01,
1988 ,	2.75E+04,	3.26E+04,	3.01E+04,	2.26E+04,	1.29E+04,	8.63E+03,	5.73E+03,	4.85E+03,	3.15E+03,	1.64E+03,	5.04E+02,	5.69E+02,
1989 ,	3.12E+04,	2.35E+04,	2.74E+04,	2.40E+04,	1.67E+04,	8.20E+03,	4.68E+03,	3.22E+03,	2.54E+03,	9.93E+02,	7.62E+02,	3.02E+02,
1990 ,	3.02E+04,	2.64E+04,	1.87E+04,	1.94E+04,	1.52E+04,	8.99E+03,	4.05E+03,	2.54E+03,	1.42E+03,	1.04E+03,	3.85E+02,	1.70E+02,
1991 ,	2.16E+04,	2.58E+04,	2.23E+04,	1.47E+04,	1.35E+04,	9.16E+03,	4.82E+03,	2.35E+03,	1.30E+03,	6.92E+02,	5.63E+02,	1.33E+02,
1992 ,	1.98E+03,	1.83E+04,	2.11E+04,	1.75E+04,	9.99E+03,	8.86E+03,	5.96E+03,	3.10E+03,	1.03E+03,	2.61E+02,	8.19E+01,	1.26E+02,

Terminal population estimates.

,	0.00E+00,	1.69E+03,	1.54E+04,	1.63E+04,	1.21E+04,	6.14E+03,	4.83E+03,	3.31E+03,	1.48E+03,	4.11E+02,	9.09E+01,	9.44E+01,

Log catchability residuals.

Fleet : FLT01: Greenland hal

Age	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992
5 ,	-.47,	.12,	-.44,	-.42,	.58,	-.22,	.66,	.11
6 ,	-.20,	-.28,	.92,	-.35,	.58,	-.70,	.43,	-.41
7 ,	-.16,	-.27,	.55,	-.28,	.42,	-.19,	-.08,	-.01
8 ,	.01,	.01,	-.20,	-.26,	.21,	-.01,	.19,	.03
9 ,	.17,	.13,	-.42,	.00,	.19,	.05,	-.11,	.01
10 ,	.00,	.13,	.03,	.11,	.06,	.04,	-.37,	.02
11 ,	.17,	.00,	-.22,	.16,	.00,	-.01,	-.20,	.11
12 ,	-.01,	-.34,	-.17,	.01,	.07,	-.03,	.34,	.10
13 ,	.86,	.35,	-.23,	.71,	.18,	.05,	1.10,	.36
14 ,	.53,	1.07,	-.32,	.22,	.25,	-.15,	1.40,	.52

an catchability and Standard error.

Age ,	5,	6,	7,	8,	9,	10,	11,	12,	13,	14,	15
Mean Q ,	-15.63,	-14.11,	-13.05,	-12.37,	-11.95,	-11.65,	-11.78,	-11.48,	-11.48,	-11.48,	-11.48
S.E ,	.45,	.56,	.31,	.16,	.19,	.16,	.14,	.20,	.65,	.98,	1.05

Table 6.6.2

Run title : Greenland halibut in the Iceland and Faroes Grounds and East Green (run name: FI

At 9-May-93n 15:08

Extended survivors analysis.

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,
AGE							
5,	.0018,	.0000,	.0009,	.0009,	.0013,	.0007,	.0003,
6,	.0153,	.0017,	.0044,	.0091,	.0187,	.0049,	.0097,
7,	.0427,	.0415,	.0198,	.0940,	.0865,	.0257,	.0424,
8,	.0690,	.1625,	.0791,	.1636,	.2078,	.0826,	.1368,
9,	.0870,	.3649,	.1557,	.3357,	.3377,	.1577,	.2590,
10,	.0825,	.2285,	.2102,	.3187,	.4285,	.3057,	.4168,
11,	.0684,	.1923,	.2266,	.3313,	.5940,	.4268,	.5528,
12,	.0600,	.3391,	.2021,	.2298,	.5802,	.4461,	.6135,
13,	.0438,	.1572,	.2973,	.2296,	.5804,	.6314,	.9142,
14,	.1770,	.1849,	.2847,	.3971,	.4668,	.5084,	1.5060,
15,	.0875,	.2193,	.2538,	.2984,	.5596,	.5067,	.9055,
+gp,	.0875,	.2193,	.2538,	.2984,	.5596,	.5067,	.9055,
FBAR 8-12,	.0734,	.2575,	.1747,	.2758,	.4297,	.2838,	.3958,

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
5,	.0004,	.0030,	.0031,	.0059,	.0052,	.0051,	.0174,	.0067,	.0145,	.0093,	.0102,
6,	.0091,	.0126,	.0186,	.0179,	.0918,	.0248,	.0790,	.0191,	.0524,	.0251,	.0322,
7,	.0627,	.0400,	.0558,	.0524,	.1823,	.0768,	.1940,	.0913,	.0908,	.1090,	.0970,
8,	.1244,	.1052,	.1303,	.1361,	.1701,	.1538,	.3111,	.2169,	.2361,	.2238,	.2256,
9,	.2390,	.2321,	.2332,	.2359,	.2084,	.3061,	.4669,	.3535,	.2679,	.3364,	.3192,
10,	.3814,	.3382,	.2664,	.3197,	.4465,	.4624,	.5562,	.4732,	.2798,	.4574,	.4035,
11,	.5347,	.5158,	.2777,	.2448,	.3025,	.4271,	.4600,	.3945,	.2914,	.4383,	.3748,
12,	.6258,	.7988,	.3139,	.2358,	.4310,	.4965,	.6703,	.5217,	.6776,	.5880,	.5958,
13,	.5678,	.9352,	.7549,	.4713,	.4061,	1.0040,	.7438,	.5660,	1.4556,	.7649,	.9288,
14,	.6855,	1.4282,	.5430,	.9822,	.3697,	.6172,	.7966,	.4639,	1.9842,	.9042,	1.1174,
15,	.6082,	.9287,	.4547,	.4476,	.3535,	.6198,	.7179,	.4832,	1.0646,	.6417,	.7298,
+gp,	.6082,	.9287,	.4547,	.4476,	.3535,	.6198,	.7179,	.4832,	1.0646,	.6417,	
FBAR 8-12,	.3810,	.3980,	.2443,	.2344,	.3117,	.3692,	.4929,	.3920,	.3506,	.4088,	

Table 6.6.3

Run title : Greenland halibut in the Iceland and Faroes Grounds and East Green (run name: FI

At 9-May-93n 15:08

Extended survivors analysis.

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,
AGE							
5,	25824,	26146,	27246,	33921,	40220,	38973,	33369,
6,	20988,	22187,	22504,	23429,	29169,	34574,	33520,
7,	15046,	17790,	19065,	19285,	19983,	24640,	29612,
8,	10045,	12408,	14689,	16087,	15110,	15775,	20670,
9,	5578,	8070,	9078,	11681,	11756,	10565,	12501,
10, •	3266,	4401,	4822,	6687,	7187,	7218,	7767,
11,	1973,	2588,	3015,	3364,	4185,	4030,	4576,
12,	1591,	1586,	1838,	2069,	2079,	1989,	2264,
13,	930,	1289,	972,	1293,	1415,	1002,	1096,
14,	213,	766,	948,	622,	884,	682,	458,
15,	180,	153,	548,	614,	360,	477,	353,
+gp,	116,	769,	977,	520,	289,	428,	236,
TOTAL,	85748,	98154,	105702,	119571,	132638,	140352,	146422,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	GMST 76-89	AMST 76-89
AGE													
5,	27635,	30096,	43365,	44872,	38124,	27455,	31235,	30235,	21577,	1981,	0,	32881,	33463,
6,	28714,	23777,	25826,	37208,	38394,	32645,	23511,	26421,	25849,	18303,	1689,	27749,	28318,
7,	28572,	24492,	20208,	21820,	31458,	30149,	27409,	18699,	22312,	21112,	15364,	22988,	23538,
8,	24429,	23098,	20253,	16449,	17822,	22564,	24031,	19431,	14690,	17537,	16295,	17553,	18102,
9,	15517,	18567,	17896,	15303,	12356,	12941,	16652,	15153,	13463,	9985,	12068,	12166,	12747,
10,	8305,	10517,	12671,	12199,	10404,	8635,	8201,	8986,	9159,	8865,	6140,	7522,	8020,
11,	4406,	4882,	6454,	8355,	7627,	5730,	4680,	4047,	4818,	5959,	4829,	4377,	4705,
12,	2266,	2222,	2509,	4208,	5630,	4851,	3217,	2543,	2348,	3099,	3309,	2521,	2737,
13,	1055,	1043,	860,	1577,	2861,	3149,	2541,	1417,	1299,	1026,	1482,	1368,	1506,
14,	378,	515,	352,	348,	847,	1641,	993,	1040,	692,	261,	411,	605,	689,
15,	88,	164,	106,	176,	112,	504,	762,	385,	563,	82,	91,	260,	328,
+gp,	110,	35,	135,	101,	18,	569,	302,	170,	133,	126,	94,		
TOTAL,	141477,	139406,	150636,	162617,	165654,	150831,	143535,	128527,	116903,	88336,	61771,		

Table 6.6.4

Run title : Greenland halibut in the Iceland and Faroes Grounds and East Green (run name: FI

At 9-May-93n 15:08

Extended survivors analysis.

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,
AGE							
5,	0,	0,	0,	0,	0,	0,	0,
6,	998,	696,	809,	662,	1123,	1304,	2293,
7,	2660,	2542,	2713,	2465,	2971,	3548,	9582,
8,	7664,	7791,	9532,	9437,	9286,	9165,	12994,
9,	11039,	13844,	15769,	18637,	19489,	16002,	13670,
10,	9462,	11353,	12068,	14977,	15725,	15647,	13679,
11,	7358,	7808,	9288,	9159,	10454,	10136,	10740,
12,	6446,	6206,	6600,	6820,	6359,	5866,	6658,
13,	4478,	5210,	4476,	5151,	5353,	3455,	4147,
14,	1137,	3612,	4453,	2902,	3985,	2749,	2052,
15,	1036,	828,	2824,	2943,	1848,	2220,	1759,
+gp,	819,	4305,	6301,	2800,	1732,	2281,	1437,
TOTSPBIO,	53097,	64196,	74834,	75951,	78326,	72374,	79011,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
5,	1088,	0,	431,	462,	393,	310,	263,	311,	216,	40,
6,	2689,	2425,	1906,	2764,	2806,	2554,	1477,	1918,	1934,	920,
7,	6759,	7408,	6917,	6869,	10127,	9756,	8202,	6173,	9524,	3254,
8,	12641,	13430,	13830,	11151,	11378,	13979,	14525,	12173,	12763,	7532,
9,	12731,	17468,	19486,	16634,	12430,	13310,	16277,	14819,	15742,	9616,
10,	12129,	16564,	21384,	20541,	17752,	14826,	13840,	14584,	13856,	14684,
11,	9749,	10380,	14972,	19513,	18736,	14481,	12357,	10666,	12020,	14527,
12,	6738,	6741,	8075,	13473,	19431,	16876,	11530,	9015,	8774,	10347,
13,	3992,	4133,	3447,	6371,	12678,	13579,	10508,	6301,	5717,	4628,
14,	1681,	2540,	1689,	1714,	4356,	8364,	5343,	5403,	3477,	1221,
15,	416,	857,	556,	963,	647,	2627,	5004,	2270,	3371,	492,
+gp,	704,	253,	852,	604,	131,	3280,	1963,	1031,	853,	648,
TOTSPBIO,	71316,	82200,	93545,	101060,	110864,	113943,	101291,	84665,	88247,	67909,

Table 6.7.1

Greenland halibut in the Iceland and Faroes Grounds and East Green

Prediction with management option table: Input data

Year: 1993								
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
5	33000.000	0.1500	0.0100	0.0000	0.0000	1.023	0.0110	1.020
6	28140.000	0.1500	0.0554	0.0000	0.0000	1.238	0.0340	1.236
7	23498.000	0.1500	0.1846	0.0000	0.0000	1.511	0.1030	1.506
8	16295.000	0.1500	0.3430	0.0000	0.0000	1.825	0.2410	1.826
9	12068.000	0.1500	0.5100	0.0000	0.0000	2.198	0.3400	2.202
10	6140.000	0.1500	0.6923	0.0000	0.0000	2.545	0.4290	2.548
11	4829.000	0.1500	0.8515	0.0000	0.0000	2.927	0.3990	2.935
12	3309.000	0.1500	0.9669	0.0000	0.0000	3.461	0.6350	3.468
13	1482.000	0.1500	1.0000	0.0000	0.0000	4.146	0.9900	4.172
14	411.000	0.1500	1.0000	0.0000	0.0000	4.827	1.1900	4.820
15	91.000	0.1500	1.0000	0.0000	0.0000	5.411	0.4090	5.397
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1994								
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
5	33000.000	0.1500	0.0100	0.0000	0.0000	1.023	0.0110	1.020
6	.	0.1500	0.0554	0.0000	0.0000	1.238	0.0340	1.236
7	.	0.1500	0.1846	0.0000	0.0000	1.511	0.1030	1.506
8	.	0.1500	0.3430	0.0000	0.0000	1.825	0.2410	1.826
9	.	0.1500	0.5100	0.0000	0.0000	2.198	0.3400	2.202
10	.	0.1500	0.6923	0.0000	0.0000	2.545	0.4290	2.548
11	.	0.1500	0.8515	0.0000	0.0000	2.927	0.3990	2.935
12	.	0.1500	0.9669	0.0000	0.0000	3.461	0.6350	3.468
13	.	0.1500	1.0000	0.0000	0.0000	4.146	0.9900	4.172
14	.	0.1500	1.0000	0.0000	0.0000	4.827	1.1900	4.820
15	.	0.1500	1.0000	0.0000	0.0000	5.411	0.4090	5.397
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Prediction with management option table: Input data

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
5	33000.000	0.1500	0.0100	0.0000	0.0000	1.023	0.0110	1.020
6	.	0.1500	0.0554	0.0000	0.0000	1.238	0.0340	1.236
7	.	0.1500	0.1846	0.0000	0.0000	1.511	0.1030	1.506
8	.	0.1500	0.3430	0.0000	0.0000	1.825	0.2410	1.826
9	.	0.1500	0.5100	0.0000	0.0000	2.198	0.3400	2.202
10	.	0.1500	0.6923	0.0000	0.0000	2.545	0.4290	2.548
11	.	0.1500	0.8515	0.0000	0.0000	2.927	0.3990	2.935
12	.	0.1500	0.9669	0.0000	0.0000	3.461	0.6350	3.468
13	.	0.1500	1.0000	0.0000	0.0000	4.146	0.9900	4.172
14	.	0.1500	1.0000	0.0000	0.0000	4.827	1.1900	4.820
15	.	0.1500	1.0000	0.0000	0.0000	5.411	0.4090	5.397
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : JESPER
Date and time: 11MAY93:15:04

Table 6.7.2

Greenland halibut in the Iceland and Faroes Grounds and East Green

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.7677	0.3138	210198	75094	30000	0.2000	0.0818	216981	78322	9395	245799	98774
.	.	.	.	.	0.3000	0.1226	.	78322	13771	241081	95204
.	.	.	.	.	0.4000	0.1635	.	78322	17950	236577	91824
.	.	.	.	.	0.5000	0.2044	.	78322	21945	232276	88621
.	.	.	.	.	0.6000	0.2453	.	78322	25768	228164	85582
.	.	.	.	.	0.7000	0.2862	.	78322	29428	224230	82698
.	.	.	.	.	0.8000	0.3270	.	78322	32937	220462	79957
.	.	.	.	.	0.9000	0.3679	.	78322	36301	216851	77351
.	.	.	.	.	1.0000	0.4088	.	78322	39531	213388	74871
.	.	.	.	.	1.1000	0.4497	.	78322	42634	210064	72509
.	.	.	.	.	1.2000	0.4906	.	78322	45616	206872	70258
.	.	.	.	.	1.3000	0.5314	.	78322	48485	203804	68111
.	.	.	.	.	1.4000	0.5723	.	78322	51246	200852	66062
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Prediction with management option table

Year: 1993					Year: 1994					Year: 1995	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.7677	0.3138	210198	75094	30000	0.4370	0.1786	216981	78322	19449	234963	90619
.	.	.	.	.	1.0820	0.4423	.	78322	42084	210653	72926
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : JESPER
Date and time : 11MAY93:15:23
Computation of ref. F: Simple mean, age 8 - 12
Basis for 1993 : TAC constraints

Table 7.3.1 Nominal catch of REDFISH (in tonnes) by countries in Division Va (Iceland) as reported officially to ICES.

Country	1978	1979	1980	1981	1982	1983	1984
Belgium	1,549	1,385	1,381	924	283	389	291
Faroe Is.	242	629	1,055	1,212	1,046	1,357	686
Iceland	33,318	62,253	69,780	93,349	115,051	122,749	108,270
Norway	93	43	33	32	11	32	12
Total	35,202	64,310	72,249	95,517	116,391	124,527	109,259

Country	1985	1986	1987	1988	1989	1990	1991	1992[1]
Belgium	400	423	398	372	190	70	146	107
Faroe Is.	291	144	332	372	394	624	412	389
Iceland	91,381	85,992	87,768	93,995	91,536	90,891	96,770	87,897
Norway	8	2	7	7	1	-	-	-
Total	92,080	86,561	88,505	94,746	92,121	91,585	97,328	88,393

[1]Provisional data.

Table 7.3.2 Landings of REDFISH in Va (in tonnes) by countries in Division Va as used by the working group.

Year	Belgium	Faroes	Iceland	Norway	Total
1978	1,549	242	33,318	93	35,202
1979	1,385	629	62,253	43	64,310
1980	1,381	1,055	69,780	33	72,249
1981	924	1,212	93,349	32	95,517
1982	283	1,046	115,051	11	116,391
1983	389	1,357	122,749	32	124,527
1984	291	686	108,270	12	109,259
1985	400	291	91,381	8	92,080
1986	423	253	85,992	2	86,670
1987	398	332	87,768	7	88,505
1988	372	372	94,011	7	94,762
1989	190	394	91,488	1	92,073
1990	70	624	90,891	0	91,585
1991	146	412	96,193	0	96,751
1992	107	389	93,378	0	93,874

Table 7.3.3 Nominal catch of REDFISH (in tonnes) by countries in Division Vb (Faroe Islands) as reported officially to ICES.

Country	1978	1979	1980	1981	1982	1983	1984
Denmark	-	-	-	-	-	-	-
Faroe Islands	1,525	5,693	5,509	3,232	3,999	4,642	8,770
France	448	862	627	59	204	439	559
Germany, Fed. Rep.	7,767	6,108	3,891	3,841	4,660	4,300	4,460
Iceland	-	-	-	-	1	-	-
Netherlands	+		-	-	-	-	-
Norway	9	11	12	13	7	3	1
UK	57	+	-	-	-	-	-
USSR	-	-	-	-	-	-	142
Total	9,806	12,674	10,039	7,145	8,871	9,384	13,932

Country	1985	1986	1987	1988	1989	1990	1991	1992[1]
Denmark	-	36	176	8	-	+	-	-
Faroe Islands	12,634	15,224	13,477	12,966	12,636	10,014	14,090	13,985
France	1,157	752	819	582	-	-	473[1]	-
Germany, Fed. Rep.	5,091	5,142	3,060	1,595	1,191	441	447	451
Iceland	-	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-
Norway	4	2	5	5	21	21	20[1]	35
UK	-	-	-	-	-	+	3	29
USSR	-	-	-	-		-	-	-
Total	18,886	21,156	17,537	15,156	13,848	10,476	15,033	14,500

[1]Provisional data.
[2]Includes former GDR.

Table 7.3.4 Landings of Redfish (in tonnes) by countries in Division Vb as used by the Working Group.

Year	Denmark	Faroes	France	Germany	Iceland	Lithuania	Norway	UK	Russia	USSR	Total
1978	0	1,525	448	7,767	0	0	9	57	0	0	9,806
1979	0	5,693	862	6,108	0	0	11	0	0	0	12,674
1980	0	5,509	627	3,891	0	0	12	0	0	0	10,039
1981	0	3,232	59	3,841	0	0	13	0	0	0	7,145
1982	0	3,999	204	5,230	1	0	7	0	0	0	9,441
1983	0	4,642	439	4,300	0	0	3	0	0	0	9,384
1984	0	8,770	559	4,460	0	0	1	0	0	142	13,932
1985	0	12,634	1,157	5,091	0	0	4	0	0	868	19,754
1986	36	15,224	752	5,142	0	0	2	0	0	320	21,476
1987	176	13,478	819	3,060	0	0	5	0	0	0	17,538
1988	8	13,318	582	1,595	0	0	5	0	0	0	15,508
1989	0	12,860	928	1,191	0	0	21	0	0	0	15,000
1990	0	10,364	1,410	441	0	0	21	0	0	2	12,238
1991	0	14,055	585	447	0	0	20	3	0	4	15,114
1992	0	14,213	173	451	0	4	35	39	47	0	14,962

Table 7.3.5 Nominal catch of REDFISH (in tonnes) by countries in Sub-area VI as reported officially to ICES.

Country	1978	1979	1980	1981	1982	1983	1984
Faroe Islands	-	1	-	-	-	-	19
France	307	215	202	24	44	93	102
Germany, Fed. Rep.	18	604	907	983	604	359	563
Norway	4	4	2	3	4	2	9
Spain	-	-	-	1	-	2	-
UK (Engl. & Wales)	1	-	-	-	2	-	1
UK (Scotland)	1	1	-	-	-	-	1
Total	331	825	1,111	1,011	654	456	695

Country	1985	1986	1987	1988	1989	1990	1991	1992[1]
Faroe Islands	18	-	-	1	61	-	22	9
France	397	480	1,032	1,024	726	684[1]	483[1]	-
Germany, Fed. Rep.	76	24	-	16	1	6	8	-
Norway	-	14	2	1	2	5	+[1]	4
Spain	-	-	-	-	-	-	-	-
UK (Engl. & Wales)	1	2	3	75	4	29	11	4
UK (Scotland)	-	10	17	6	4	6	39	31
Total	492	530	1,054	1,123	798	730	563	48

[1]Preliminary.

Table 7.3.6 Landings of REDFISH (in tonnes) by countries in Sub-area VI as used by the Working Group.

Year	Faroes	France	Germany, F.R.	Norway	Spain	UK	Total
1978	0	307	18	4	0	2	331
1979	1	215	604	4	0	1	825
1980	0	202	907	2	0	0	1,111
1981	0	24	983	3	1	0	1,011
1982	0	44	604	4	0	2	654
1983	0	93	359	2	2	0	456
1984	19	102	563	9	0	2	695
1985	18	397	76	0	0	1	492
1986	0	480	24	14	0	12	530
1987	0	1,032	0	2	0	20	1,054
1988	1	1,024	16	1	0	81	1,123
1989	61	726	1	2	0	8	798
1990	0	684	6	5	0	35	730
1991	22	664	8	+	0	50	745
1992	9	211	0	4	0	35	259

Table 7.3.7 Nominal catch of REDFISH (in tonnes) by country in Sub-area XII as reported officially to ICES.

Country	1982	1983	1984	1985	1986
Bulgaria	-	-	-	-	-
Estonia	-	-	-	-	-
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	5,696	2,209	-	-	-
Greenland	-	-	-	-	-
Iceland	-	-	-	-	-
Norway	-	-	-	-	-
Poland	-	-	-	-	-
USSR	39,783	60,079	60,643	17,300	24,131
Total	45,479	62,288	60,643	17,300	24,131

Country	1987	1988	1989	1990	1991	1992[1]
Bulgaria	-	-	-	1,617	-	-
Estonia	-	-	-	-	-	1,452
German Dem. Rep.	-	-	352	-	62	-
Germany, Fed. Rep.	-	-	1	7	-	-
Greenland	-	-	-	-	-	9
Iceland	-	-	567	185	95	-
Norway	-	-	-	249	4,122	7,427
Poland	-	-	112	-	-	-
USSR	2,948	9,772	15,543	4,274	6,624	-
Total	2,948	9,772	16,575	6,332	10,903	8,888

[1]Provisional.

Table 7.3.8 Landings of REDFISH (in tonnes) by countries in Sub-area XII as used by the Working Group.

Year	Bulgaria	Estonia	Iceland	France	Norway	Greenland	GDR	FRG	Poland	Russia	USSR	Total
1978												0
1979												0
1980												0
1981												0
1982											39,783	39,783
1983											60,079	60,079
1984											60,643	60,643
1985											17,300	17,300
1986											24,131	24,131
1987											2,948	2,948
1988											9,772	9,772
1989			658[1]				352	1	112		15,543	16,666
1990	1,617		215[1]		926[2]		0	7	0		4,274	7,039
1991	-		110[1]		473[2]		0	0	0		6,624	7,207
1992	-	1,452	46	2	196	9		0	0	8,555		10,260

[1]Raised by 16% to account for discarding.
[2]Raised by 5% to account for discarding.

Table 7.3.9 Nominal catch of REDFISH (in tonnes) by countries in Sub-area XIV (East Greenland) as reported officially to ICES.

Country	1982	1983	1984	1985	1986
Bulgaria	-	-	2,961	5,825	11,385
Denmark	11	-	-	-	-
Faroe Islands	-	27	-	-	5
German Dem. Rep.	-	155	989	5,438	8,574
Germany, Fed. Rep.	37,119	28,878	14,141	5,974	5,584
Greenland	+	1	10	5,519[2]	9,542[2]
Iceland	17	-	-	+	-
Norway	-	-	17	-	-
Poland	581	-	239	135	149
UK (Engl. & Wales)	-	-	-	-	-
UK (Scotland)	-	-	-	-	-
USSR	20,217	-	-	42,973	60,863
Total	57,945	29,061	18,357	65,864	96,102

Country	1987	1988	1989	1990	1991	1992[1]
Bulgaria	12,270	8,455	4,546	1,073	-	-
Denmark	-	-	-	-	-	-
Faroe Islands	382	1,634	226	-	115	-
German Dem. Rep.	7,023	16,848	6,444	7,950	-	-
Germany, Fed. Rep.	4,691	5,734	2,372	3,268	9,122	8,400
Greenland	670	42	3	24	42	962
Iceland	-	-	814	3,726	7,477	13,845
Norway	-	-	-	6,070	1[1]	2,839
Poland	25	-	-	-	-	-
UK (Engl. & Wales)	-	-	5	39	219	177
UK (Scotland)				3	+	28
USSR	68,521	55,254	7,177	3,040	2,665	-
Total	93,582	87,967	21,587	25,193	19,641	26,251

[1]Provisional.
[2]Fished mainly by the Japanese fleet.

Table 7.3.10 Landings of REDFISH (in tonnes) by country in Sub-area XIV, as used by the Working Group.

Year	Bulgaria	Greenland	Faroes	France	GDR	FRG	Iceland	Japan	Norway	Poland	Russia	UK	USSR	Total
1978	0	3	0	0	0	20,711	151	0	2	0	0	13	0	20,880
1979	0	0	0	490	0	20,428	0	0	0	0	0	0	0	20,918
1980	0	0	0	0	0	32,520	89	0	0	0	0	0	0	32,609
1981	0	1	18	0	0	42,980	0	0	0	0	0	0	0	42,999
1982	0	0	0	0	0	42,815	17	0	0	581	0	0	20,217	63,630
1983	0	1	27	0	155	30,815	0	0	0	0	0	0	0	30,998
1984	2,961	10	0	0	989	14,141	0	0	15	239	0	0	0	18,355
1985	5,825	5,519	0	0	5,438	5,974	0	0	0	135	0	0	42,973	65,864
1986	11,385	9,542	5	0	8,574	5,584	0	0	0	149	0	0	60,683	96,102
1987	12,270	2,912	382	0	7,023	4,691	0	0	0	25	0	0	68,521	95,824
1988	8,455	3,751	1,634	0	16,848	5,734	0	0	0	0	0	0	55,254	91,676
1989	4,546	285	226	0	6,444	2,372	3158[1]	307	0	0	0	5	7,177	24,520
1990	1,073	24	0	0	7,950	3,268	4,322[1]	3,450	6,159[2]	0	0	42	4,973	31,261
1991	-	42	115	0	0	9,122	8,781[1]	1,224	3,856[2]	0	0	219	2,665	26,024
1992	-	3,769	0	0	0	8,400	15,137[1]	-	15,380[2]	0	4,278	231	-	48,762

[1]Raised by 16% to account for discarding.
[2]Raised by 5% for discarding.

Table 7.3.11 *S.marinus* landings by area as used by the Working Group.

Year	Va	Vb	VI	XII	XIV	Total
1978	31,300	2,039	313	0	15,477	49,129
1979	56,616	4,805	6	0	15,787	77,213
1980	62,052	4,920	2	0	22,203	89,177
1981	75,828	2,538	3	0	23,608	101,977
1982	97,899	1,810	28	0	30,692	130,429
1983	87,412	3,394	60	0	15,636	106,502
1984	84,766	6,228	86	0	5,040	96,120
1985	67,312	9,194	245	0	2,117	78,868
1986	67,772	6,300	288	0	2,988	77,348
1987	69,212	6,143	576	0	1,196	77,127
1988	80,472	5,020	533	0	3,964	89,989
1989	59,961	4,140	530	0	685	65,316
1990	67,953	2,428	540	0	727	71,648
1991[1]	565	2,132	548	0	3,910	7,155

[1]Excluding landings from Iceland for area V.

Table 7.3.12 *S. mentella* landings by area as used by the Working Group.

Year	Va	Vb	VI	XII	XIV	Total
1978	3,902	7,767	18	0	5,403	17,090
1979	7,694	7,869	819	0	5,131	21,513
1980	10,197	5,119	1,109	0	10,406	26,831
1981	19,689	4,607	1,008	0	19,391	44,695
1982	18,492	7,631	626	0	12,140	38,889
1983	37,115	5,990	395	0	15,207	58,707
1984	24,493	7,704	609	0	9,126	41,932
1985	24,768	10,560	248	0	9,376	44,952
1986	18,898	15,176	242	0	12,138	46,454
1987	19,293	11,395	478	0	6,407	37,573
1988	14,290	10,488	590	0	6,065	31,433
1989	32,112	10,860	542	0	2,284	46,798
1990	23,631	9,810	506	0	6,090	40,037
1991[1]	0	13,059	506	0	6,526	20,091

[1]Excluding landings from Iceland for area V.

Table 7.3.13 *S.mentella,* oceanic type. Landings (in tonnes) by area as used by the Working Group.

Year	Va	Vb	VI	XII	XIV	Total
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	0	0	0	0	0	0
1981	0	0	0	0	0	0
1982	0	0	0	39,783	20,798	60,581
1983	0	0	0	60,079	155	60,234
1984	0	0	0	60,643	4,189	64,832
1095	0	0	0	17,300	54,371	71,671
1986	0	0	0	24,131	80,976	105,107
1987	0	0	0	2,948	88,221	91,169
1988	0	0	0	9,772	81,647	91,419
1989	0	0	0	16,892	21,325	38,217
1990	0	0	0	7,039	24,477	31,516
1991	0	0	0	7,207	15,597	22,804
1992	877	0	0	10,258	45,412	56,547

Table 7.3.14 *S. mentella*, oceanic type. Landings (in tonnes) by countries as used by the Working Group.

Year	Bulgaria	Estonia	German Dem.Rep.	Germany, Fed.Rep.	Green-land	Faroes	Iceland	Norway	Poland	Russia	USSR	Total
1980	0	0	0	0	0	0	0	0	0	0	-	-
1981	0	0	0	0	0	0	0	0	0	0	-	-
1982	0	0	0	0	0	0	0	0	581	0	60,000	60,581
1983	0	0	155	0	0	0	0	0	0	0	60,079	60,234
1984	2,961	0	989	0	0	0	0	0	239	0	60,643	64,832
1985	5,825	0	5,438	0	0	0	0	0	135	0	60,273	71,671
1986	11,385	0	8,574	0	0	5	0	0	149	0	84,994	105,107
1987	12,270	0	7,023	0	0	382	0	0	25	0	71,469	91,169
1988	8,455	0	16,848	0	0	1,090	0	0	0	0	65,026	91,419
1989	4,546	0	6,796	1	0	226	3,816	0	112	0	22,720	38,217
1990	2,690	0	7,950	7	0	0	4,537	7,085	0	0	9,247	31,516
1991	-	0		180	0	115	8,891	4,328	0	0	9,289	22,803
1992[1]	-	1,452		6,251	606	3,769	16,060	15,576	0	12,833		56,547

[1]Provisional.

Table 7.4.1 Number of 0-group REDFISH millions $(\text{nautical mile})^2$ from the Icelandic 0-group survey.

Year	Number
1970	8.6
1971	12.6
1972	31.1
1973	74.0
1974	23.6
1975	12.6
1976	5.8
1977	13.0
1978	6.5
1979	1.3
1980	3.0
1981	9.0
1982	2.7
1983	0.7
1984	4.3[1]
1985	22.6[1]
1986	12.1[1]
1987	22.9[1]
1988	17.0[1]
1989	14.3[1]
1990	23.5[1]
1991	26.4[1]
1992	11.6

[1]Reduced area.

Table 7.5.1 Catch per unit effort for oceanic *S. mentella* in Sub-areas XII and XIV.

Year	CPUE (t/h)				
	Bulgaria	GDR (FVSIV)	Iceland	Norway	USSR-Russia (BMRT)
1982	-	-	-	-	1.99
1983	-	-	-	-	1.60
1984	1.25	-	-	-	1.48
1985	1.85	-	-	-	1.68
1986	2.04	-	-	-	1.35
1987	1.22	0.79	-	-	1.10
1988	1.22	1.28	-	-	1.00
1989	0.82	0.70	1.03	-	1.00
1990	-	0.89	1.12	1.09	0.99
1991	-	-	1.49	1.35	0.80
1992	-	-	-	1.73	0.63

Table 7.5.2 Abundance and biomass of oceanic *S. mentella* as estimated from Russian trawl-acoustic surveys in May-July 1982-19921.

Year	Area surveyed ('000 sq miles)			Abundance (millions)			Biomass ('000 t)		
	Irminger Sea	E.Greenland zone	Total	Irminger Sea	E.Greenland zone	Total	Irminger Sea	E.Greenland zone	Total
1982	40.0	-	40.0	790.0	-	790.0	560.0	-	560.0
1983	50.0	-	50.0	960.0	-	960.0	700.0	-	700.0
1984	55.0	-	55.0	660.0	-	660.0	526.0	-	526.0
1985	71.0	-	71.0	1,122.0	-	1,122.0	700.0	-	700.0
1986	43.0	74.0	117.0	923.0	989.0	1,912.0	570.0	610.0	1,180.0
1987	156.0	59.0	215.0	1,221.0	682.0	1,903.0	783.0	437.0	1,220.0
1988	91.0	72.0	163.0	714.0	796.0	1,510.0	452.0	504.0	956.0
1989	78.5	69.6	148.1	1,040.0	570.0	1,610.0	582.0	335.8	917.8
1990	73.2	-	73.2	1,495.0	-	1,495.0	847.5	-	847.5
1991	59.9	44.6	104.5	274.0	387.0	661.0	169.0	226.8	395.8
1992	150.0	40.0	190.0	1,600.0	950.0	2,550.0	1,000.0	600.0	1,600.0

Table 7.5.3 Oceanic *S. mentella* length composition in 1992. (Open part and East-Greenland zone together.

Length cm	Frequences %			No. ex.
	Males	Females	Total	
24	0.0	0.1	0.1	4
25	0.1	0.1	0.1	6
26	0.4	0.2	0.2	14
27	0.1	0.1	0.1	4
28	0.3	0.2	0.2	14
29	0.4	0.2	0.2	17
30	0.2	0.4	0.4	30
31	1.1	1.6	1.6	124
32	2.9	5.5	5.5	426
33	7.4	12.4	12.4	969
34	9.8	14.0	14.0	1,093
35	18.6	17.8	17.8	1,393
36	15.7	14.1	14.1	1,107
37	14.8	13.2	13.2	1,026
38	12.4	10.3	10.3	804
39	8.7	6.3	6.3	491
40	5.1	2.7	2.7	207
41	1.5	0.7	0.7	54
42	0.2	0.1	0.1	8
43	0.0	0.0	0.0	2
44	0.1	0.0	0.0	3
45	-	0.0	0.0	1
46	-	-	-	-
47	0.0	0.0	0.0	1
Average, cm.	35.0	36.1	35.5	

Table 7.5.4 Age composition of oceanic *S. mentella* in 1992 (Irminger Sea and East-Greenland zone).

Age, Years	Males		Females		Total	
	N	%%	N	%%	N	%%
5	-	-	5	0.1	5	0.1
6	1	0.0	7	0.2	8	0.1
7	4	0.1	9	0.3	13	0.2
8	4	0.1	15	0.4	19	0.2
9	9	0.2	10	0.3	19	0.2
10	80	1.8	28	0.8	108	1.4
11	232	5.2	63	1.9	295	3.8
12	623	14.0	209	6.2	832	10.7
13	1,196	27.0	480	14.3	1,676	21.5
14	938	21.1	944	28.2	1,882	24.1
15	1,097	24.8	992	29.6	2,089	26.8
16	193	4.3	358	10.6	551	7.1
17	57	1.3	226	6.7	283	3.6
18	3	0.1	10	0.3	13	0.2
19	-	-	3	0.1	3	0.0
20	1	0.0	-	-	1	0.0
21	-	-	1	0.0	1	0.0
Total	4,438	100.0	3,360	100.0	7,798	100.0
Average age, years	13.7		14.4		13.9	

Table 7.5.5 Some biological data for oceanic *S.mentella* from the Irminger Sea.

Year	Average length (cm)		Average age (years)		Sex ratio (%)	
	Males	Females	Males	Females	Males	Females
1981	33.0	36.6	13.3	14.5	14.6	85.4
1982	34.2	36.2	14.1	15.4	25.1	74.9
1983	34.6	36.7	13.9	16.0	24.4	75.6
1984	32.6	35.7	13.2	14.6	33.2	66.8
1985	35.2	36.5	13.4	14.2	26.0	74.0
1986	34.5	36.5	12.9	14.1	24.8	75.2
1987	34.5	36.0	13.6	14.7	29.5	70.5
1988	34.1	35.9	13.4	14.4	35.7	64.3
1989	34.5	36.1	13.2	14.3	41.5	58.5
1990	34.2	36.1	13.2	14.4	47.9	52.1
1991	35.4	36.7	13.9	14.8	49.4	50.6
1992	35.0	36.0	13.7	14.4	56.9	42.1

Table 7.5.6 Length and weight distribution of oceanic *S. mentella* during Icelandic acoustic survey in 1992.

cm	Males		Females		Combined	
	Number	Average weight	Number	Average weight	Number	Average weight
23	1	155.0	0		1	155.0
24	0		1	185.0	1	185.0
25	1	185.0	1	205.0	2	195.0
26	0		1	220.0	1	220.0
27	0		1	235.0	1	235.0
28	1	270.0	0		1	270.0
29	0		1	335.0	1	335.0
30	3	343.3	1	335.0	4	341.3
31	14	392.1	3	391.7	17	392.1
32	56	421.5	14	413.2	70	419.9
33	114	467.7	39	458.6	153	465.4
34	173	505.1	81	497.9	254	502.8
35	173	554.2	123	539.6	296	548.2
36	143	602.8	176	587.6	319	594.4
37	124	676.0	170	646.7	294	659.1
38	87	740.5	144	709.2	231	721.0
39	60	769.1	103	757.7	163	761.9
40	41	825.9	93	825.9	134	825.9
41	7	892.1	28	887.9	35	888.7
42	2	962.5	20	924.8	22	928.2
43	1	995.0	2	1162.5	3	1106.7
45	0		1	1145.0	1	1145.0
46	0		1	1180.0	1	1180.0
No. total	1001		1004		2005	
Ave. weight		590.3		648.8		619.6
Ave. length	36.2					

Table 7.5.7 Thermo-haline conditions on redfish concentrations areas during TAS 1990-1992.

Sub-area	Year	Month	Temperature °C	Salinity %o
North	1990	July	4.3-6.0	34.91-35.03
	1991	July	4.2-5.7	34.88-35.03
	1992	May	3.7-4.8	34.89-34.96
Central	1990	June	3.8-5.1	34.85-34.95
	1991	June	3.9-5.1	34.88-34.98
	1992	June	3.7-5.3	34.84-34.94
South	1990	June	3.0-5.7	34.68-34.84
	1991	June	3.2-3.9	34.30-34.35
	1992	July	2.9-3.9	34.75-34.80

Table 7.5.8 Some projections of the oceanic *S.mentella* stock using the fixed selection pattern showed in Figure 7.5.12.

Acoustic estimated biomass (mill. t.)	Catch-level (t)	Stock in year 2001/Virgin stock (in percentage) M = 0.03	M = 0.05	M = 0.1
1	50		53	63
	100		35	43
	150		15	24
	200		4	
1.5	50		63	73
	100	42	46	58
	150		29	43
	200		14	
1.9	50		69	
	100		55	
	150		41	
	200		27	
2.5	50		75	82
	100		64	72
	150		53	62
	200		42	

Table 8.1 Roundnose grenadier (*Coryphaenoides repestris*)

Table 8.1a. Official landings of roundnose grenadier (Coryphaenoides rupestris) from Sub-areas I and II

	Germany	Norway	Russia	TOTAL
1988	0		0	0
1989	5		16	21
1990	5		12	17
1991	3	7		10
1992		29		29

Table 8.1b. Official landings of roundnose grenadier (Coryphaenoides rupestris) from Sub-areas III and IV

	Denma	Norway	Sweden	Others	TOTAL
1988	612		5		617
1989	884		1	1	886
1990	785		2	2	789
1991	1214	310	10	1	1535
1992		211			211

Table 8.1c. Official landings of roundnose grenadier (Coryphaenoides rupestris) from Division Va

	Faeroes	Iceland	TOTAL
1988		2	2
1989	2	2	4
1990		3	3
1991		48	48
1992		210	210

Table 8.1d. Official landings of roundnose grenadier (Coryphaenoides rupestris) from Division Vb

	Faeroes	Germany	Russia	Others	TOTAL
1988		1			1
1989	20	5	52		77
1990	75	4			79
1991	22			2	24
1992	538			1	539

Table 8.1e. Official landings of roundnose grenadier (Coryphaenoides rupestris) from Sub-area VI

	Faeroes	France	Germany	Norway	Others	TOTAL
1988	27	0	4			31
1989	2	2727	3		2	2734
1990	29	7501	2			7532
1991	0	10165	4	0		10169
1992	99	9870		5		9974

Table 8.1f. Official landings of roundnose grenadier (Coryphaenoides rupestris) from Sub-area XII

	Latvia	USSR	TOTAL
1988		10606	10606
1989		9495	9495
1990		2838	2838
1991	4296		4296
1992			

Table 8.1g. Official landings of roundnose grenadier (Coryphaenoides rupestris) from Sub-area XIV

	Germany	Others	TOTAL
1988	45	7	52
1989	42	3	45
1990	45	2	47
1991	26	6	32
1992			

Table 8.1h. Official landings of roundnose grenadier (Coryphaenoides rupestris) from ICES areas, all countries combined

	I+II	III+IV	Va	Vb	VI	XII	XIV	TOTAL
1988	0	617	2	1	31	10606	52	11309
1989	21	886	4	77	2734	9495	45	13262
1990	17	789	3	79	7532	2838	47	11305
1991	10	1535	48	24	10169	4296	32	16114
1992	29	211	210	539	9974			10963

Table 8.2 Orange roughy (*Hoplostethus atlanticus*)

Table 8.2a. Official landings (t) of orange roughy (Hoplostethus atlanticus) from Division Va

	Iceland	TOTAL
1988	0	0
1989	0	0
1990	0	0
1991	65	65
1992	382	382

Table 8.2b. Official landings (t) of orange roughy (Hoplostethus atlanticus) from Division VI and VII

	France	TOTAL
1988	2	2
1989	8	8
1990	19	19
1991	4952	4952
1992	4121	4121

Table 8.2c. Official landings (t) of orange roughy (Hoplostethus atlanticus) from ICES areas, all countries combined

	Va	VI+VII	TOTAL
1988	0	2	2
1989	0	8	8
1990	0	19	19
1991	65	4952	5017
1992	382	4121	4503

Table 8.3 Black scabbard (*Aphanopus carbo*).

Table 8.3a. Official landings (t) of black scabbard (Aphanopus carbo) from Division Vb

	Faeroes	TOTAL
1988	0	0
1989	0	0
1990	12	12
1991	0	0
1992	35	35

Table 8.3b. Official landings (t) of black scabbard (Aphanopus carbo) from Sub-area VI

	Faeroes	France	TOTAL
1988	0	0	0
1989	46	311	357
1990	0	1524	1524
1991	0	2912	2912
1992	3	4942	4945

Table 8.3c. Official landings (t) of black scabbard (Aphanopus carbo) from Sub-areas VIII, IX and X

	Portugal	TOTAL
1988	3380	3380
1989	3496	3496
1990	3309	3309
1991	4162	4162
1992		

Table 8.3d. Official landings (t) of black scabbard (Aphanopus carbo) from ICES areas, all countries combined

	Vb	VI	VIII+IX+X	TOTAL
	0	0	3380	3380
1988	0	357	3496	3853
1989	12	1524	3309	4845
1990	0	2912	4162	7074
1991	35	4945		4980
1992				

Table 8.4 Greater forkbeard (*Phycis blennoides*).

Table 8.4a. Official landings of greater forkbeard (Phycis blennoides) from Sub-areas I and II

	Norway	TOTAL
1988		0
1989		0
1990		0
1991	41	41
1992	34	34

Table 8.4b. Official landings of greater forkbeard (Phycis blennoides) from Sub-areas III and IV

	England	France	Norway	TOTAL
1988	3	12		15
1989				0
1990				0
1991	5		159	164
1992			130	130

Table 8.4c. Official landings of greater forkbeard (Phycis blennoides) from Division Vb

	Norway	Others	TOTAL
1988		2	2
1989			0
1990			0
1991	44		44
1992	33		33

Table 8.4d. Official landings of greater forkbeard (Phycis blennoides) from Sub-area VI

	England	France	Norway	Scotland	Spain	Others	TOTAL
1988	51	195			321	2	569
1989	6						6
1990	1			1			2
1991			119	5			124
1992			199				199

Table 8.4e. Official landings of greater forkbeard (Phycis blennoides) from Sub-area VII

	England	France	Norway	Spain	Others	TOTAL
1988	11	57		164	10	242
1989	7				14	21
1990	5					5
1991	13		7			20
1992			45			45

Table 8.4f. Official landings of greater forkbeard (Phycis blennoides) from Sub-areas VIII and IX

	France	Portugal	Spain	TOTAL
1988	7	1	50	58
1989				0
1990				0
1991		2		2
1992				0

Table 8.4g. Official landings of greater forkbeard (Phycis blennoides) from ICES areas, all countries combined

	I+II	III+IV	Vb	VI	VII	VIII+IX	TOTAL
1988	0	15	2	569	242	58	886
1989	0	0	0	6	21	0	27
1990	0	0	0	2	5	0	7
1991	41	164	44	124	20	2	395
1992	34	130	33	199	45	0	441

Table 8.5 Skates and rays nei.

Table 8.5a. Official landings (t) of skates and rays nei. from Sub-areas I and II

	Faeroes	France	Germany	Norway	Russia	Others	TOTAL
1988	15	27	76	119	3698	10	3945
1989			32	152	2102	3	2289
1990	42		52	217	454	1	766
1991				240			240
1992				158			158

Table 8.5b. Official landings (t) of skates and rays nei. from Sub-areas III and IV

	Belgium	Denmark	England	France	Norway	Scotland	Others	TOTAL
1988	673	75	975	181	395	2514	6	4819
1989	459	61	1104		517	1447	19	3607
1990	530	60	1116		412	1480	19	3617
1991	701	47	1375		308	1428	11	3870
1992					357		1	358

Table 8.5c. Official landings (t) of skates and rays nei. from Division Va

	Belgium	Faeroes	Iceland	TOTAL
1988	20	2	191	213
1989	22	2	252	276
1990	6	16	383	405
1991	9	5	588	602
1992		0	317	317

Table 8.5d. Official landings (t) of skates and rays nei. from Division Vb

	Faeroes	Norway	Others	TOTAL
1988	92	29	14	135
1989	136	84	1	221
1990	102	96	2	200
1991	207	81	2	290
1992	258	37		295

Table 8.5e. Official landings (t) of skates and rays nei. from Sub-area VI

	England	France	Ireland	Norway	Scotland	Spain	Others	TOTAL
1988	74	769	690	276	2209	44	13	4075
1989	126		630	543	2503		14	3816
1990	207			274	1929		9	2419
1991	199			286	1959		27	2471
1992				316				316

Table 8.5f. Official landings (t) of skates and rays nei. from Sub-area VII

	Belgium	England	France	Ireland	Netherl	Norway	Scotland	Spain	Others	TOTAL
1988	875	3477	11540	2558	132		211	90	77	18960
1989	983	2743		2498	137	40	122		159	6682
1990	759	3256			141	39	164		38	4397
1991	519	2518			168	83	106		51	3445
1992						87				87

Table 8.5g. Official landings (t) of skates and rays nei. from Sub-area VIII + IX + X

	Belgium	England	France	Portugal	Spain	TOTAL
1988	2	57	2355	2351	1506	6271
1989	12	223		1917		2152
1990	4			1602		1606
1991	91	7		1427		1525
1992						0

Table 8.5h. Official landings (t) of skates and rays nei. from ICES areas, all countries combined

	I + II	II + IV	Va	Vb	VI	VII	VIII + IX + X	TOTAL
1988	3945	4819	213	135	4075	18960	6271	38418
1989	2289	3607	276	221	3816	6682	2152	19043
1990	766	3617	405	200	2419	4397	1606	13410
1991	240	3870	602	290	2471	3445	1525	12443
1992	158	358	317	295	316	87		1531

Table 8.6 Sharks nei (excluding dogfish)

Table 8.6a. Official landings (t) of sharks nei. (excl. dogfish) from Sub-areas I and II

	Russia	TOTAL
1988	37	37
1989	15	15
1990		
1991		
1992		

Table 8.6b. Official landings (t) of sharks nei. (excl. dogfish) from Sub-areas III and IV

	Belgium	Denmark	England	France	Scotland	Others	TOTAL
1988		9	4	1		2	16
1989	20	6	2		14	2	44
1990	12	7	1		10	2	32
1991	10	8	4		8	2	32
1992							

Table 8.6c. Official landings (t) of sharks nei. (excl. dogfish) from Division Va

	Iceland	TOTAL
1988		0
1989		0
1990	10	10
1991	54	54
1992	181	181

Table 8.6d. Official landings (t) of sharks nei. (excl. dogfish) from Division Vb

	Faeroes	TOTAL
1988		0
1989		0
1990		0
1991	3	3
1992	36	36

Table 8.6e. Official landings (t) of sharks nei. (excl. dogfish) from Sub-area VI

	England	Faeroes	France	Scotland	Spain	TOTAL
1988			21		42	63
1989			21	8		29
1990	1		383	5		389
1991	14		1167	53		1234
1992		3	2727			2730

Table 8.6f. Official landings (t) of sharks nei. (excl. dogfish) from Sub-area VII

	Belgium	England	Netherl	Scotland	Spain	Others	TOTAL
1988		95			60		155
1989		35				5	40
1990	4	36		1			41
1991	5	285	2	53			345
1992							

Table 8.6g. Official landings (t) of sharks nei. (excl. dogfish) from Sub-area VIII+IX+X

	England	France	Portug	Spain	TOTAL
1988		149	543	3545	4237
1989			358		358
1990			734		734
1991	10		642		652
1992					

Table 8.6h. Official landings (t) of sharks nei. (excl. dogfish) from ICES areas, all countries combined

	I+II	II+IV	Va	Vb	VI	VII	VIII+IX+X	TOTAL
1988	37	16			63	155	4237	4508
1989	15	44			29	40	358	486
1990		32	10		389	41	734	1206
1991		32	54	3	1234	345	652	2320
1992			181	36	2730			2947

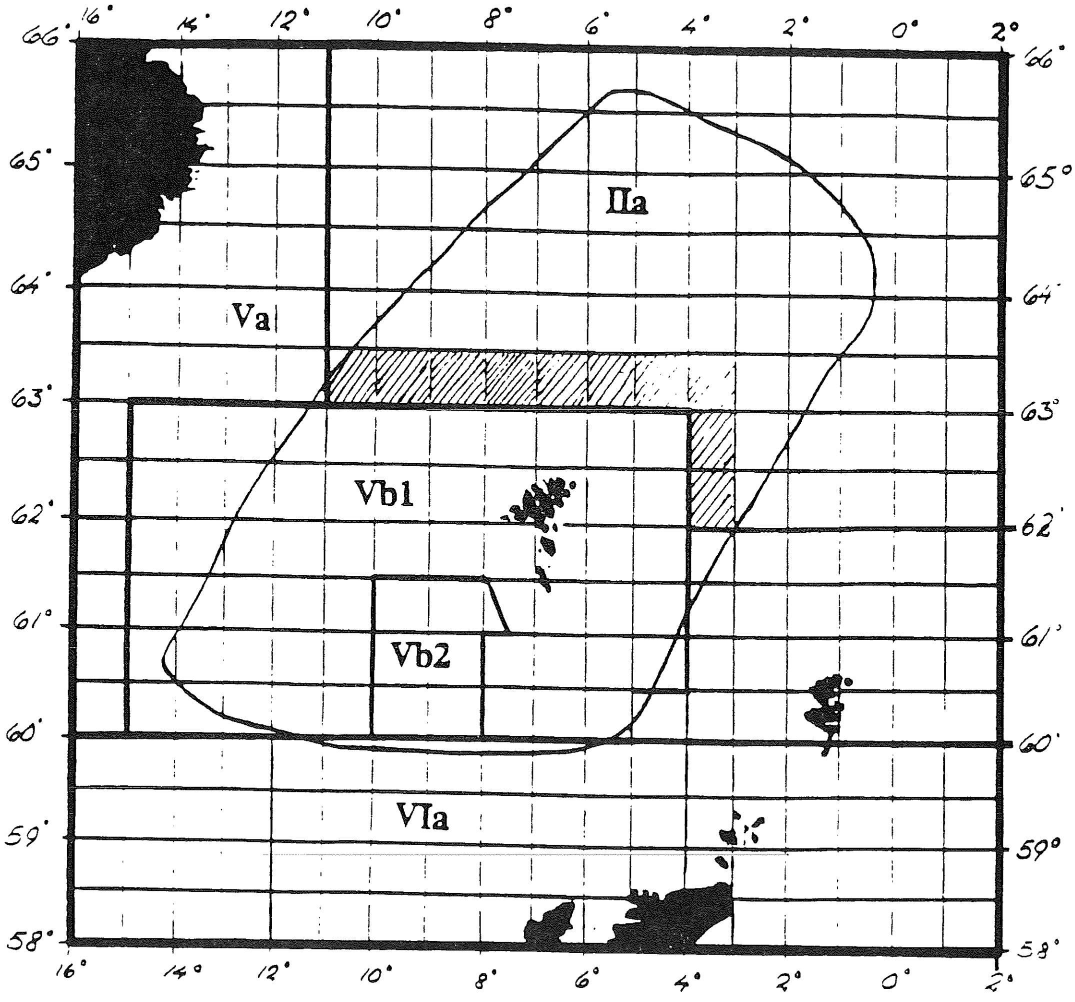


Figure 2.1.1 The Faroe area and adjacent areas divided into ICES divisions. The Faroese 200 miles economic zone is indicated.

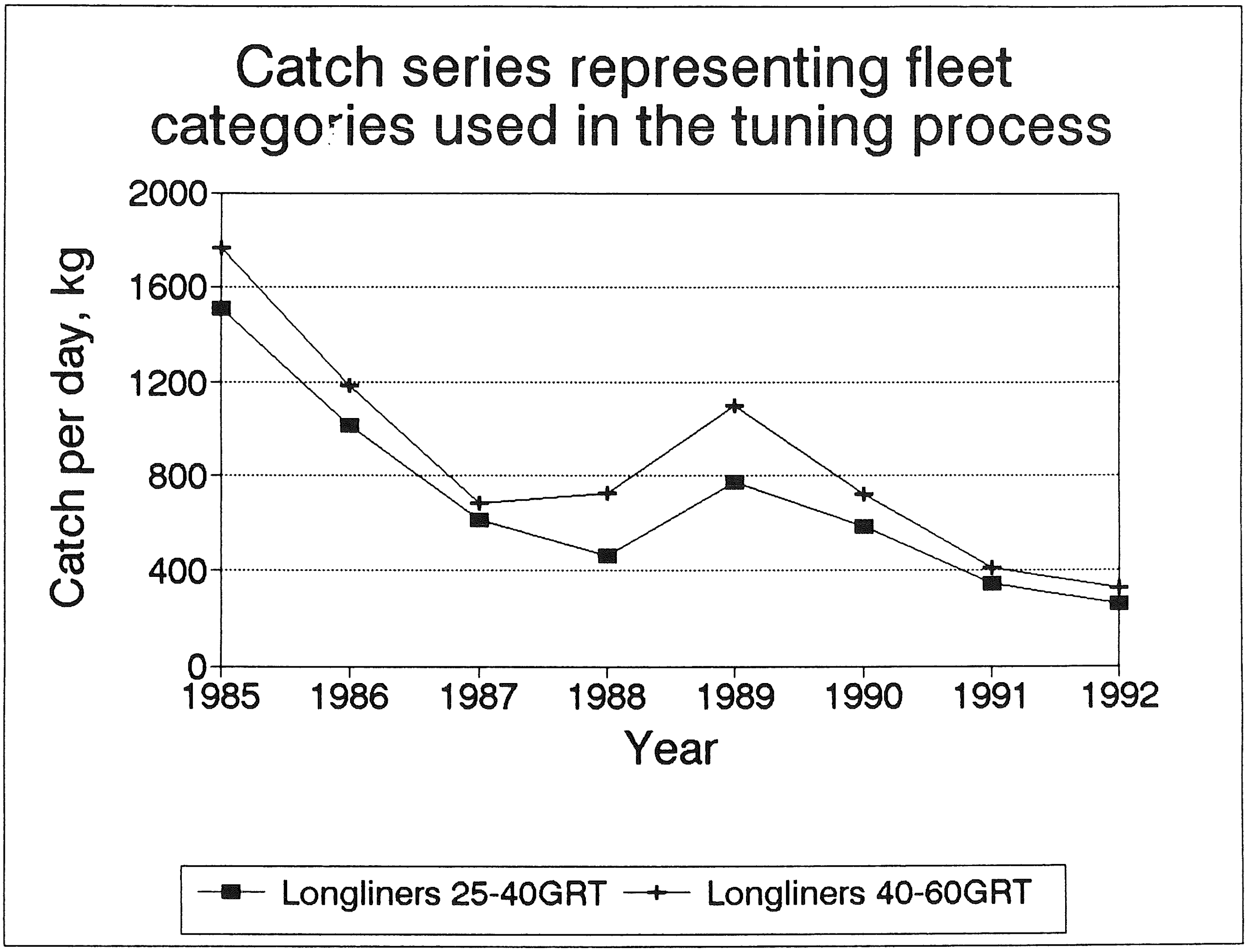

Catch series representing fleet categories used in the tuning process
Catch per day, kg
2000
1600
1200
800
400
0
1985
1986
1987
1988
1989
1990
1991
1992
Year
Longliners 25-40GRT
Longliners 40-60GRT

Figure 2.1.2

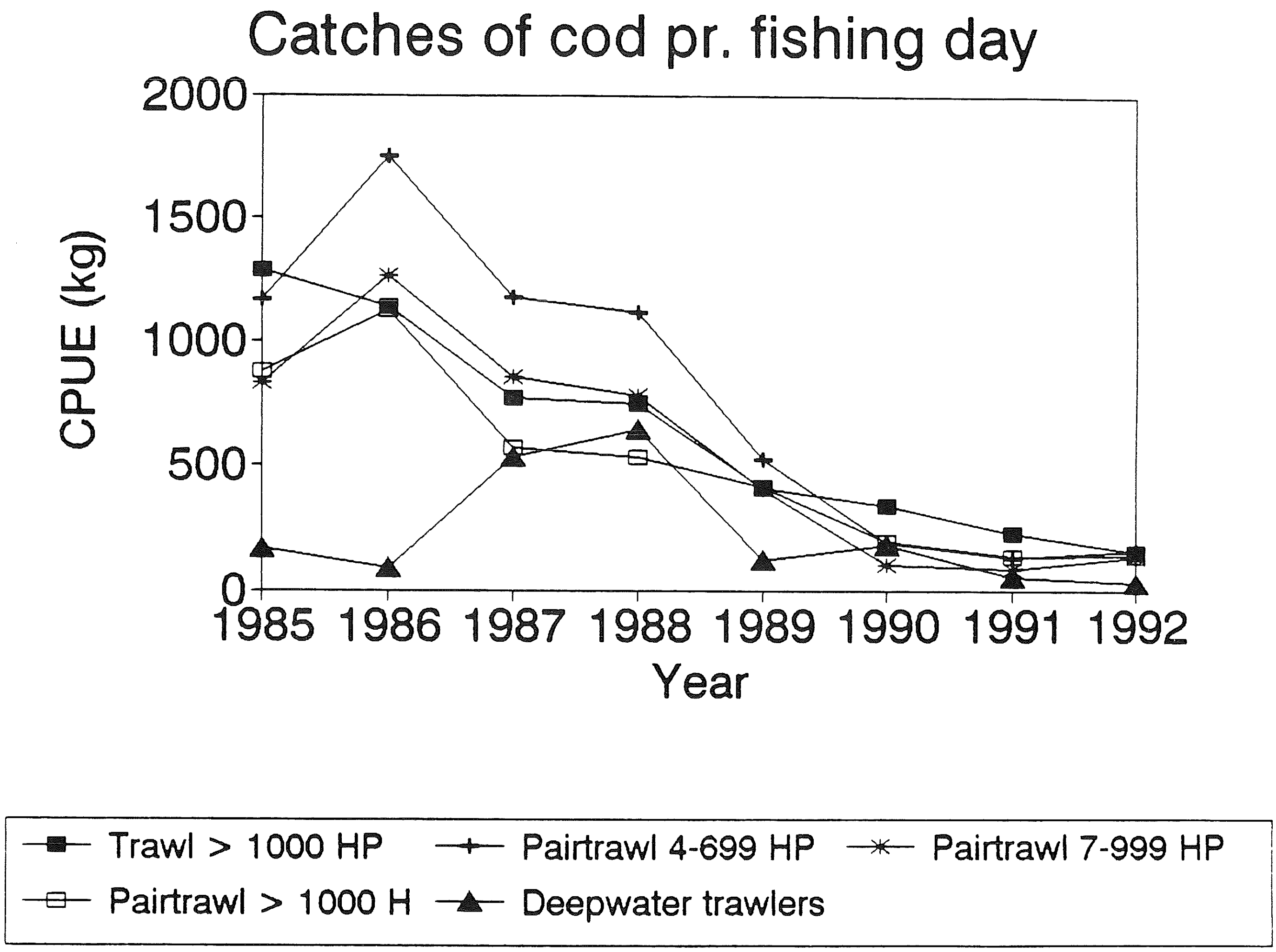

Catches of cod pr. fishing day
2000
1500
1000
500
0
CPUE (kg)
1985 1986 1987 1988 1989 1990 1991 1992
Year
Trawl > 1000 HP
Pairtrawl 4-699 HP
Pairtrawl 7-999 HP
Pairtrawl > 1000 H
Deepwater trawlers

Figure 2.1.3

Figure 2.1.4.A

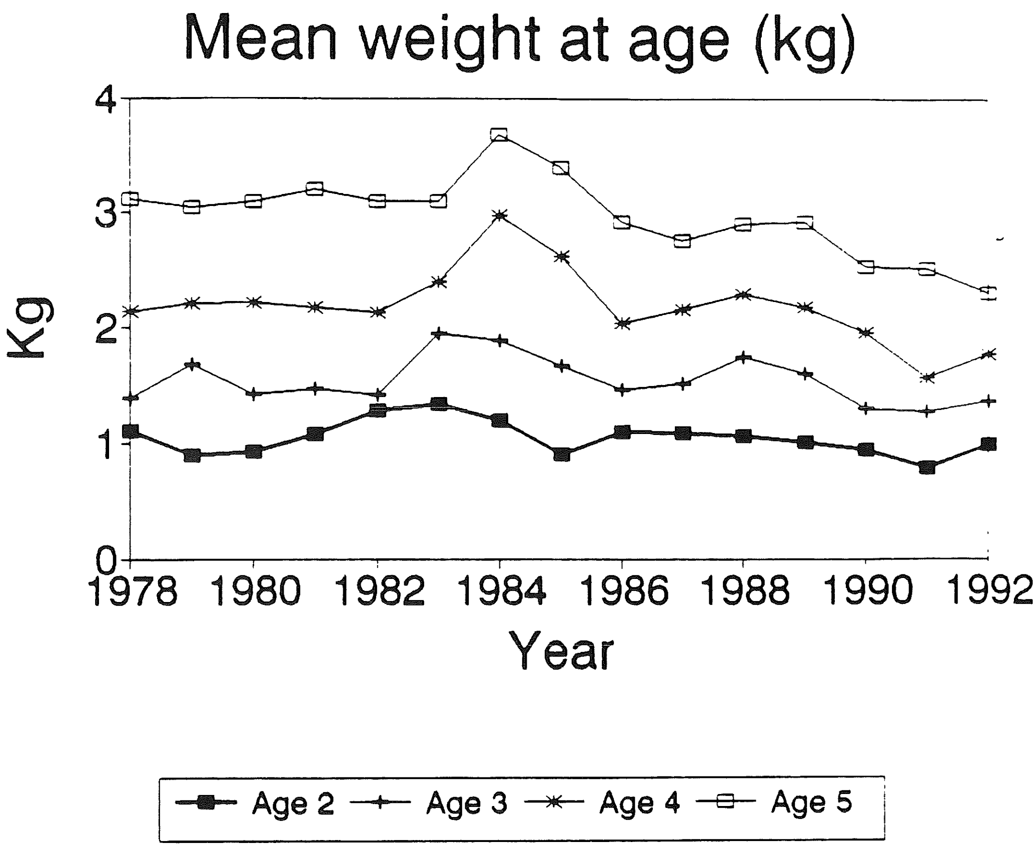
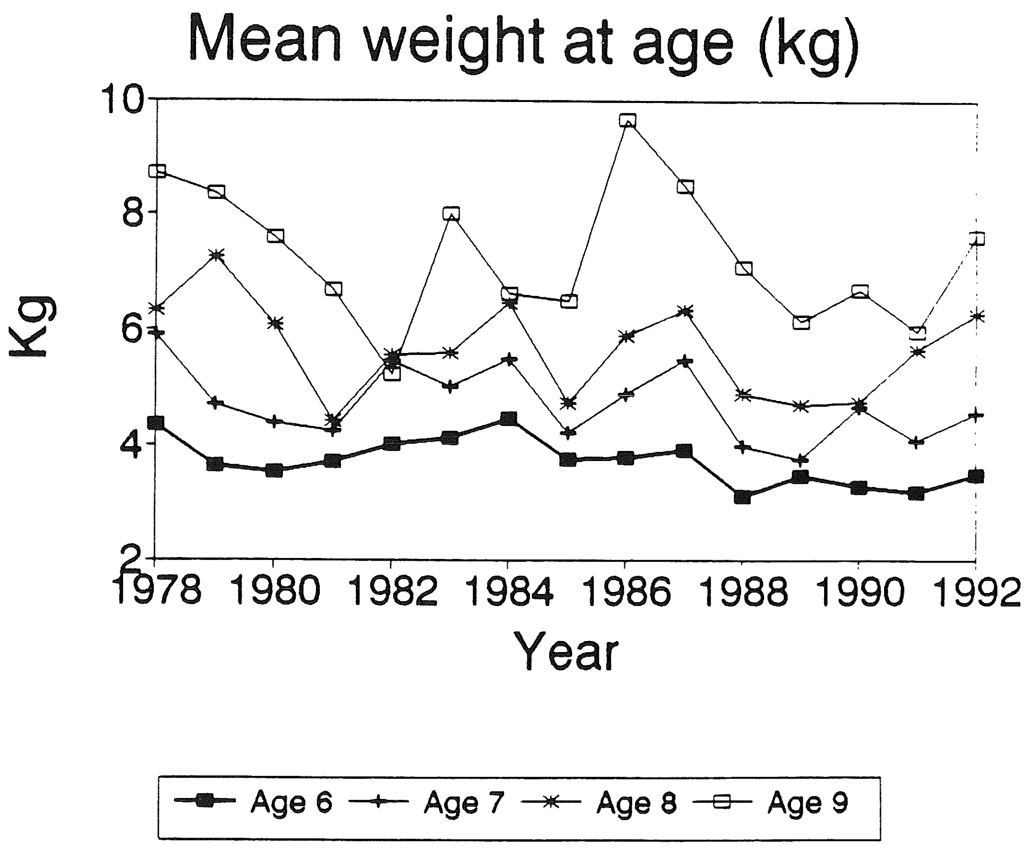


Figure 2.1.4.B



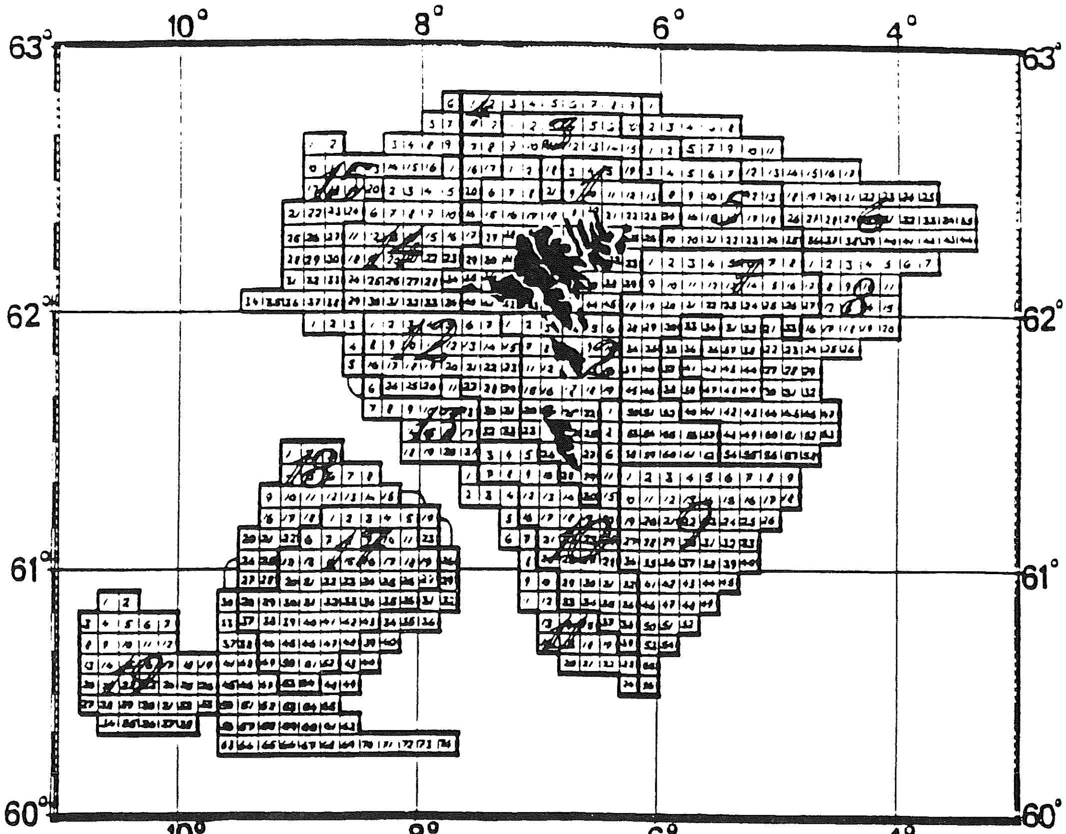


Figure 2.1.5 Stratification of the area around the Faroe Islands used in the groundfish survey.

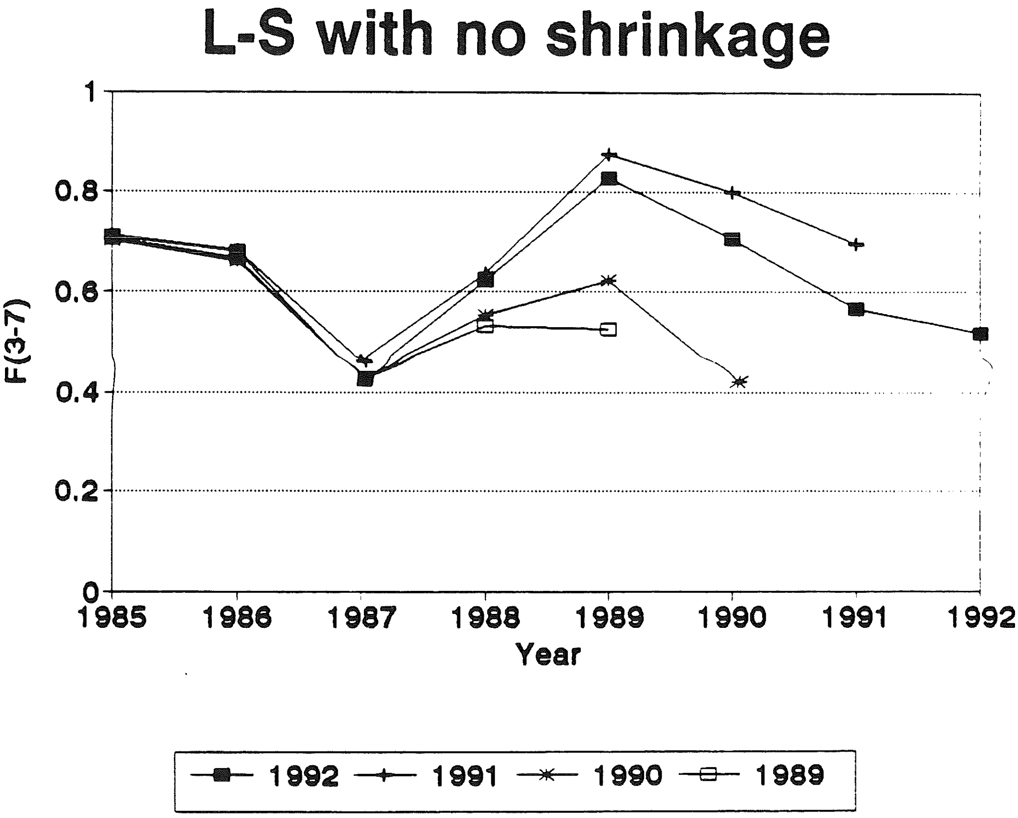


Figure 2.1.6

Figure 2.1.7

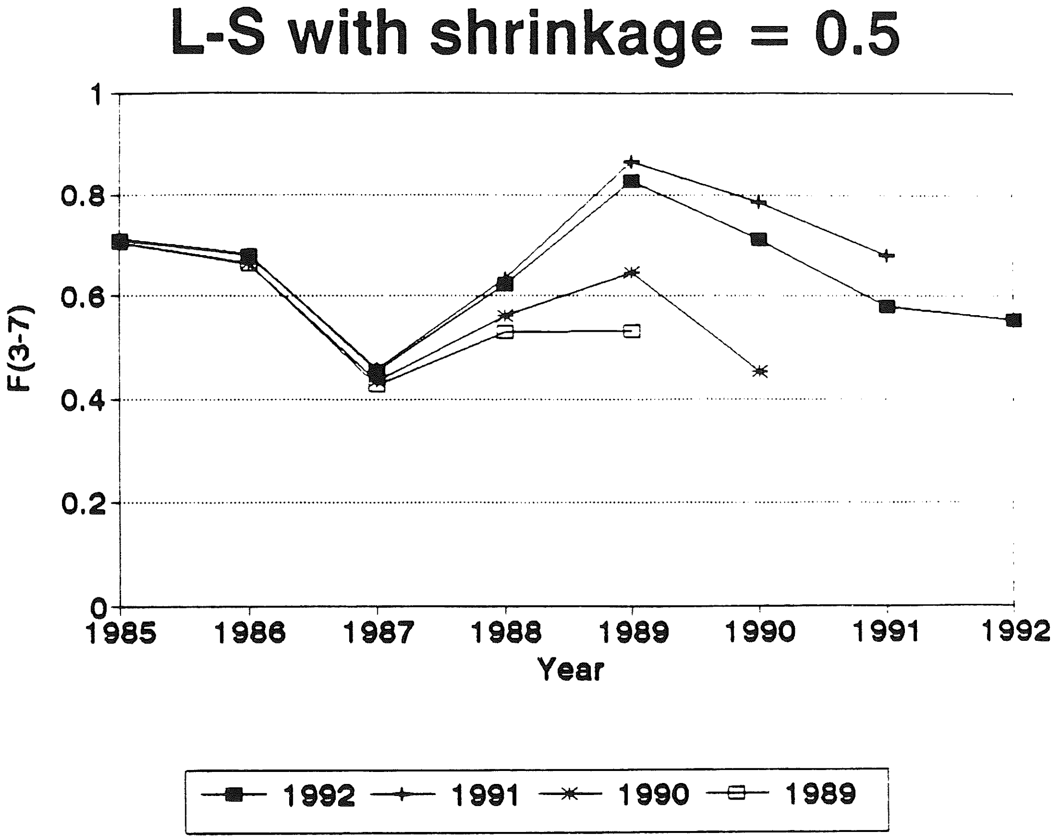


Figure 2.1.8

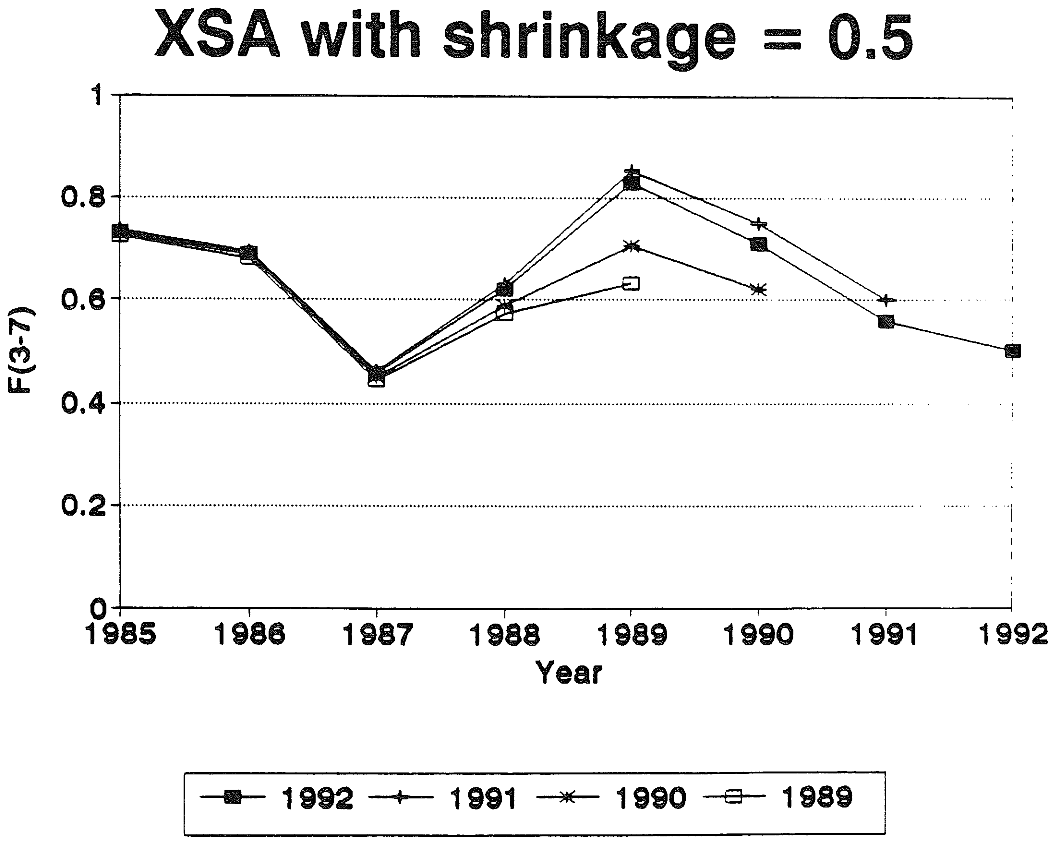
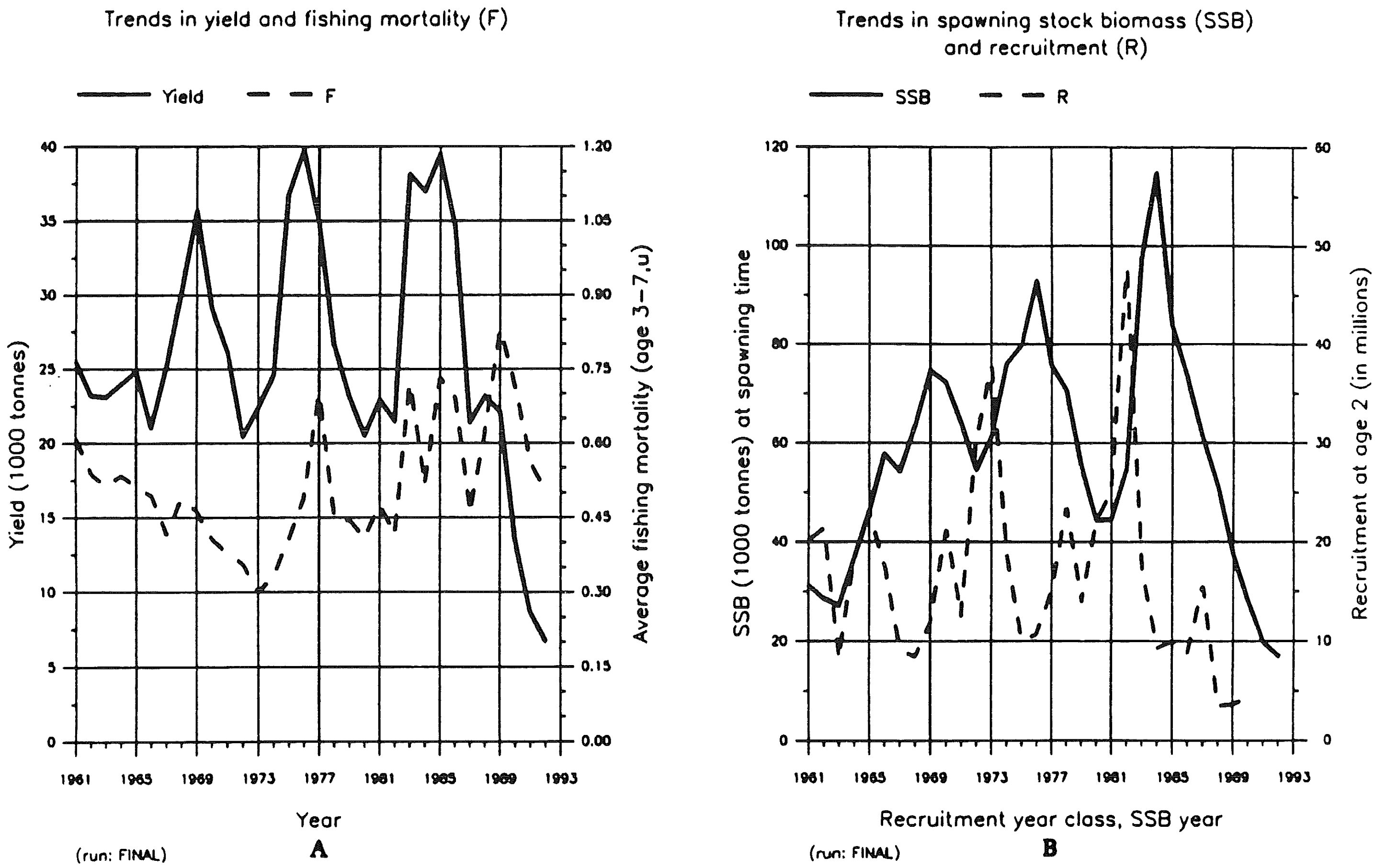
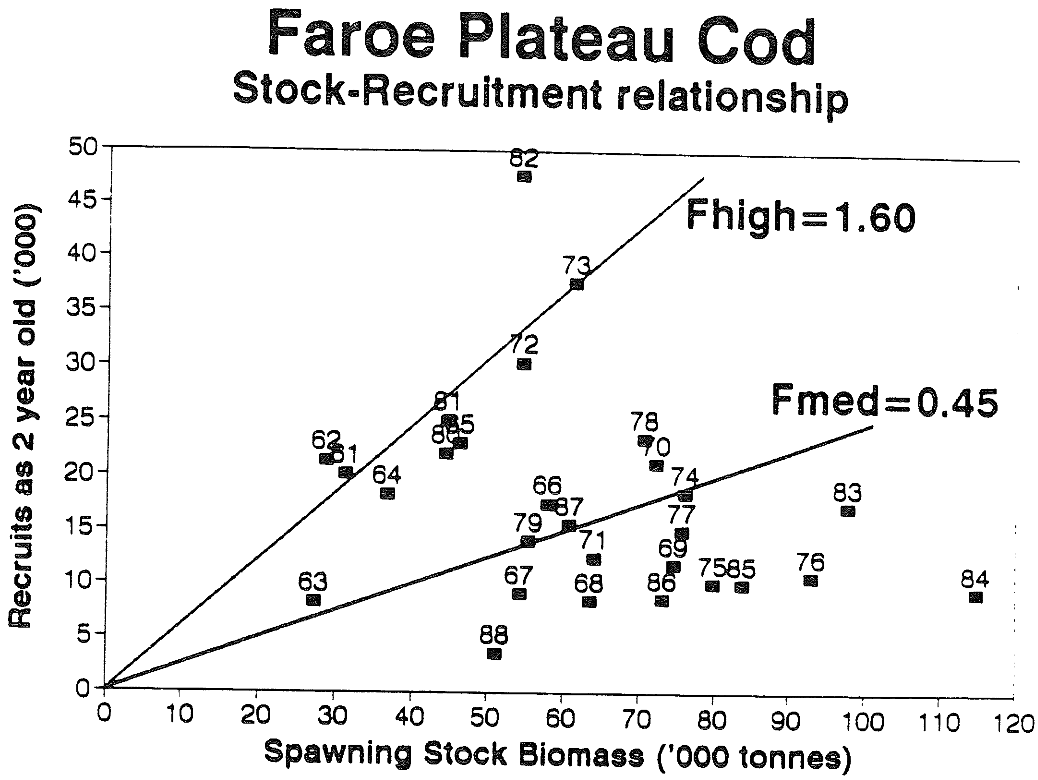


Figure 2.1.9

FISH STOCK SUMMARY
STOCK: Cod in the Faroe Plateau (Fishing Area Vb1)
7-5-1993



<u>Figure 2.1.10</u>



<u>Figure 2.1.11</u> Stratification of the area around the Faroe Islands used in the 0-group surveys.

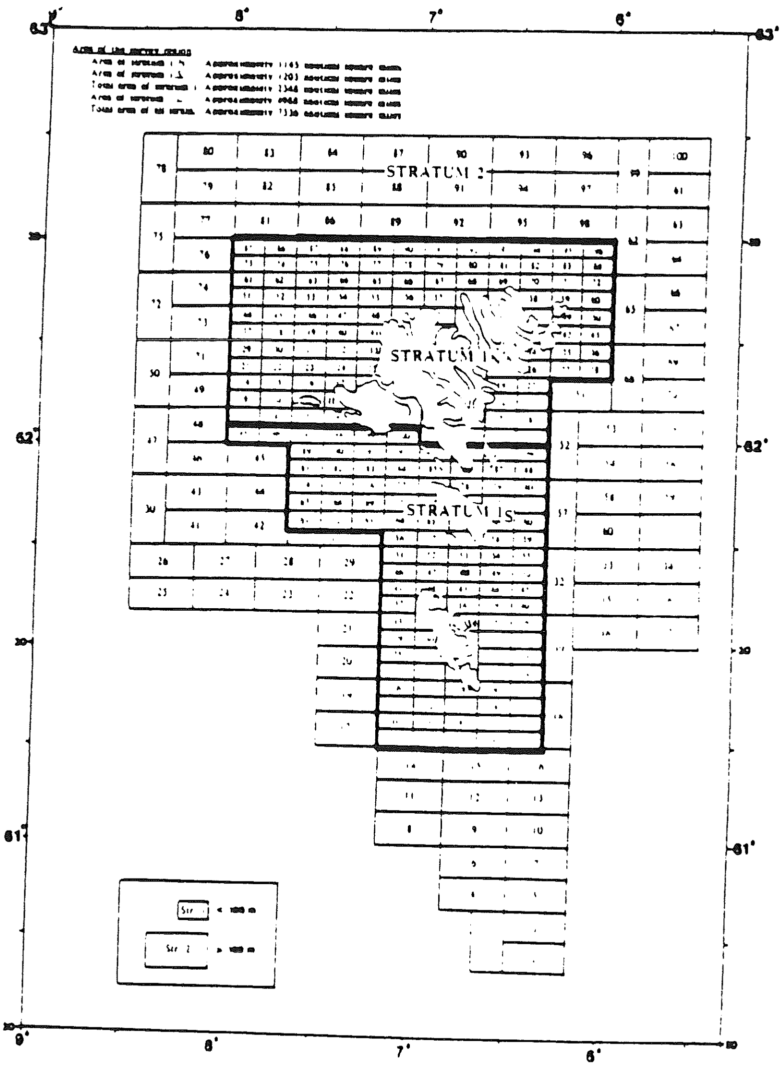
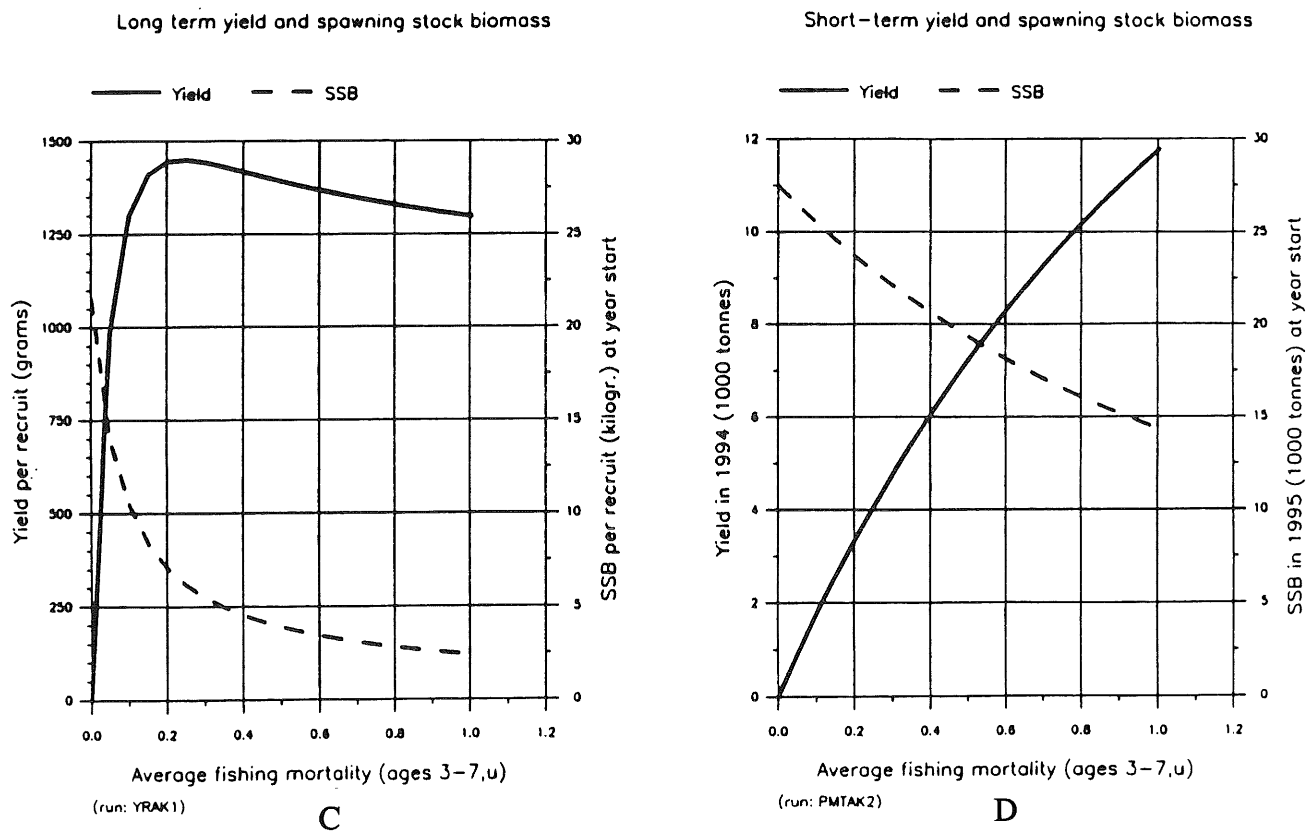


Figure 2.1.12

FISH STOCK SUMMARY
STOCK: Cod in the Faroe Plateau (Fishing Area Vb1)
9-5-1993



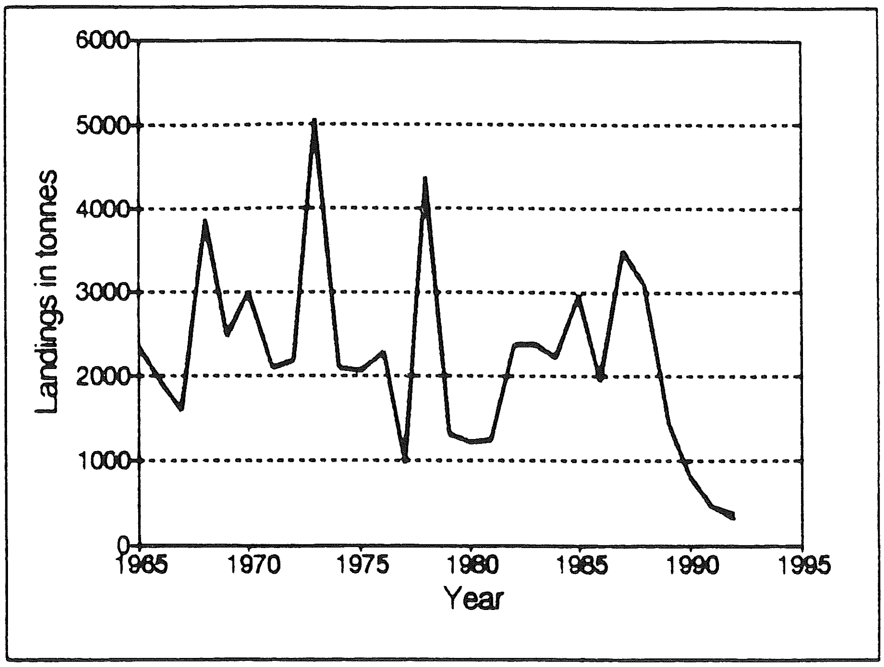


Figure 2.2.1 Total international landings of cod from Faroe Bank (ICES Sub-division Vb2). Bulletin Statistique and preliminary reported statistics).

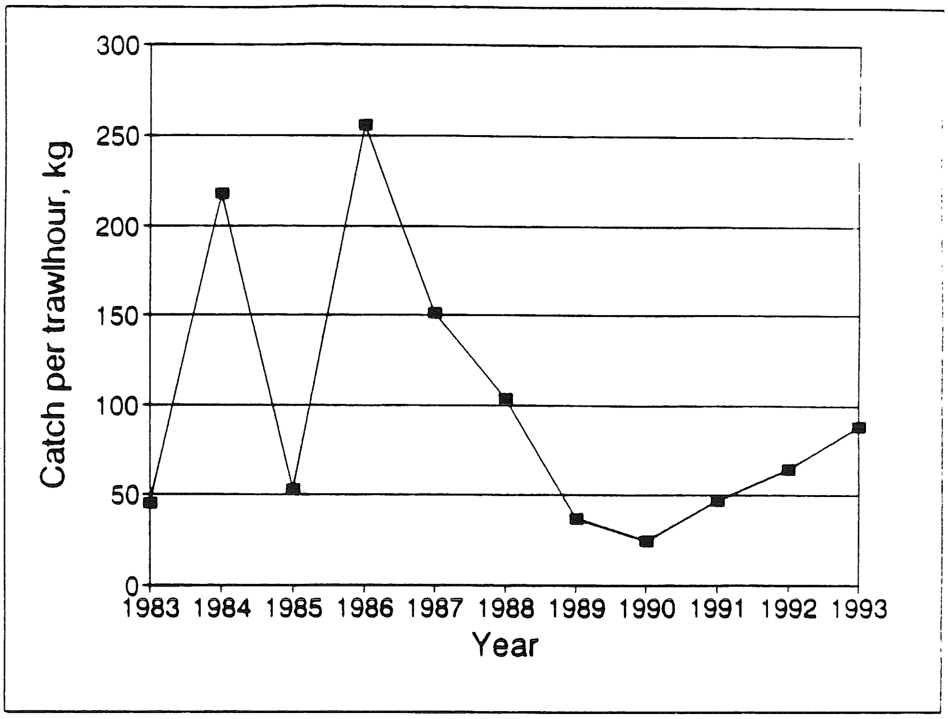


Figure 2.2.2 Cod catches per trawl per hour from from the Faroese groundfish survey.

Figure 2.2.3

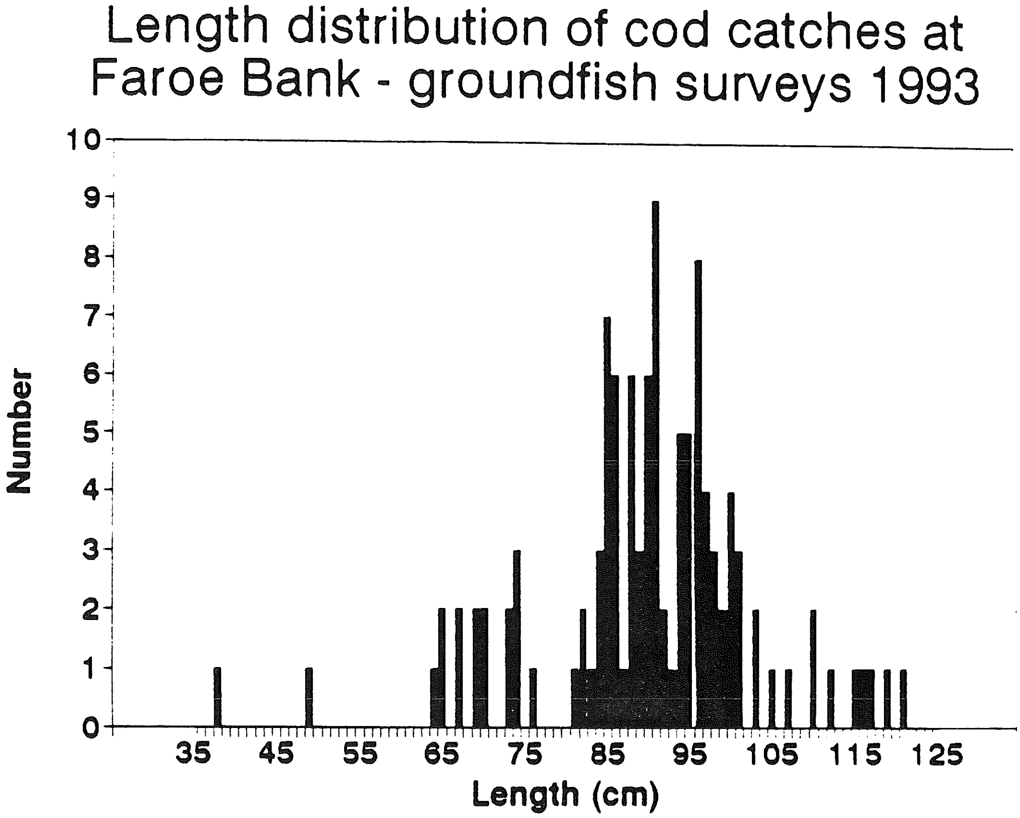


Figure 2.2.4

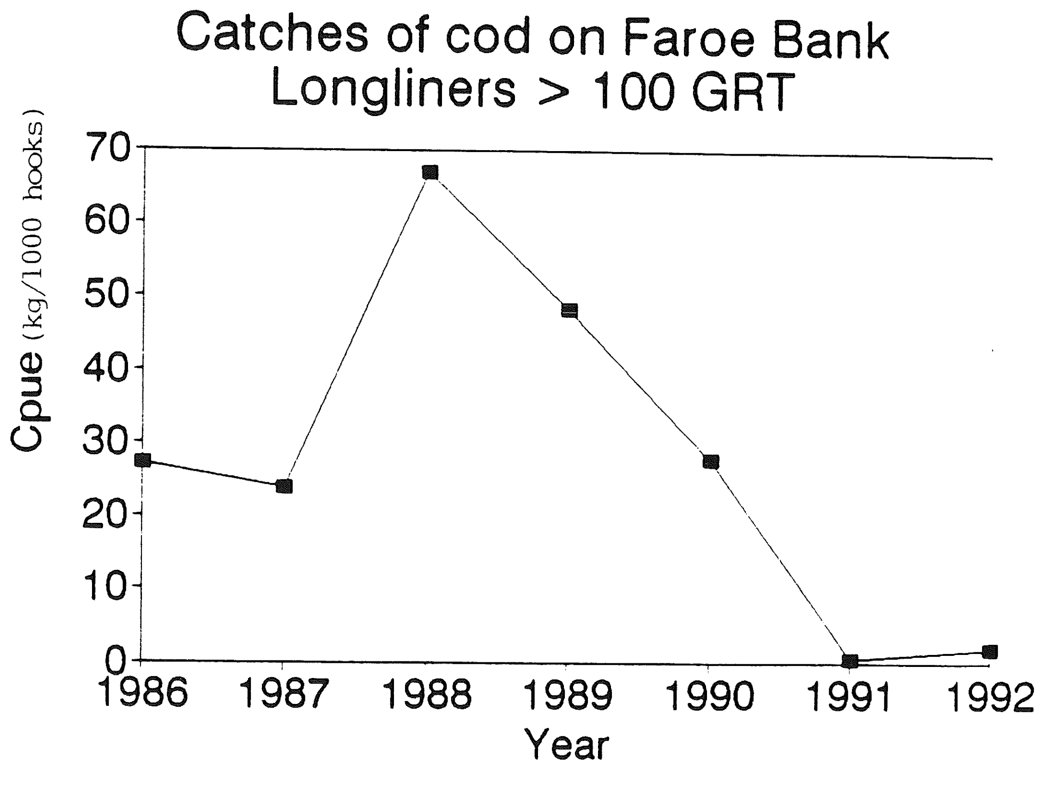


Figure 2.3.1

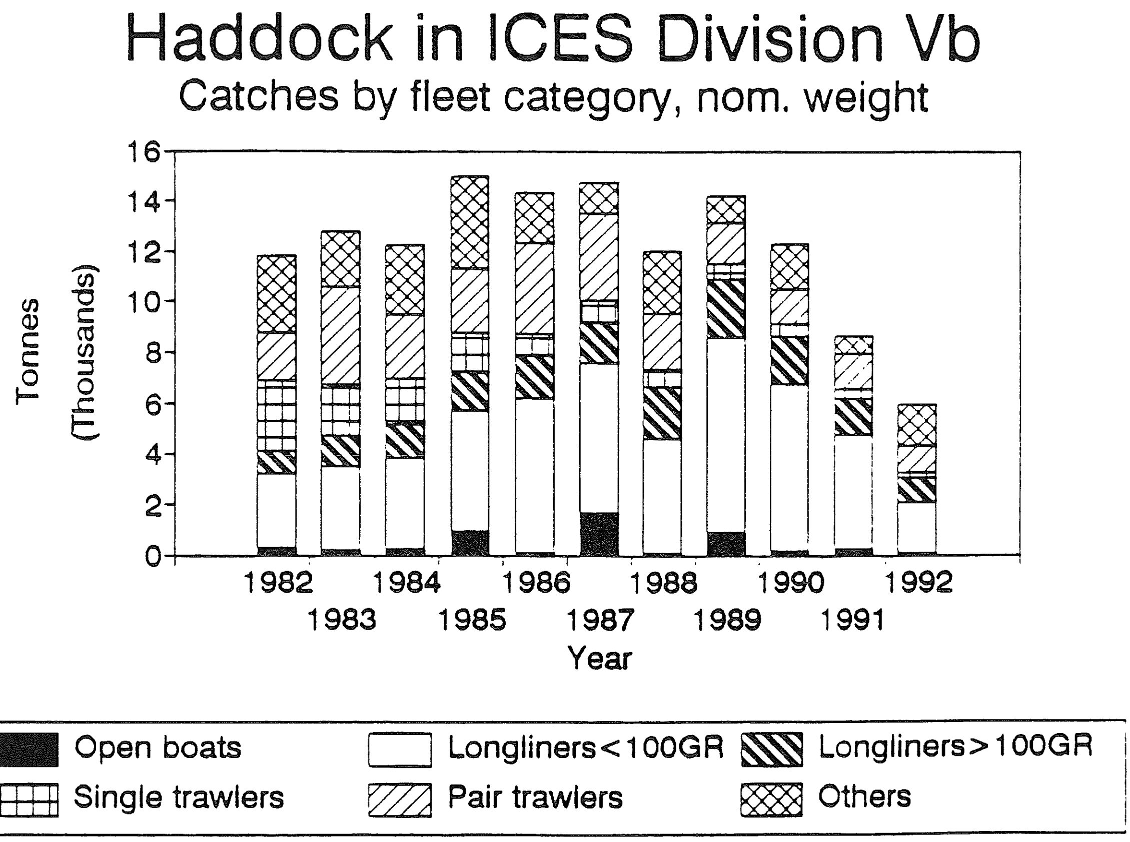


Figure 2.3.2

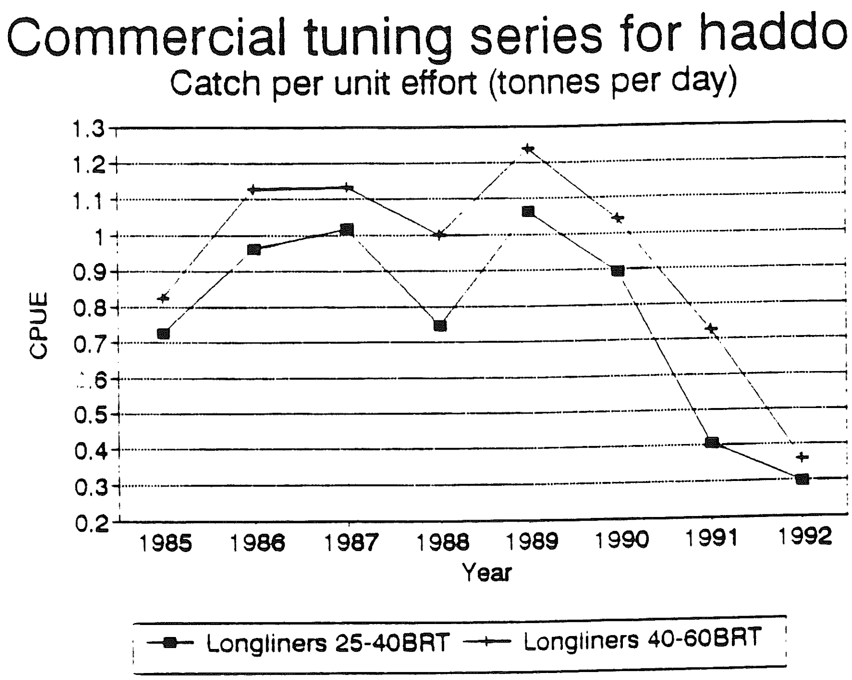


Figure 2.3.3.A

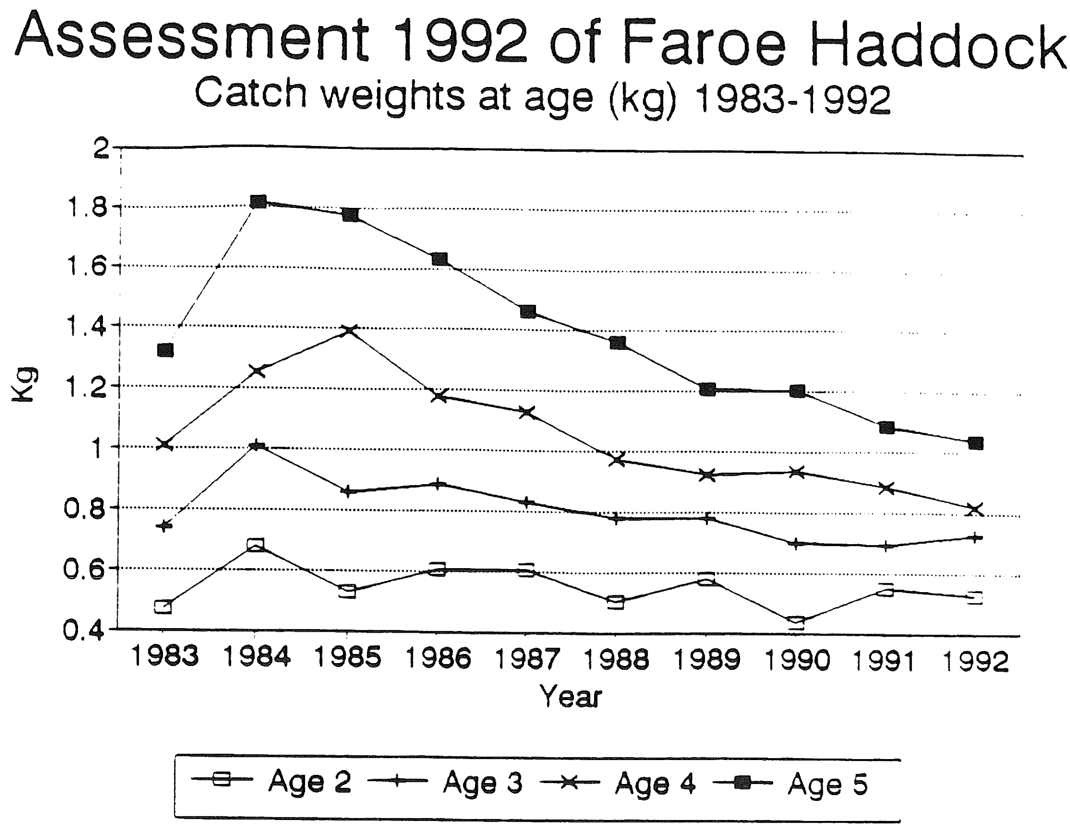
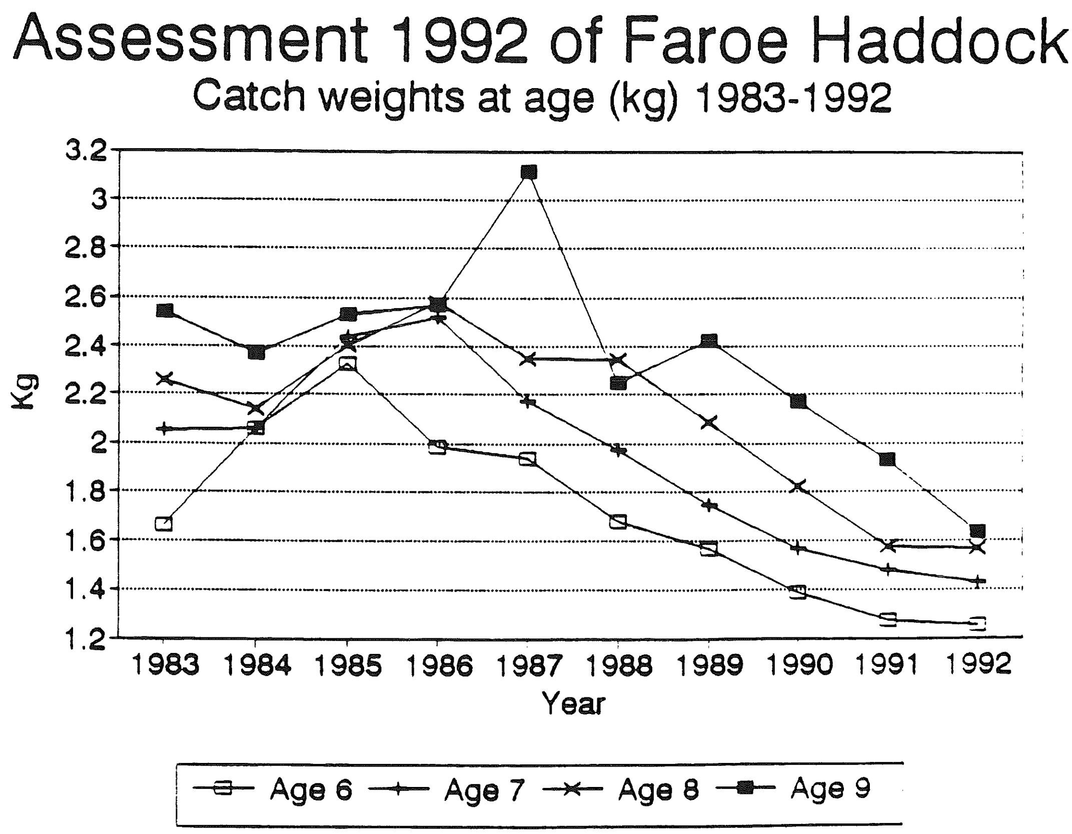


Figure 2.3.3.B



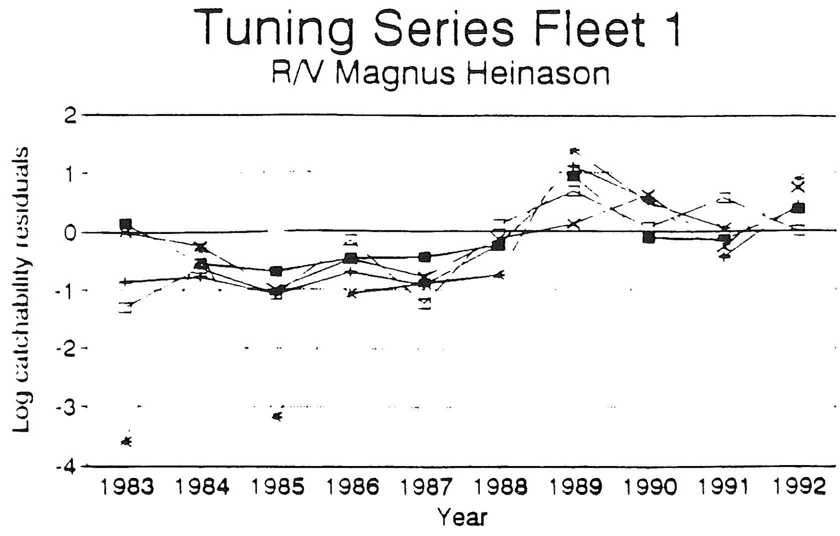


Figure 2.3.4.A

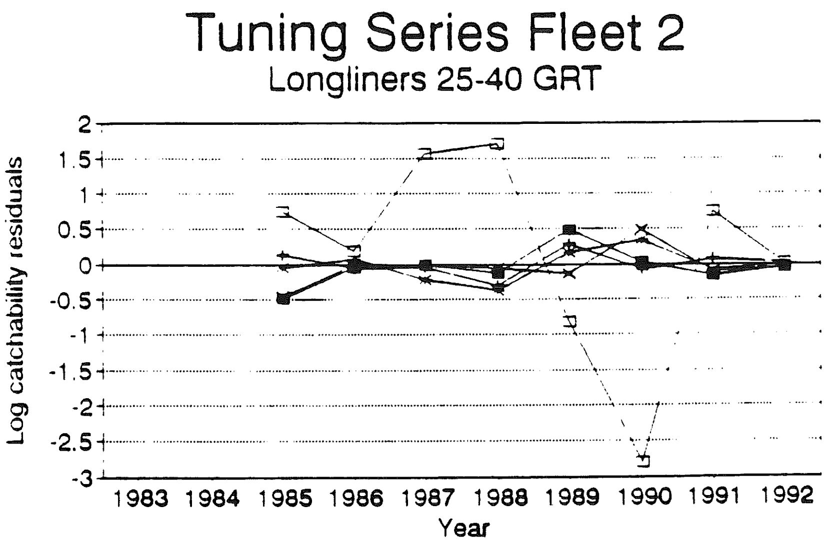


Figure 2.3.4.B

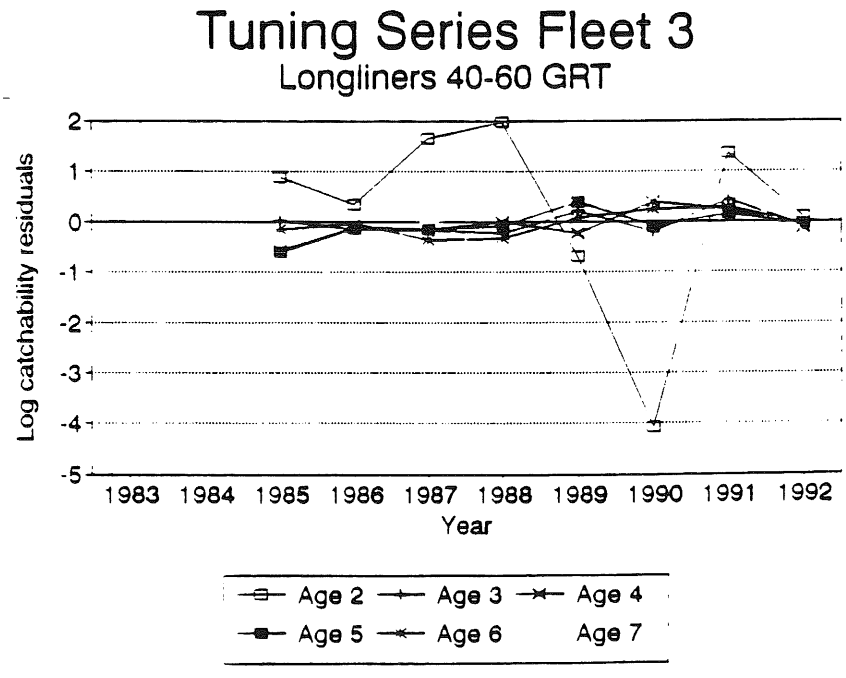


Figure 2.3.4.C

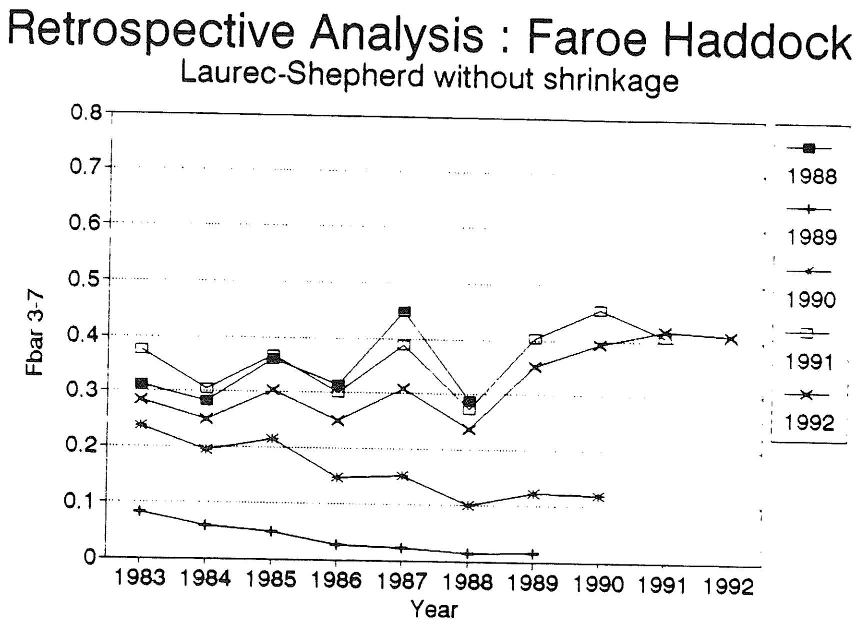


Figure 2.3.5.A

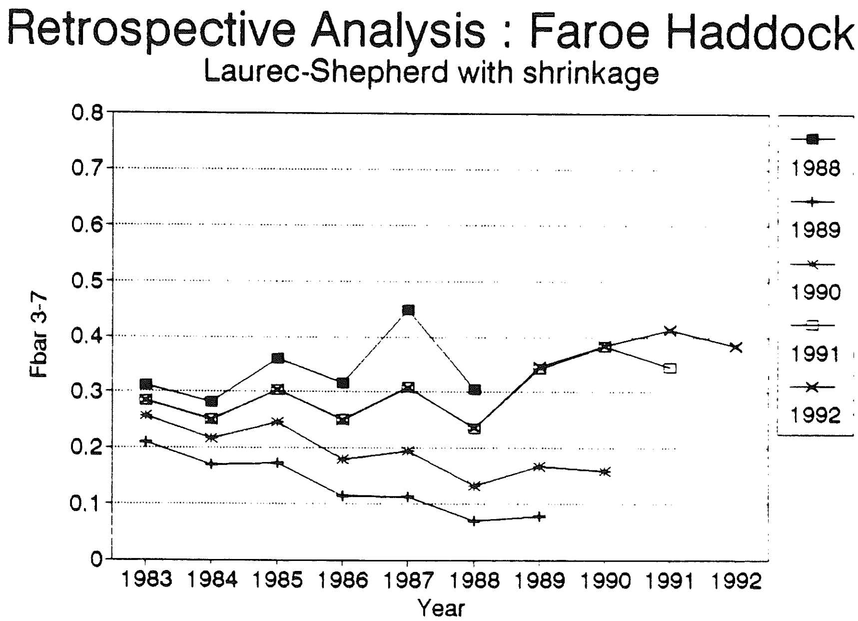


Figure 2.3.5.B

Retrospective Analysis : Faroe Haddock

XSA with shrinkage 0.5

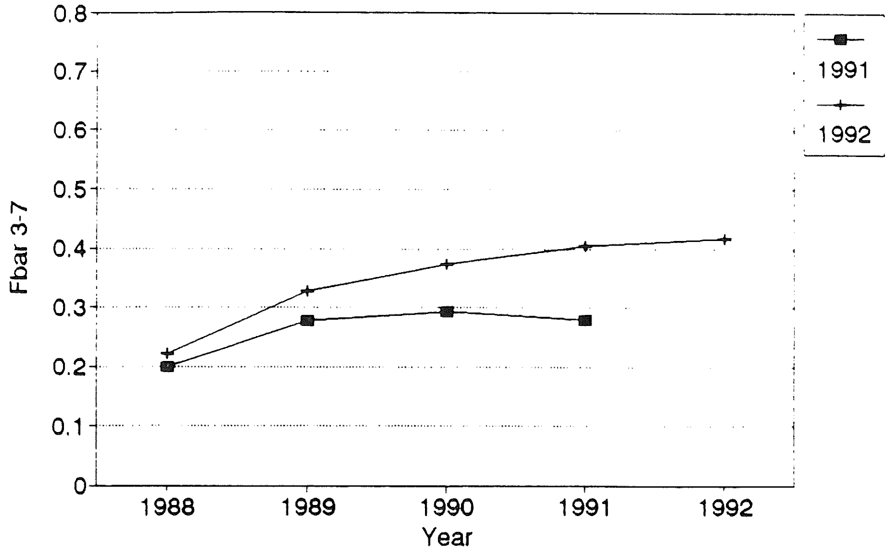


Figure 2.3.5.C

XSA with shrinkage 0.3

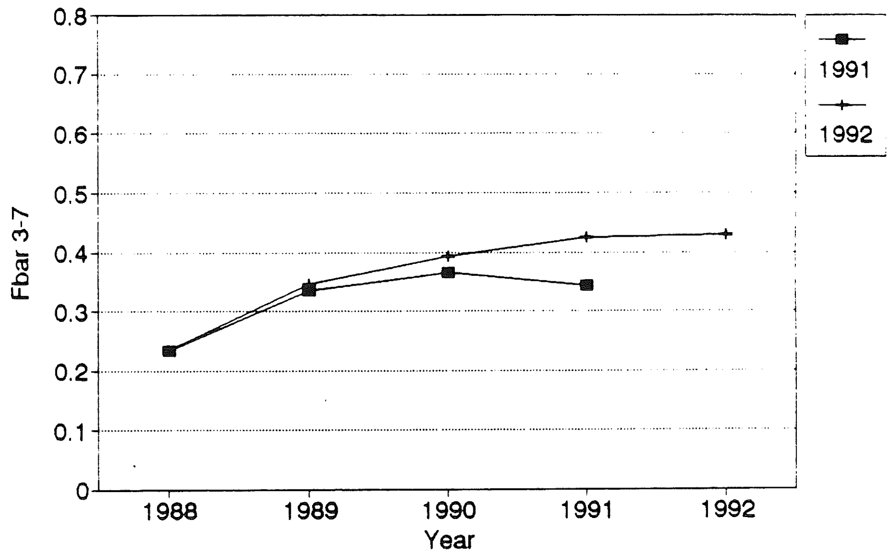


Figure 2.3.5.D

XSA with shrinkage 0.1

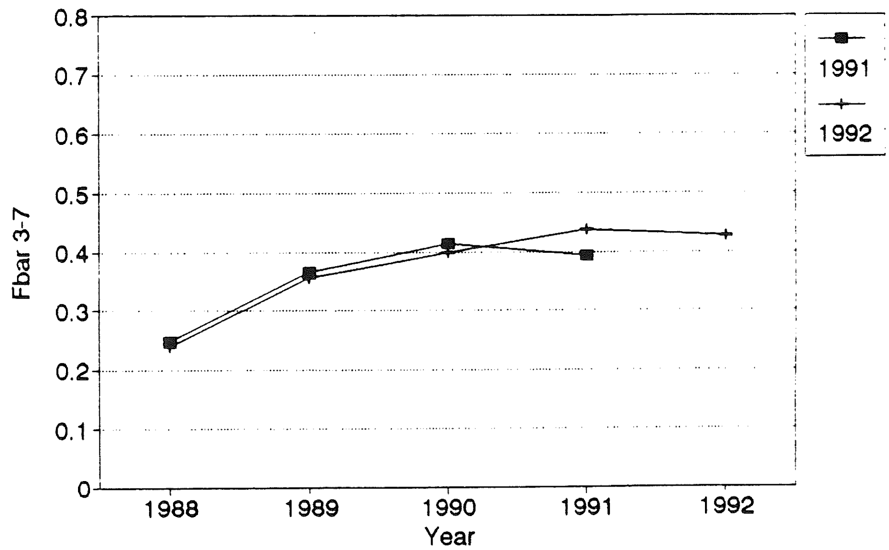
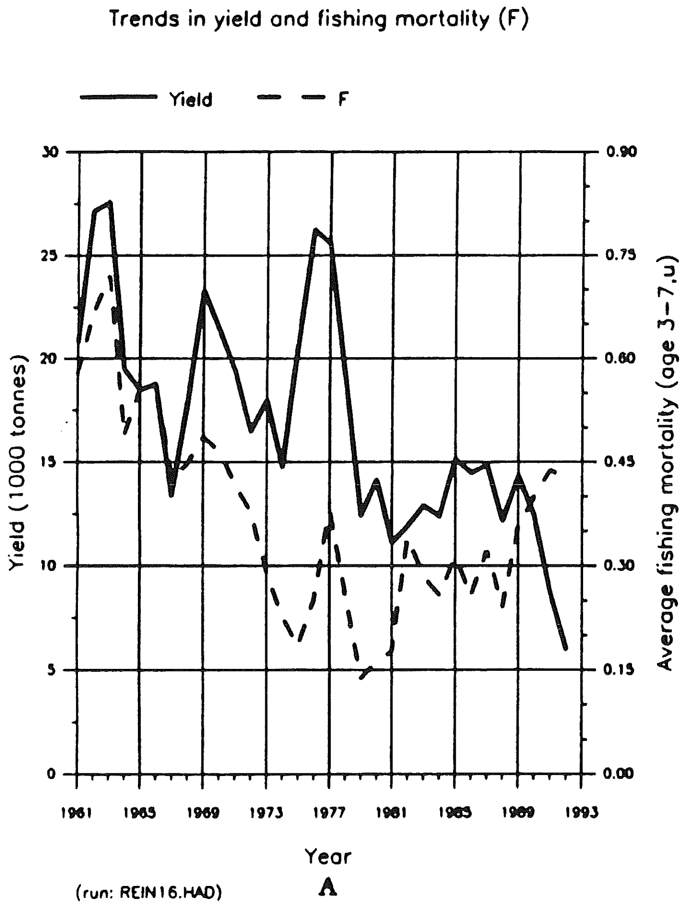


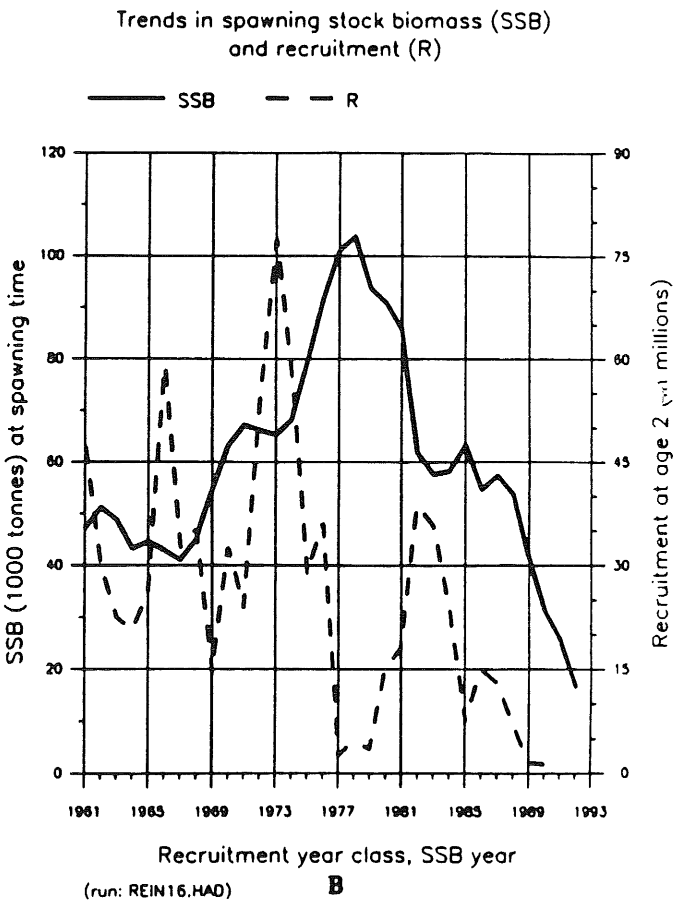
Figure 2.3.5.E

Figure 2.3.6

FISH STOCK SUMMARY
STOCK: Haddock in the Faroe Grounds (Fishing Area Vb)
7-5-1993



A

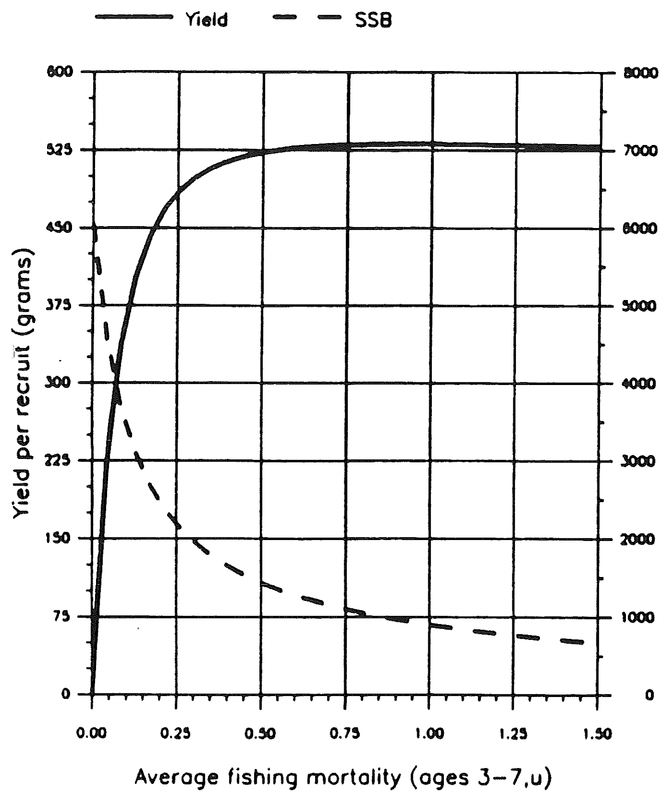


B

Figure 2.3.7

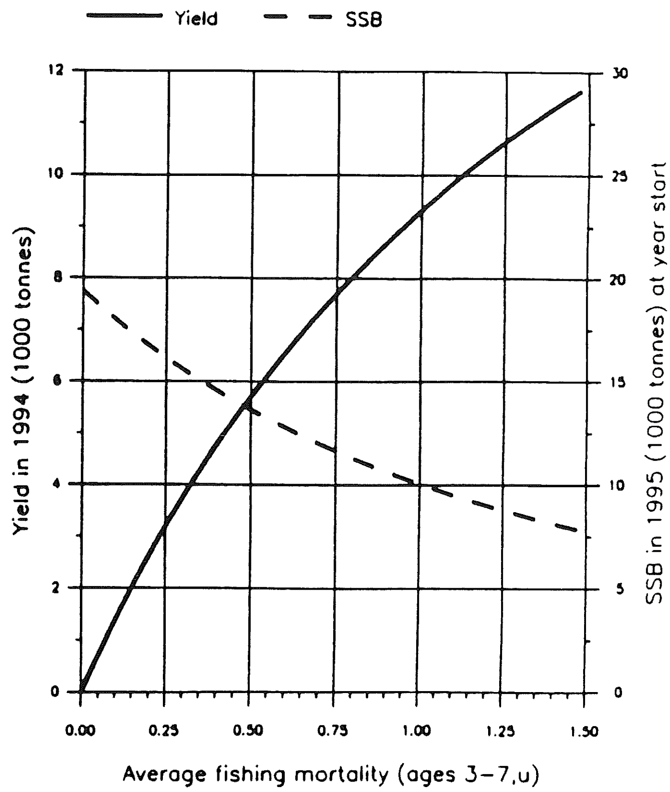
FISH STOCK SUMMARY
STOCK: Haddock in the Faroe Grounds (Fishing Area Vb)
7-5-1993

Long term yield and spawning stock biomass



(run: REIN16.HAD) C

Short-term yield and spawning stock biomass

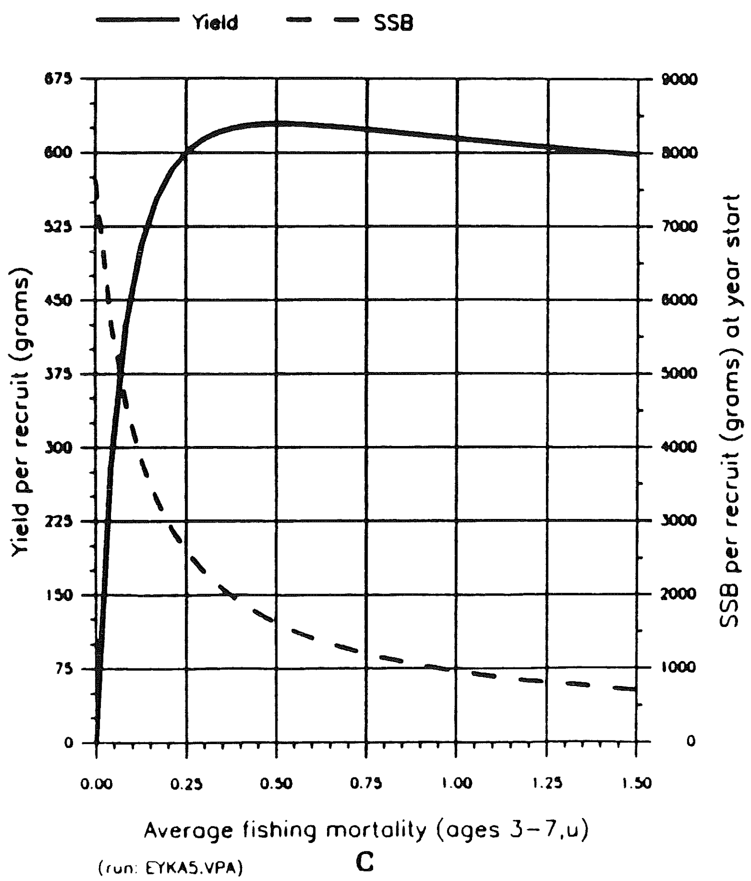


(run: REIN1.PRED) D

Figure 2.3.8

FISH STOCK SUMMARY
STOCK: Haddock in the Faroe Grounds (Fishing Area Vb)
10-5-1993

Long term yield and spawning stock biomass



C

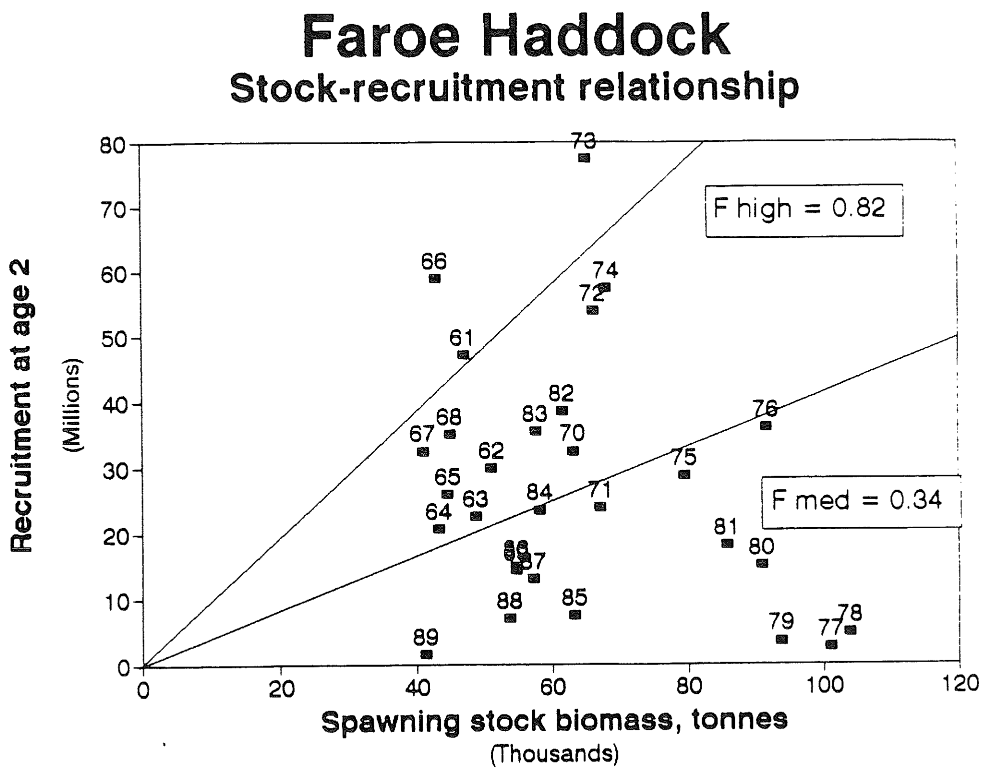


Figure 2.3.9

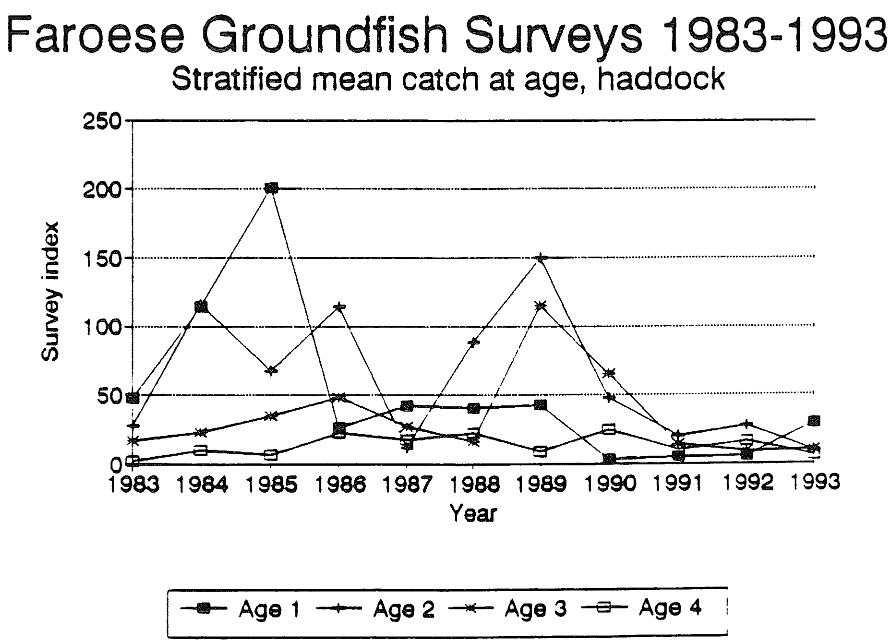


Figure 2.3.10

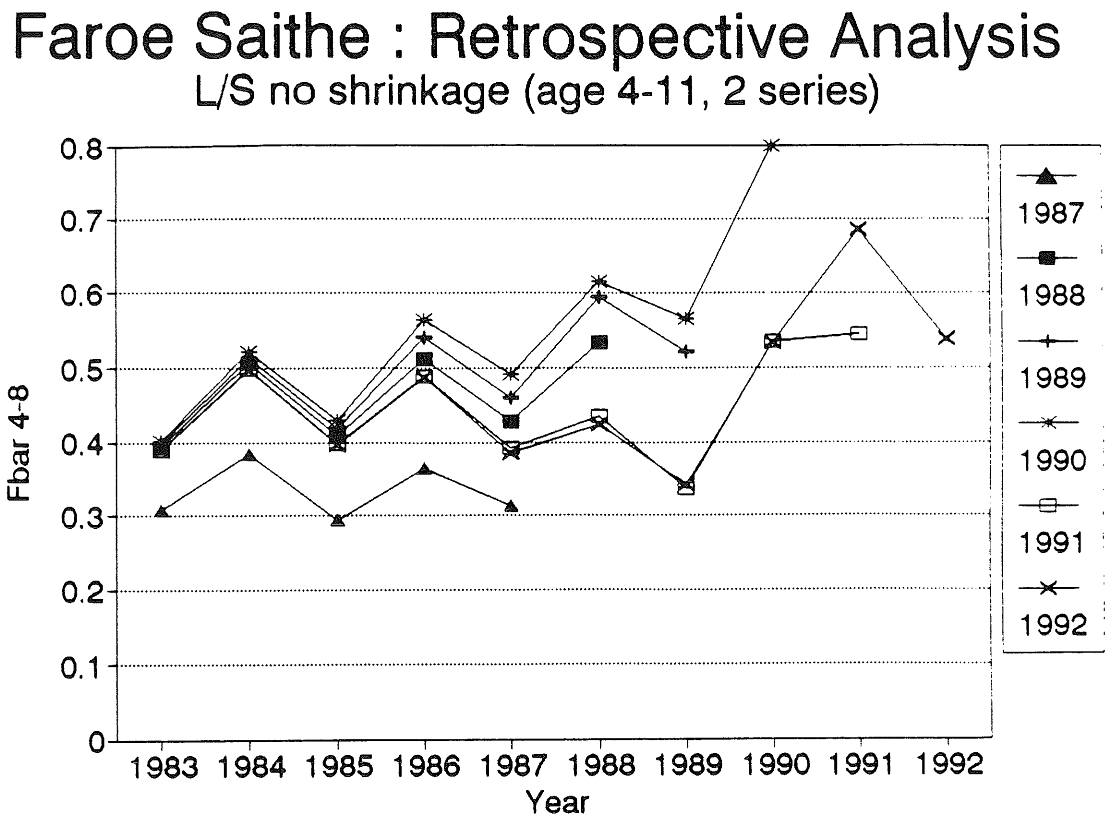


Figure 2.4.1

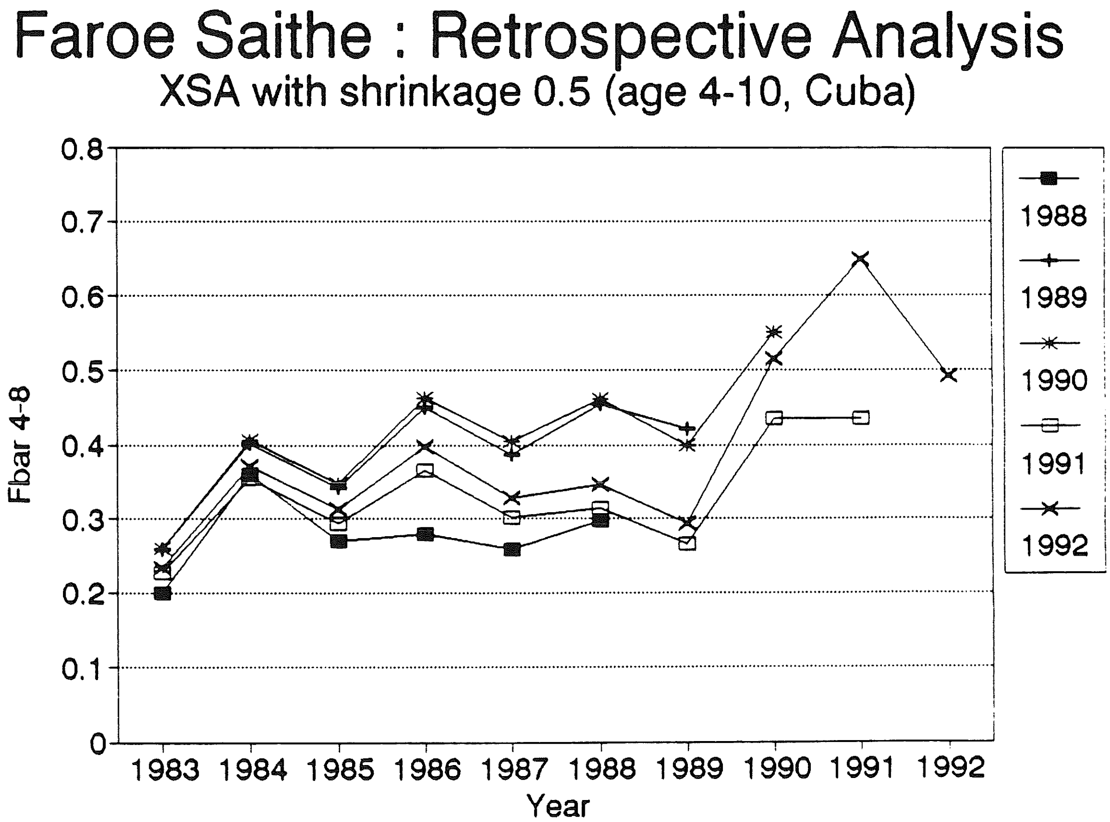


Figure 2.4.2

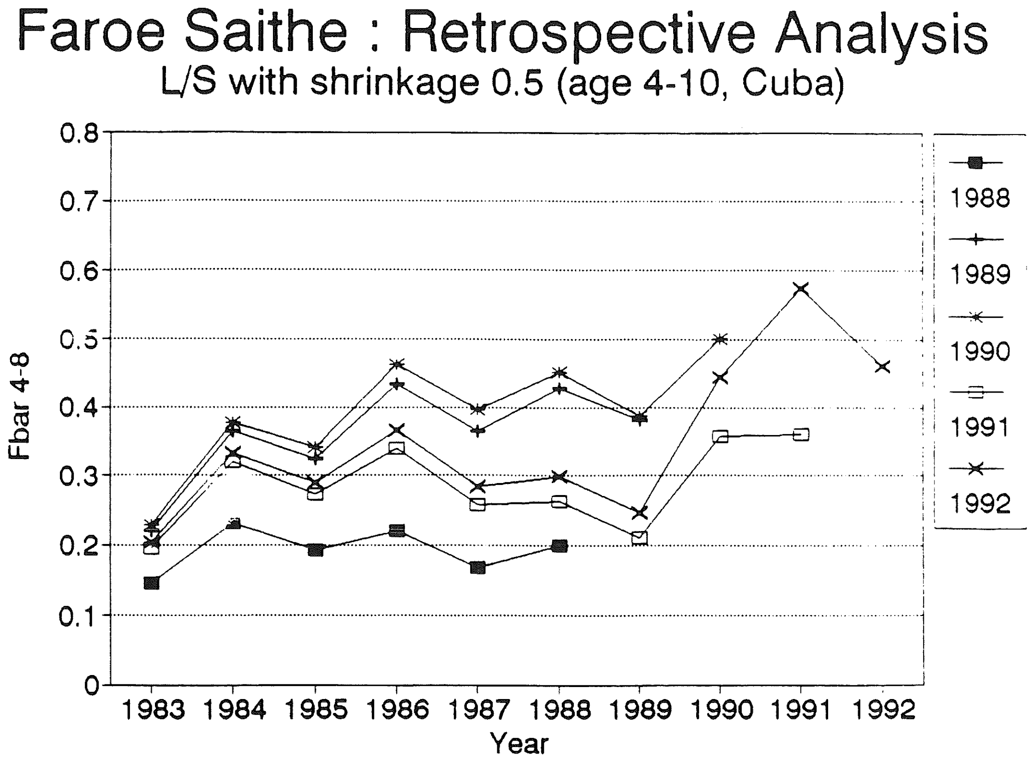


Figure 2.4.3

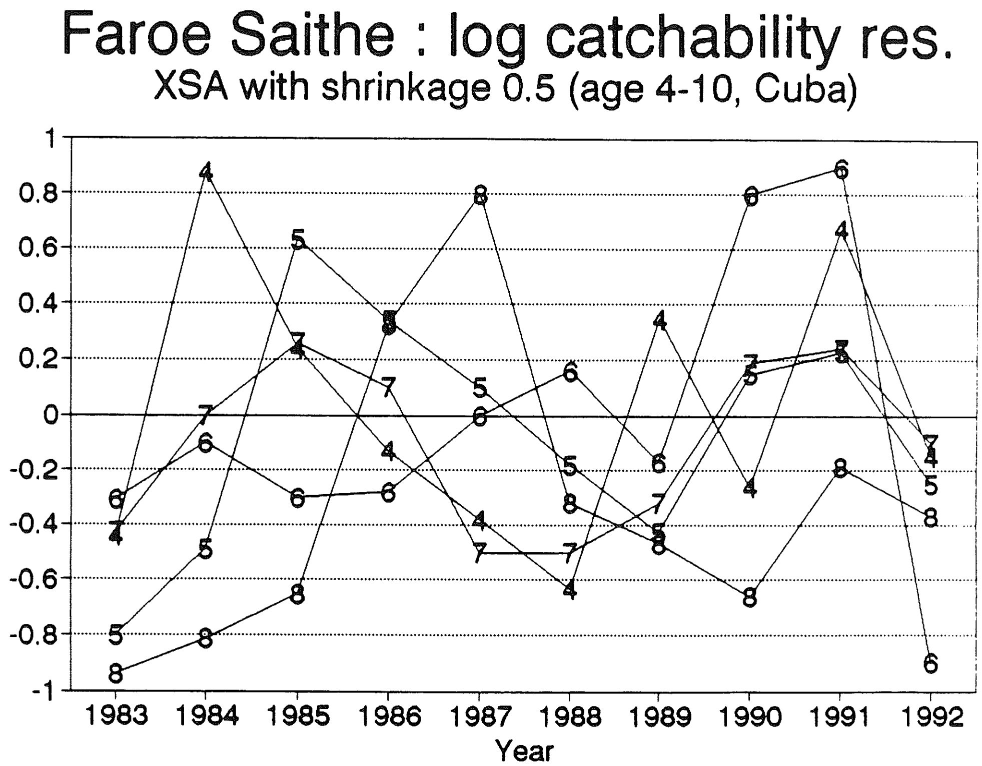


Figure 2.4.4

Figure 2.4.5

FISH STOCK SUMMARY
STOCK: Saithe in the Faroes Grounds (Fishing Area Vb)
11-5-1993

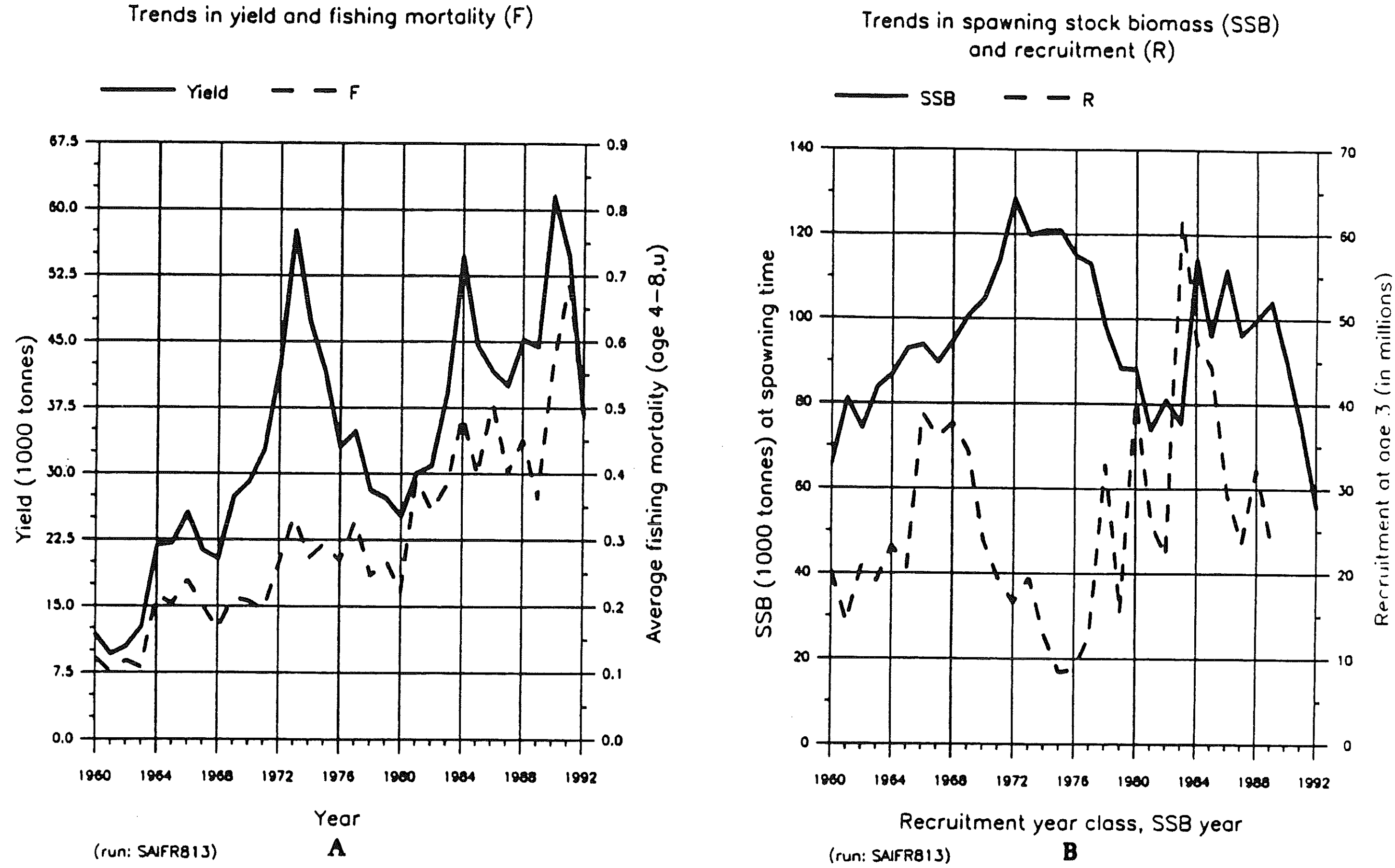
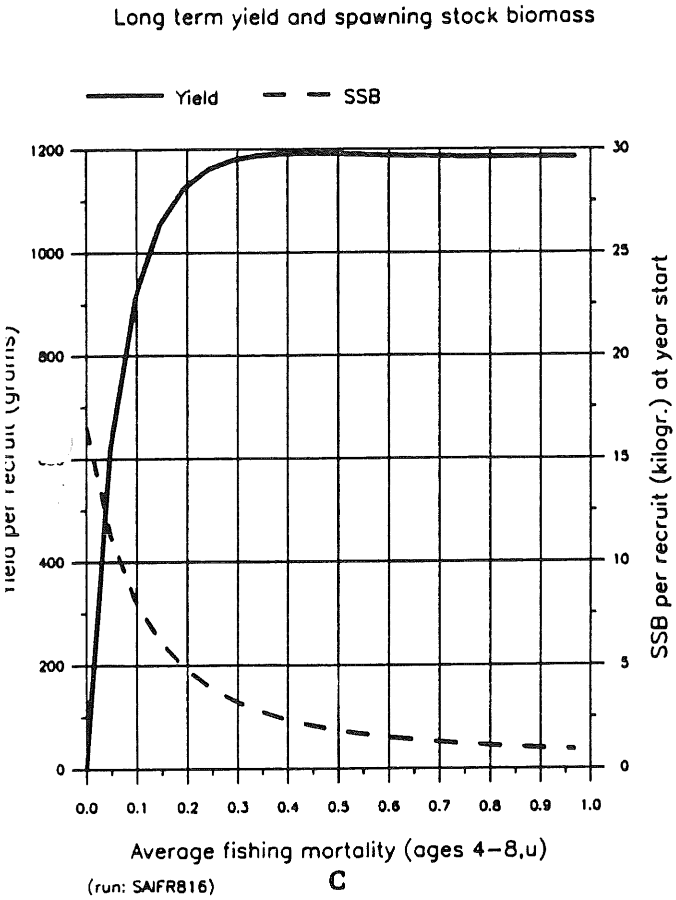
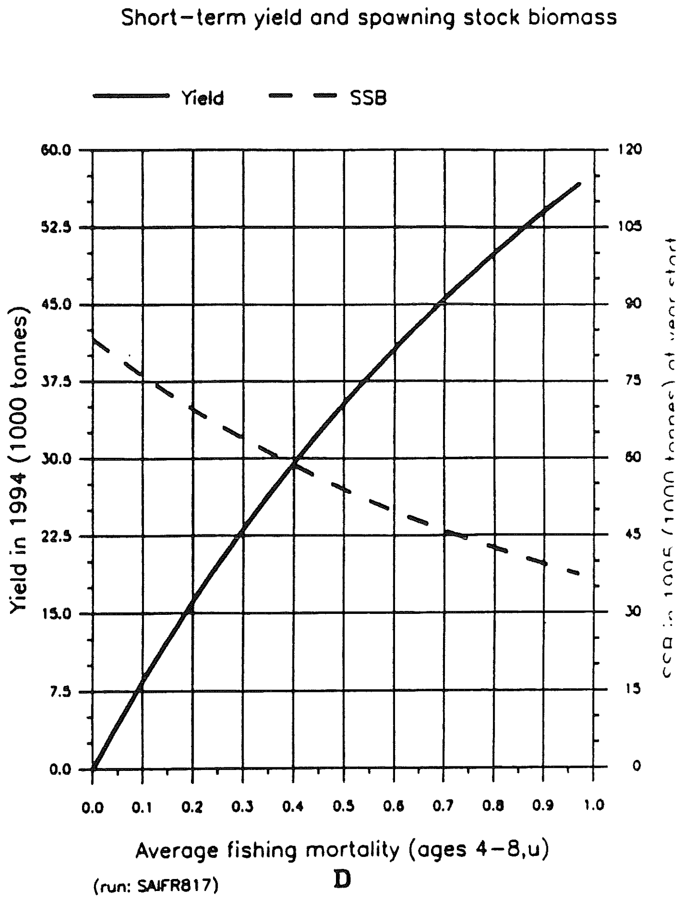


Figure 2.4.6

FISH STOCK SUMMARY
STOCK: Saithe in the Faroes Grounds (Fishing Area Vb)
11-5-1993





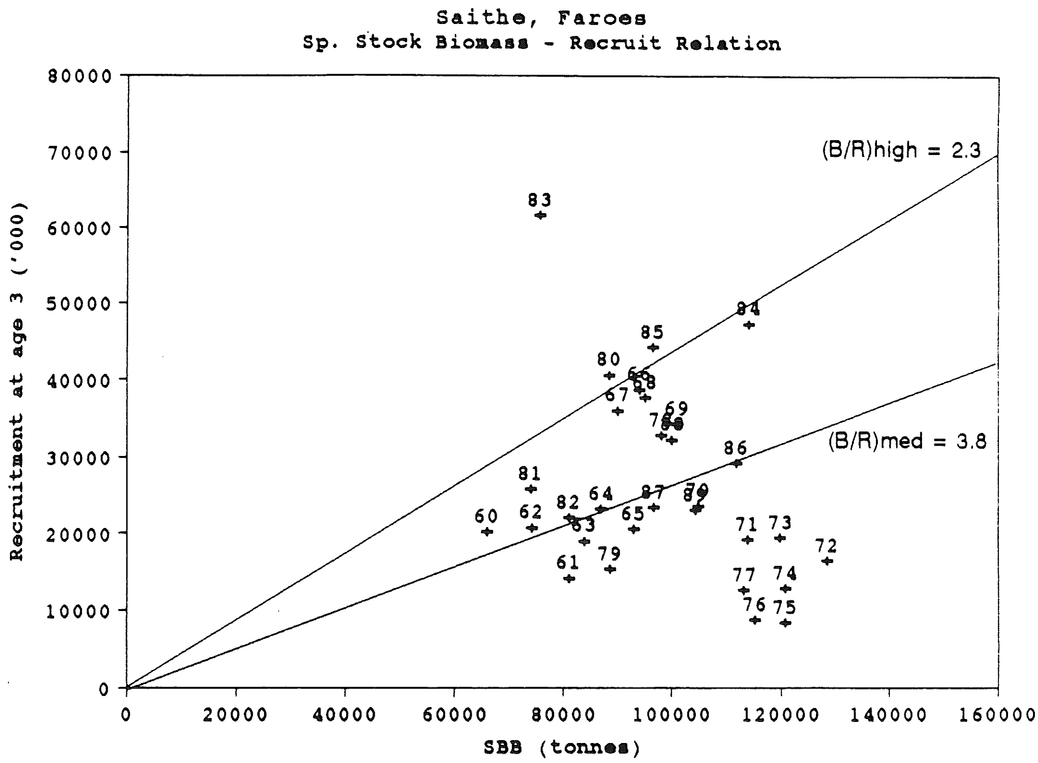
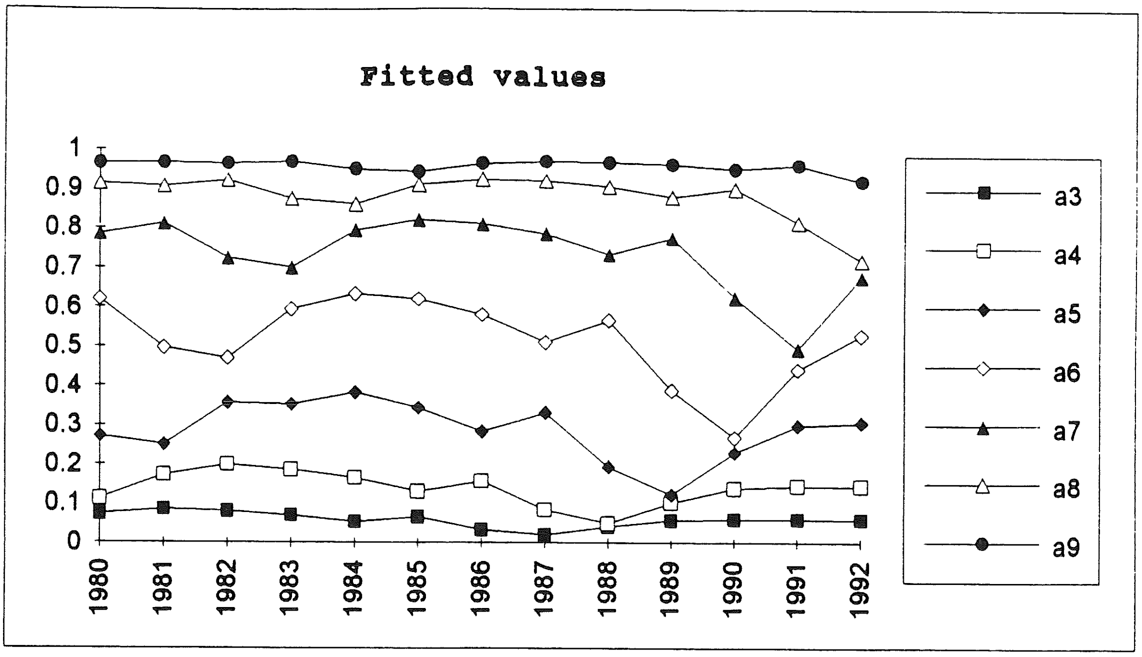

Saithe, Faroes
Sp. Stock Biomass - Recruit Relation
Recruitment at age 3 ('000)
SBB (tonnes)
(B/R)high = 2.3
(B/R)med = 3.8
0
10000
20000
30000
40000
50000
60000
70000
80000
20000
40000
60000
80000
100000
120000
140000
160000
83
84
85
80
67
69
86
81
64
87
82
60
62
63
65
71
73
72
61
79
77
74
76
75

Figure 2.4.7



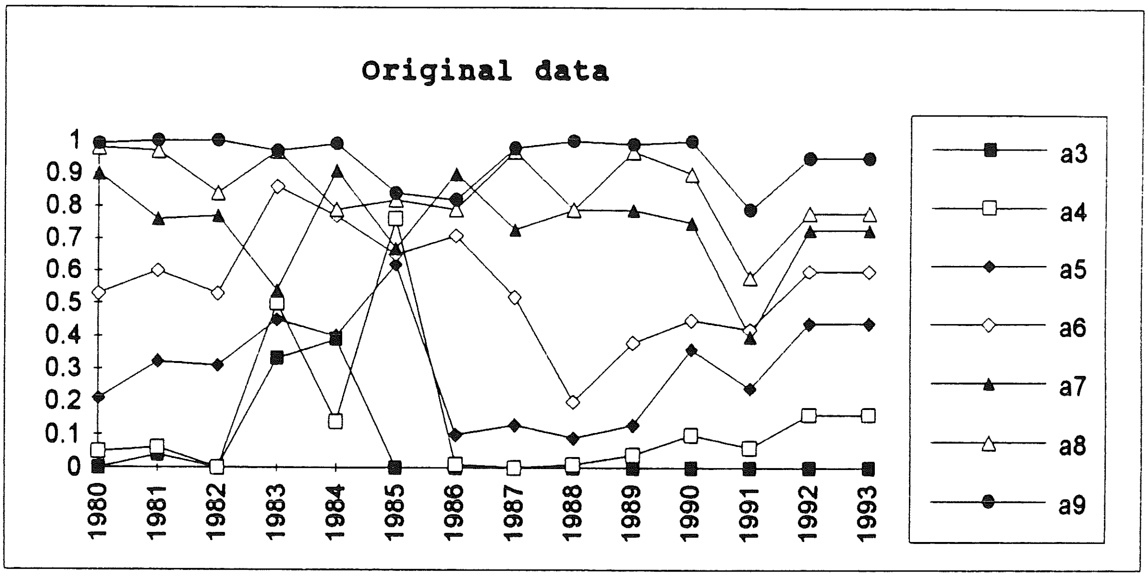


Figure 3.2.1. Icelandic Saithe. Maturity at age, data and fitted values.

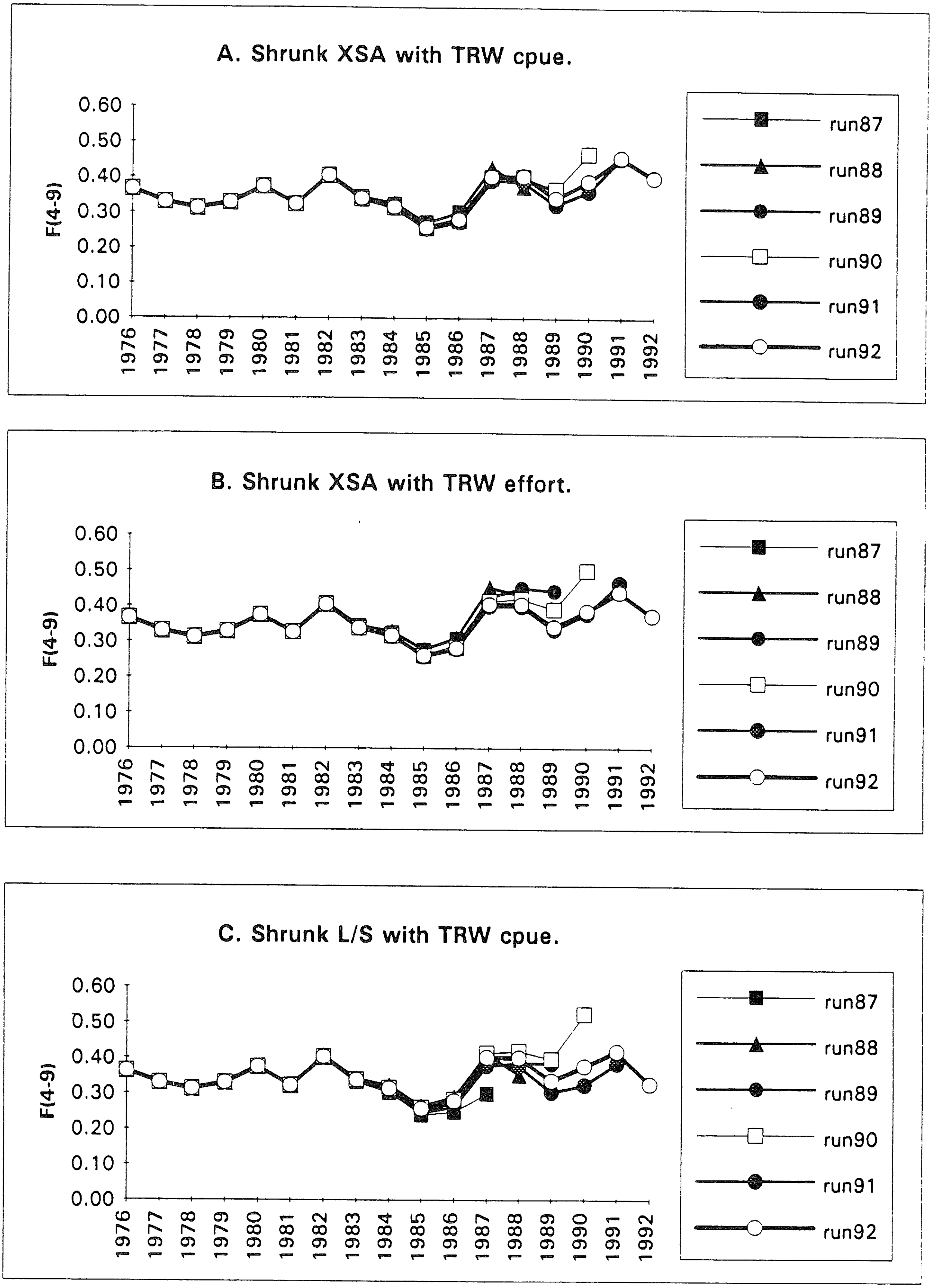
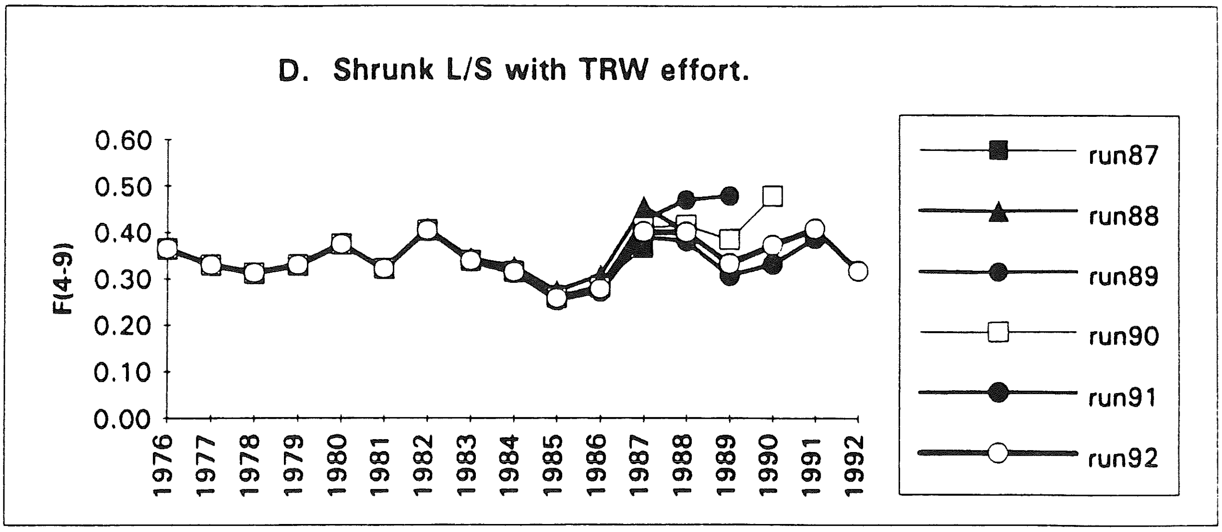
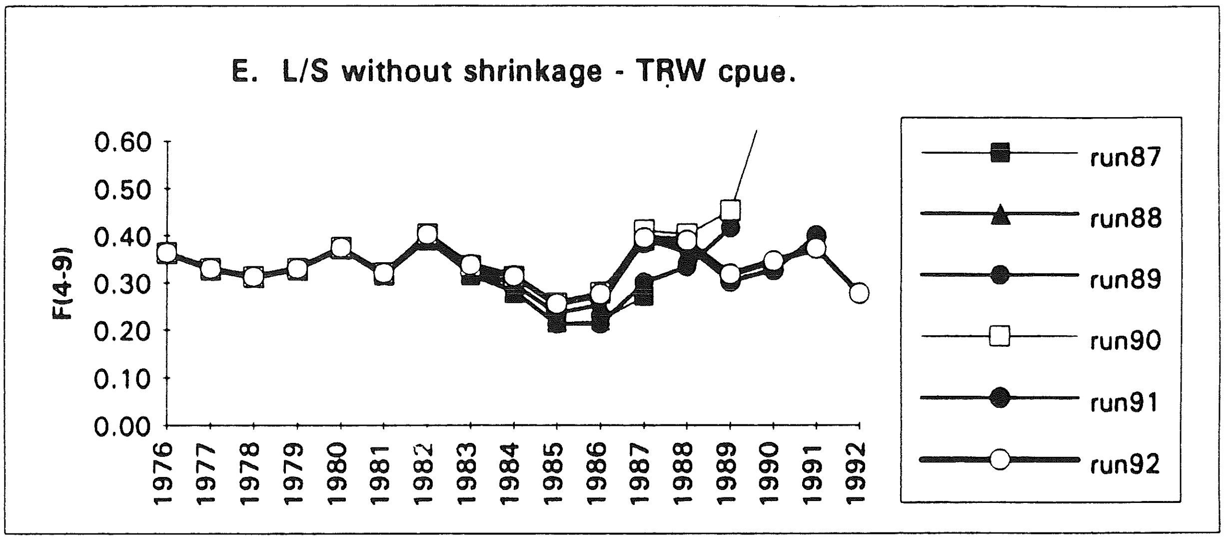


Figure 3.2.2.A-C. Icelandic Saithe. Retrospective analysis.





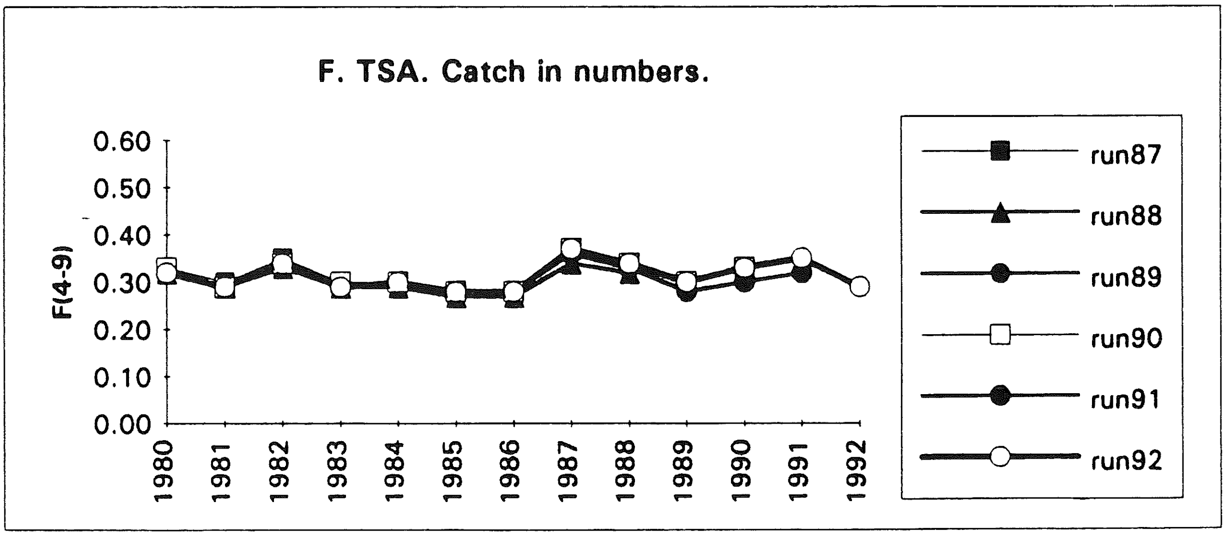


Figure 3.2.2.D-F. Icelandic Saithe. Retrospective analysis.

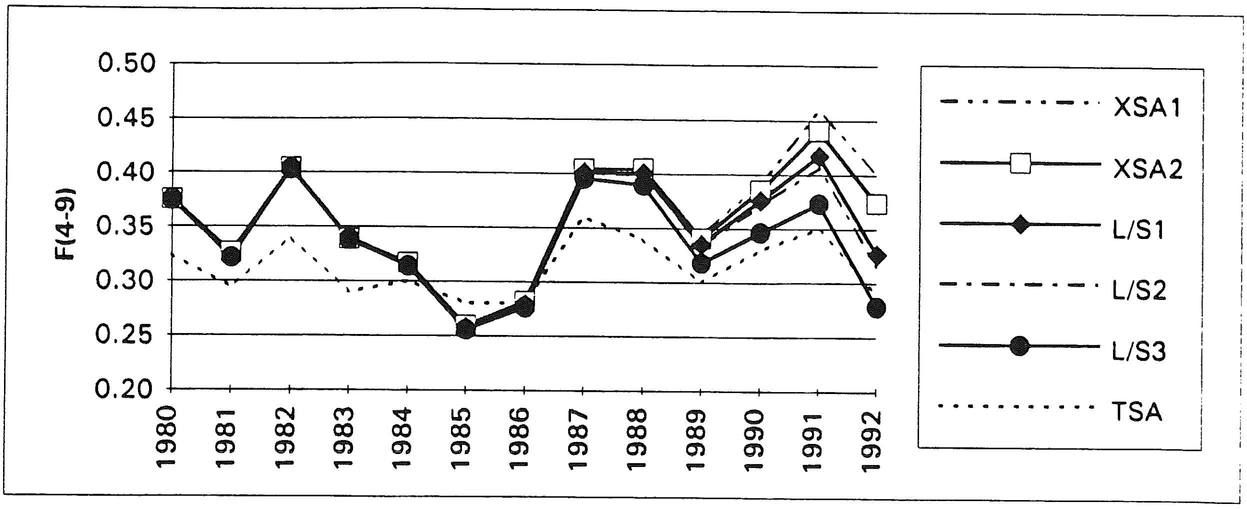
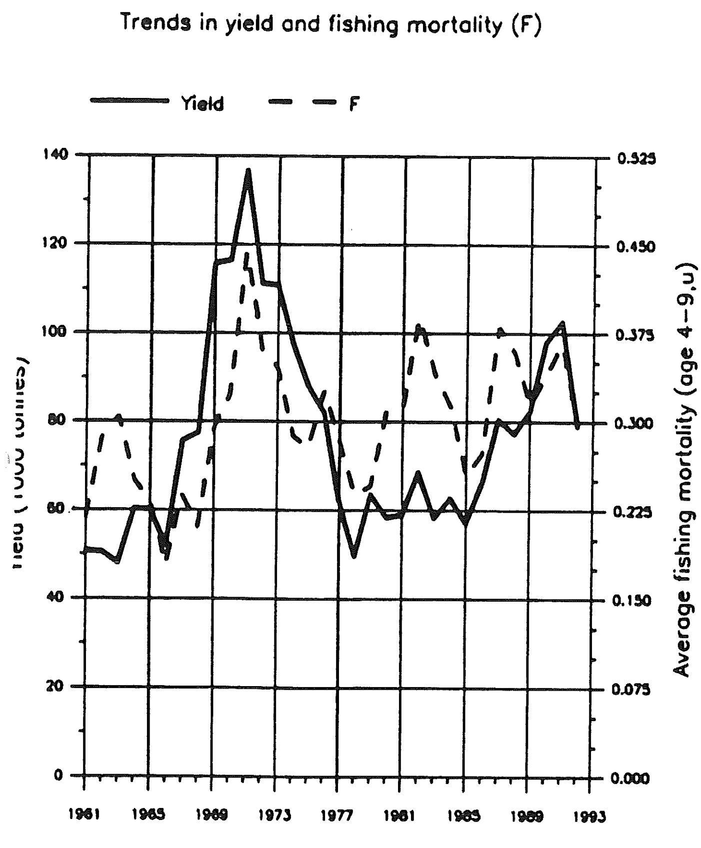


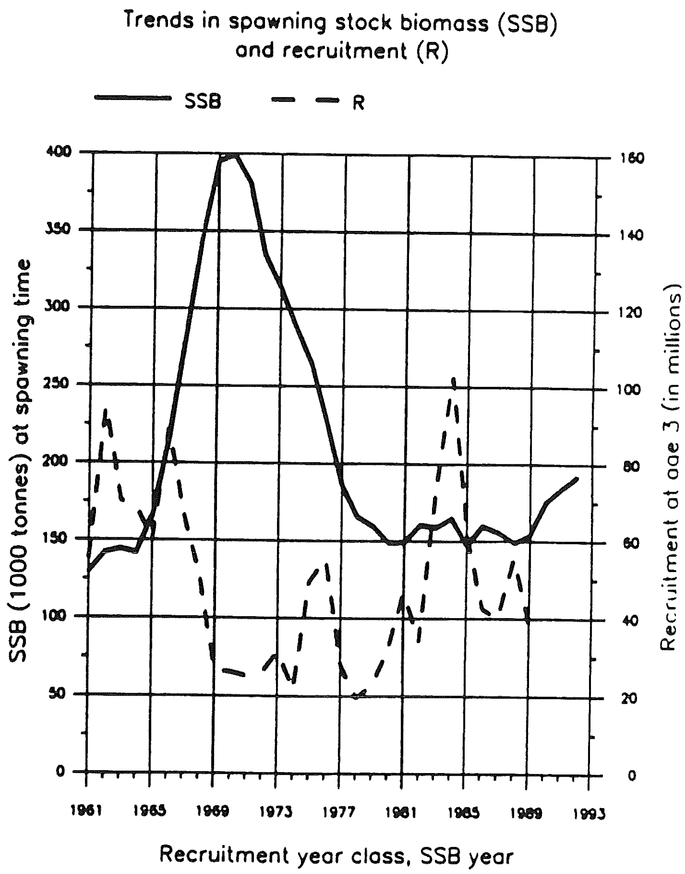
Figure 3.2.3. Icelandic Saithe. F(4-9) from different runs.

Figure 3.2.4

FISH STOCK SUMMARY
STOCK: Saithe in the Iceland Grounds (Fishing Area Va)
5-5-1993



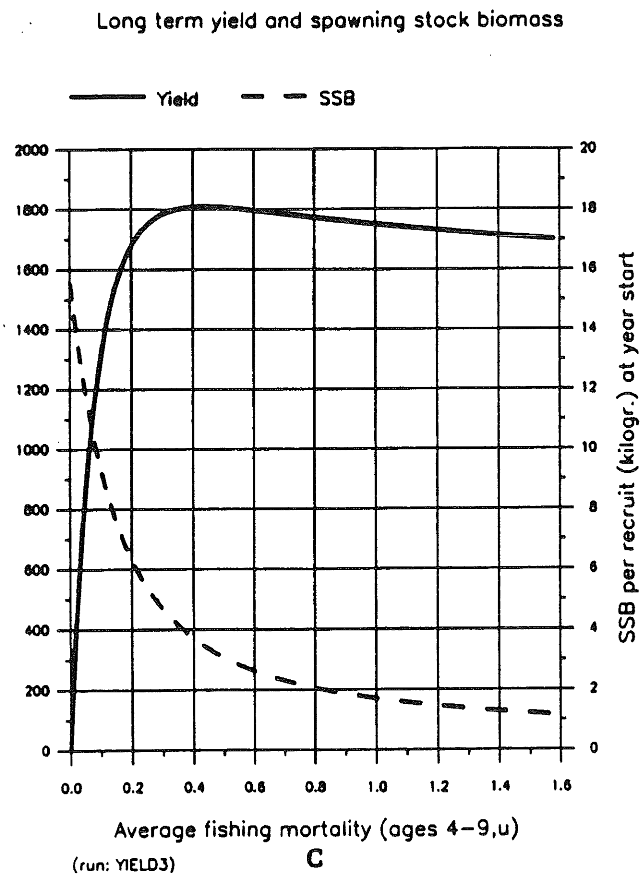
A

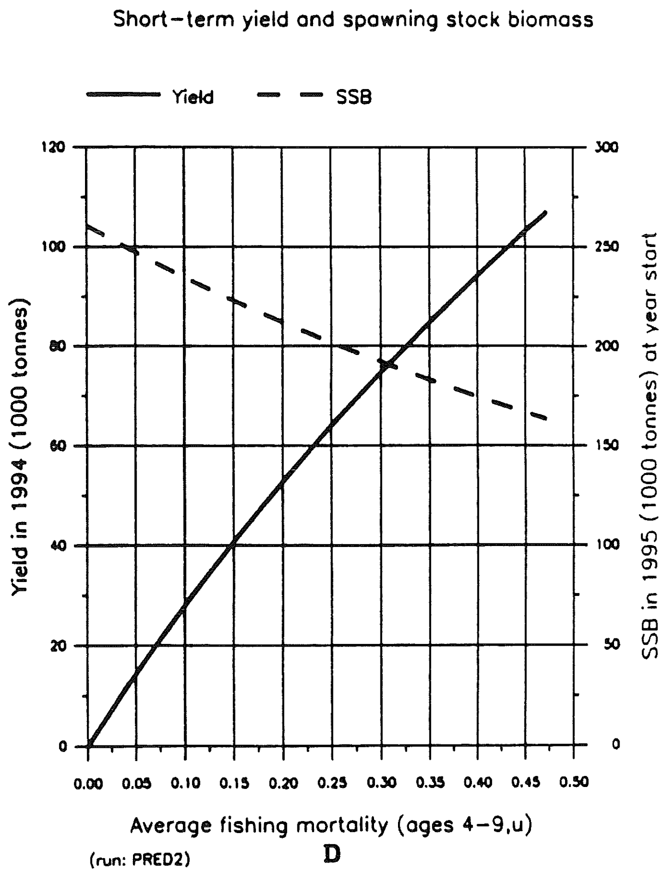


B

Figure 3.2.5

FISH STOCK SUMMARY
STOCK: Saithe in the Iceland Grounds (Fishing Area Va)
6-5-1993





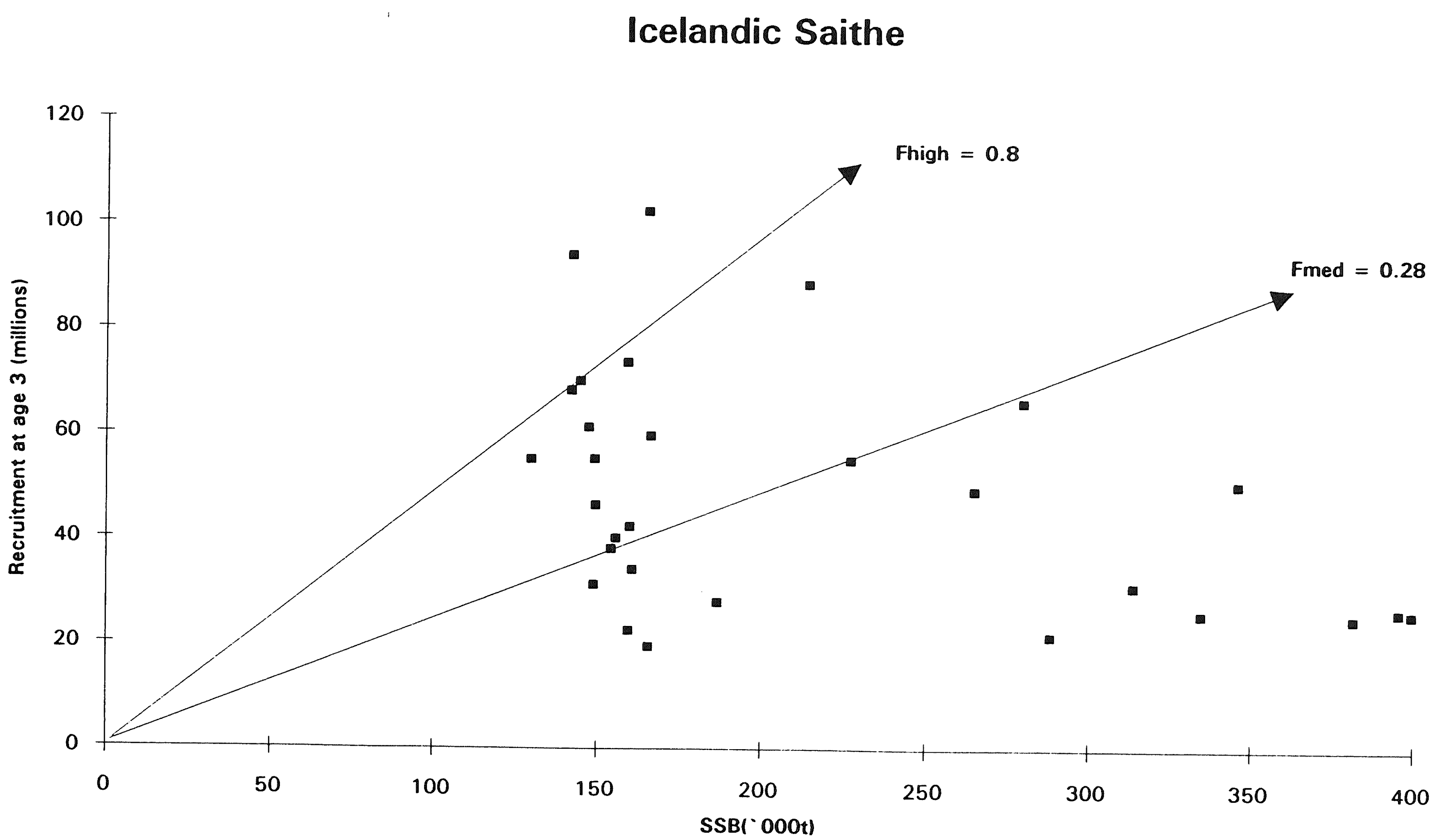
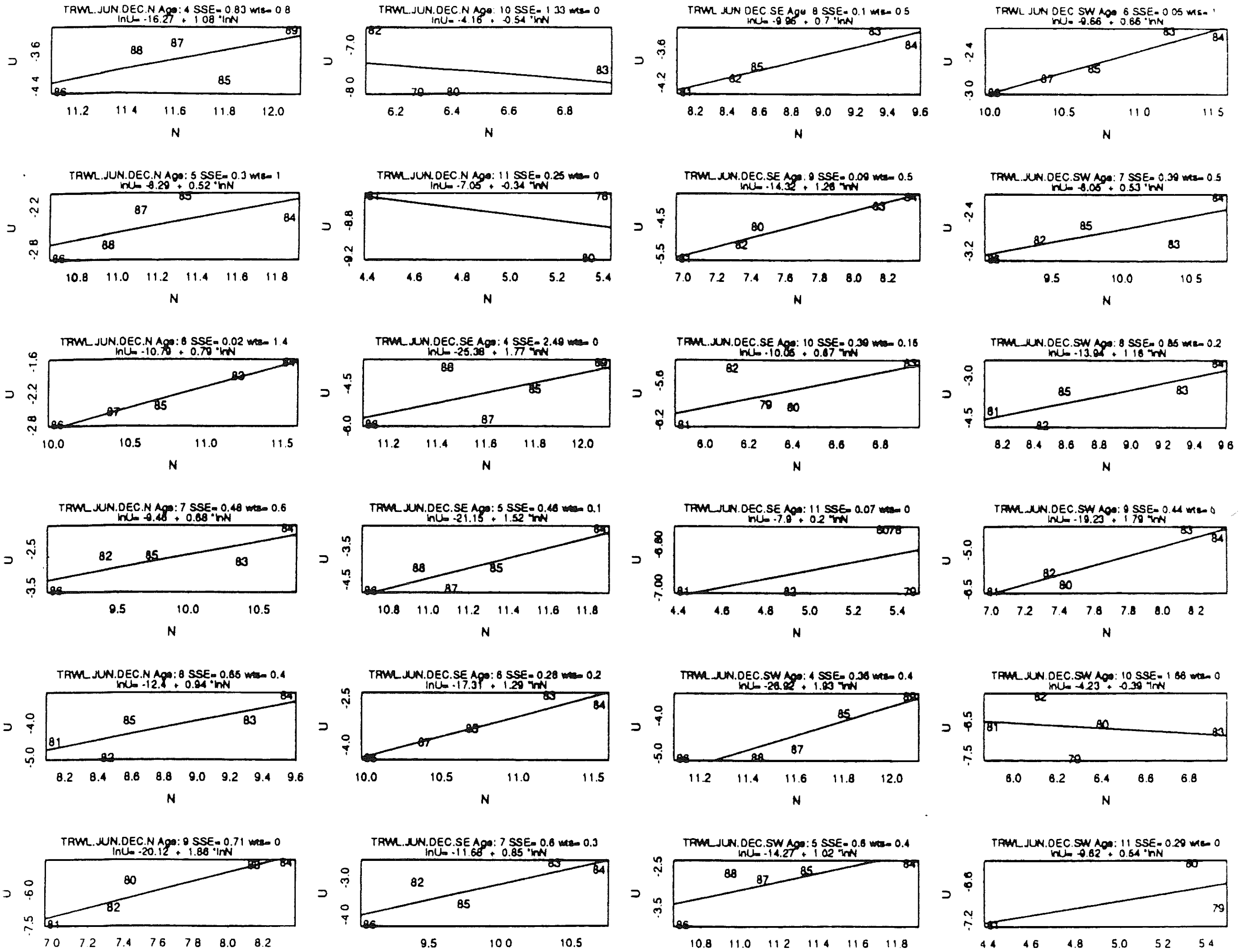

Icelandic Saithe
Fhigh = 0.8
Fmed = 0.28
Recruitment at age 3 (millions)
120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
SSB(`000t)

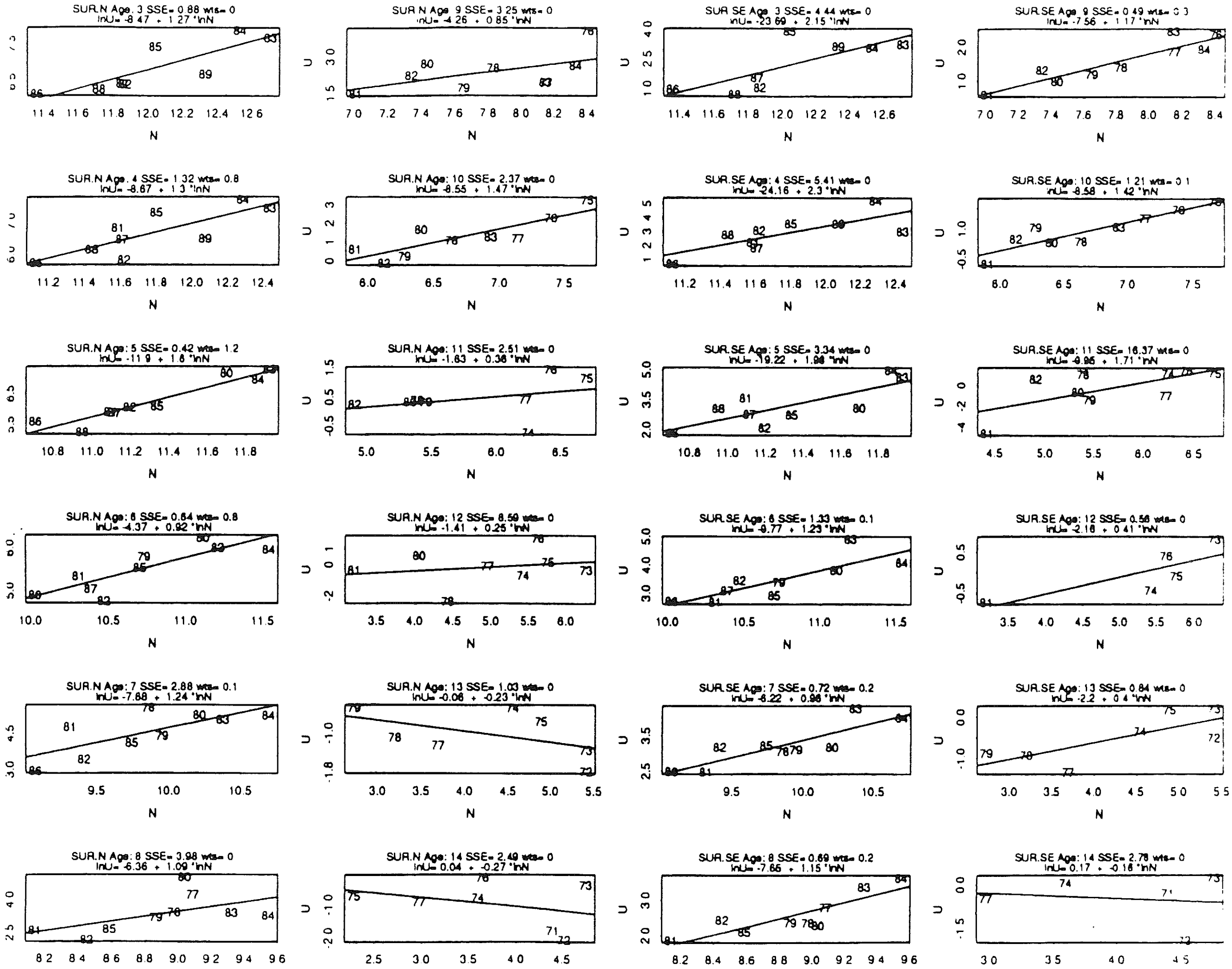
Figure 3.2.6.

Figure 3.3.1 Tuning diagnostics log-log plots of CPUE vs stock size.



cont'd.

gure 3.3.1 (cont'd.)



cont'd.

Figure 3.3.1 (cont'd.)

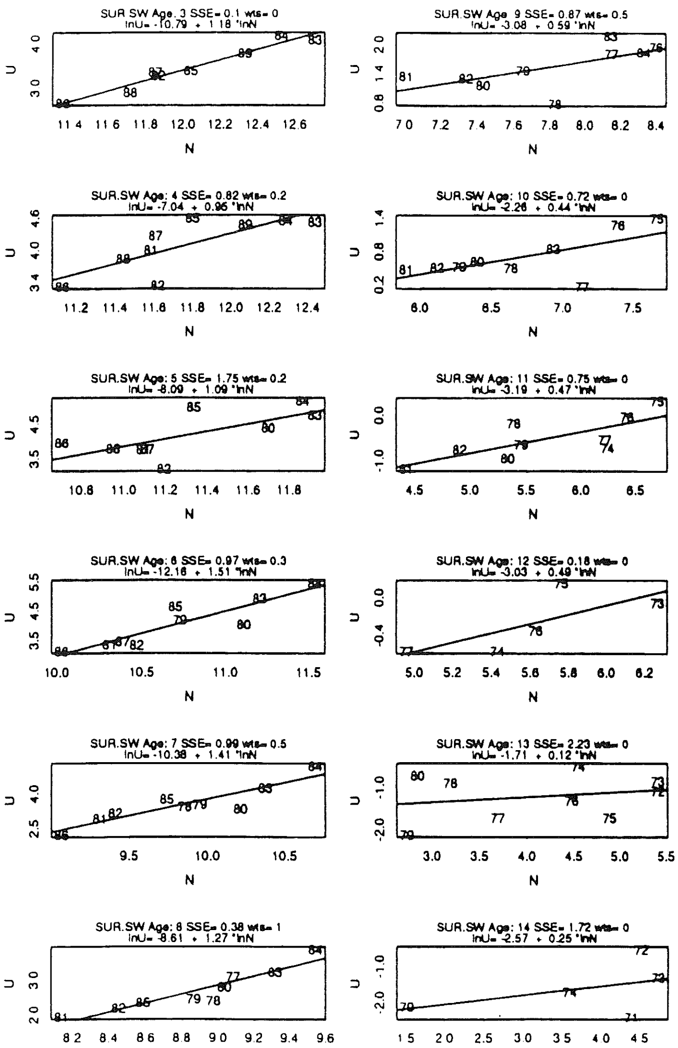


Fig. 3.3.2a. Icelandic cod. S-R data, fitted curves and reference points

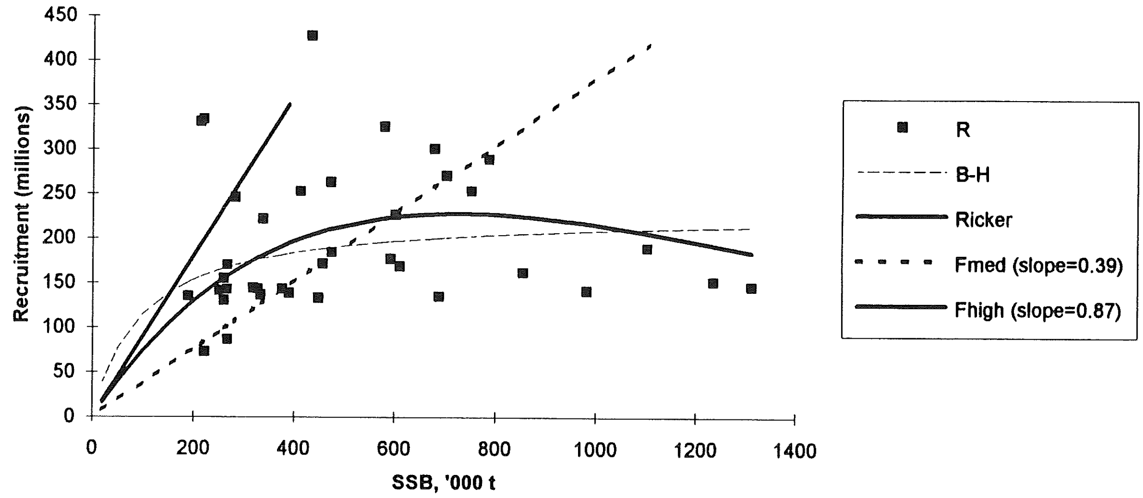


Fig. 3.3.2b. Icelandic cod. Trend in SSB and recruitment

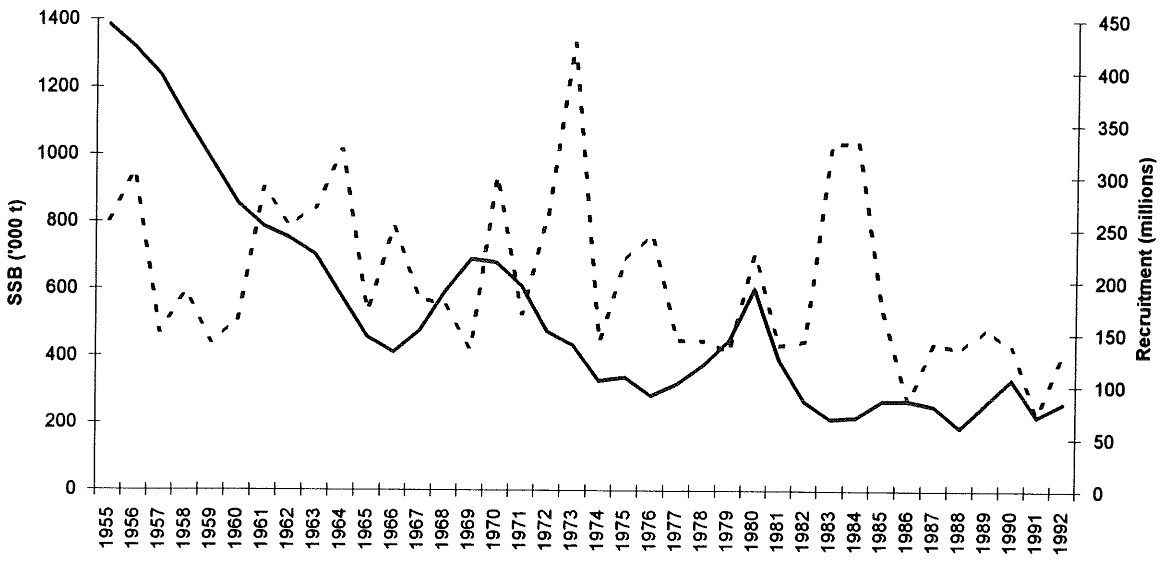


Figure 3.3.3

FISH STOCK SUMMARY
STOCK: Cod in the Iceland Grounds (Fishing Area Va)
7-5-1993

Long term yield and spawning stock biomass | Short-term yield and spawning stock biomass

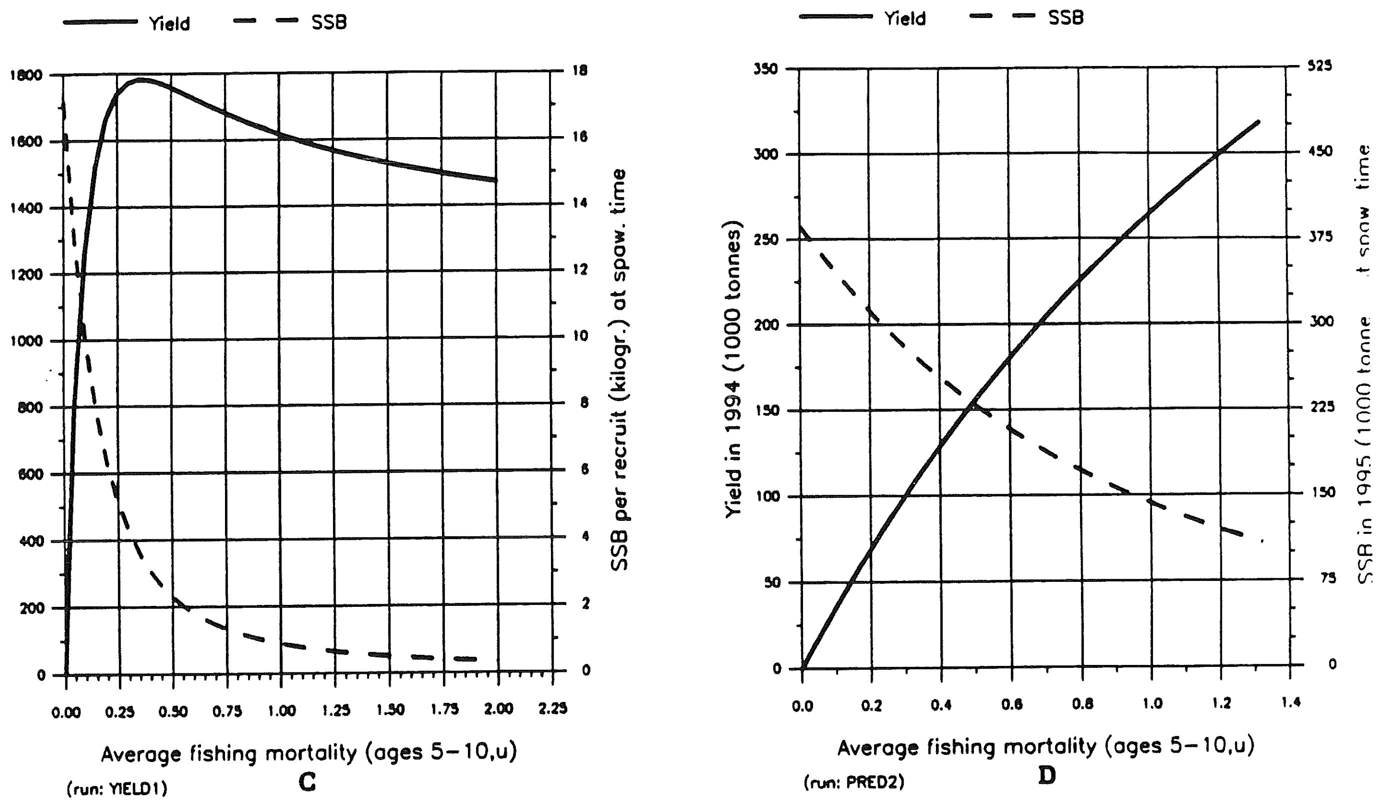
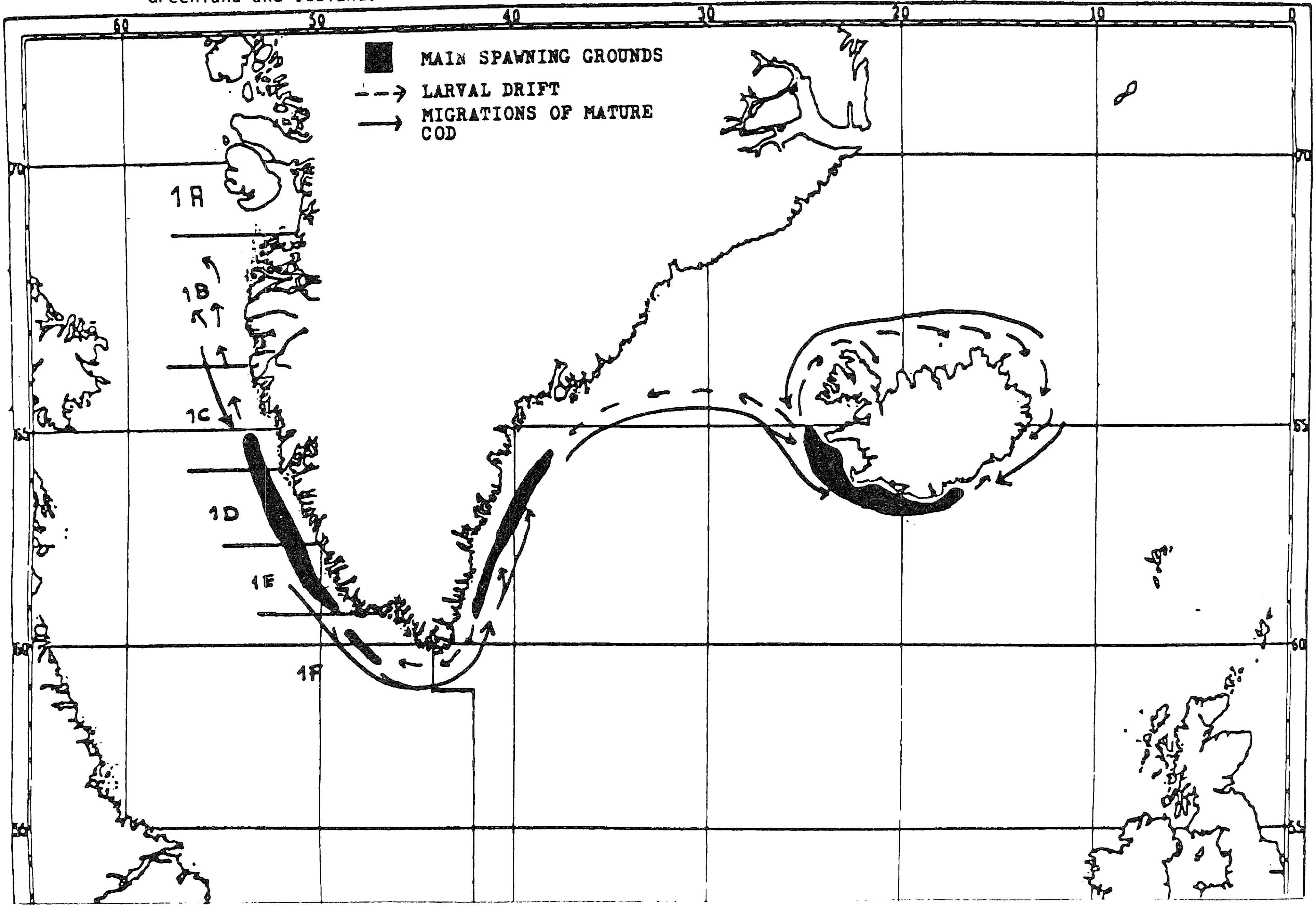


Figure 4.1.1 Main spawning grounds, migrations of mature fish and larval drift of the cod stocks at West Greenland, East Greenland and Iceland.



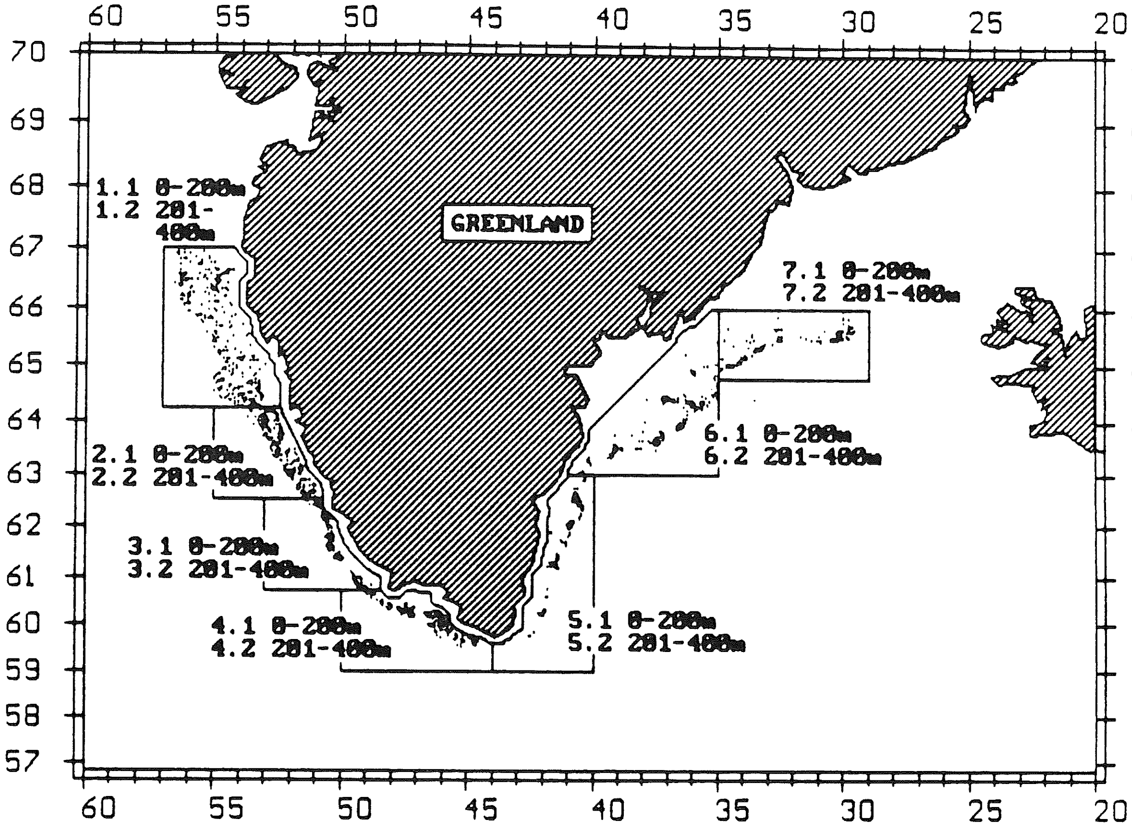


Fig. 5.1.1 Survey area. Geographic stratification scheme as specified in Table 5.1.1 and haul positions, 1982-92.

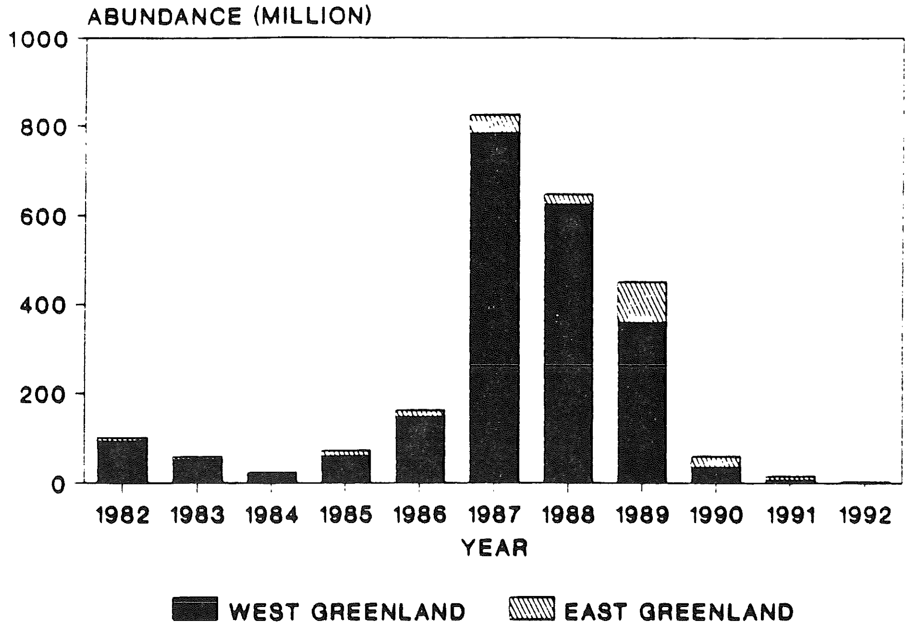


Fig. 5.1.2 Aggregate abundance indices for West and East Greenland as listed in Table 5.1.4, 1982-92. Value for East Greenland in 1992 is invalid due to incomplete sampling!

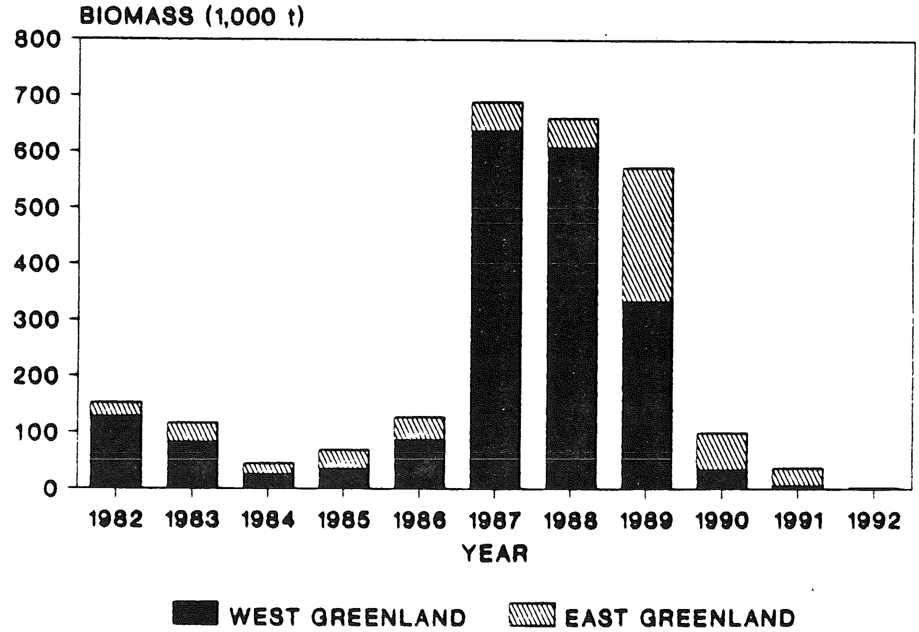


Fig. 5.1.3 Aggregate biomass indices for West and East Greenland as listed in Table 5.1.5, 1982-92. Value for East Greenland in 1992 is invalid due to incomplete sampling!

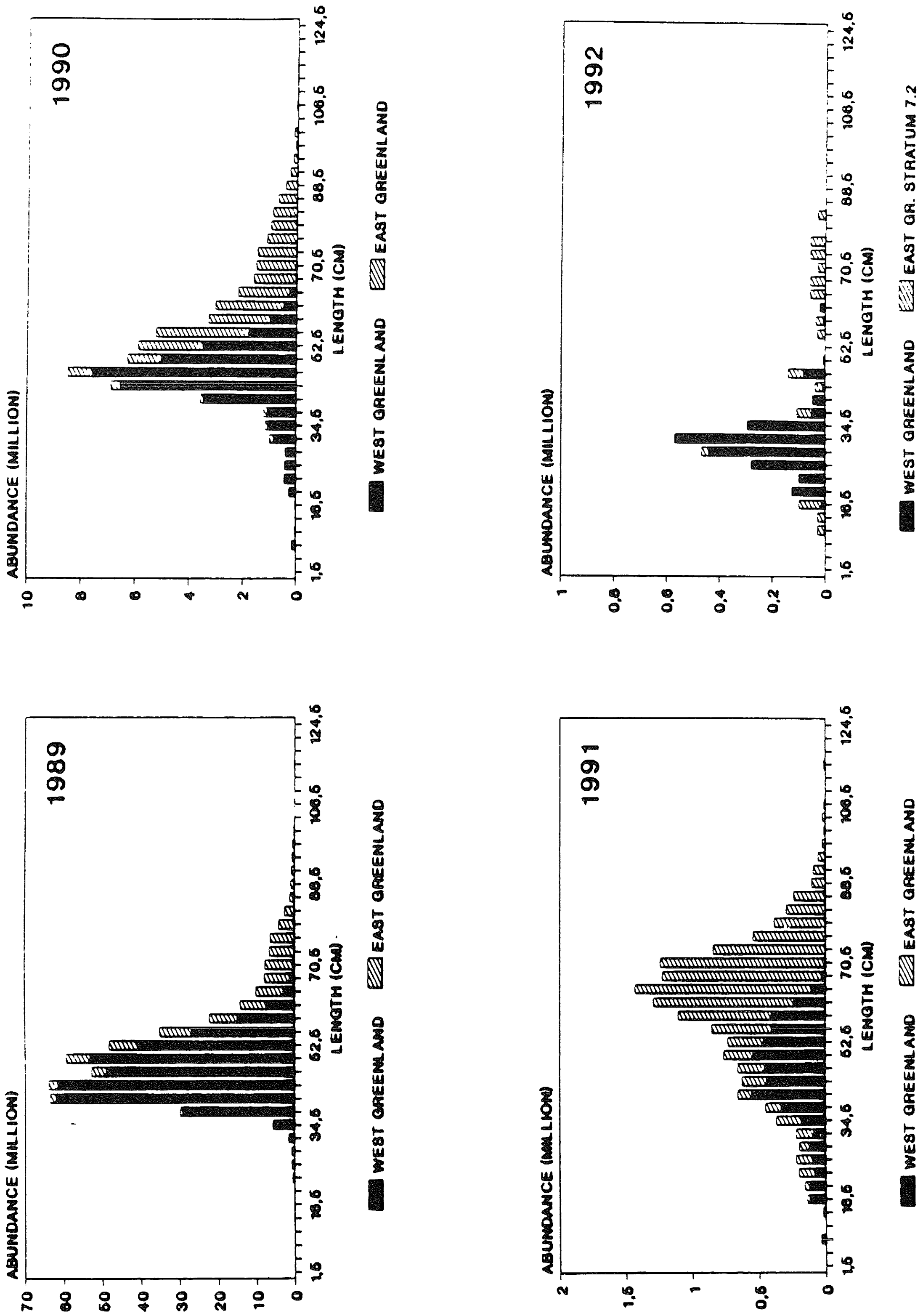


Fig. 5.1.4 Aggregate length composition for West and East Greenland, 1989-92. Values for East Greenland in 1992 are invalid due to incomplete sampling!

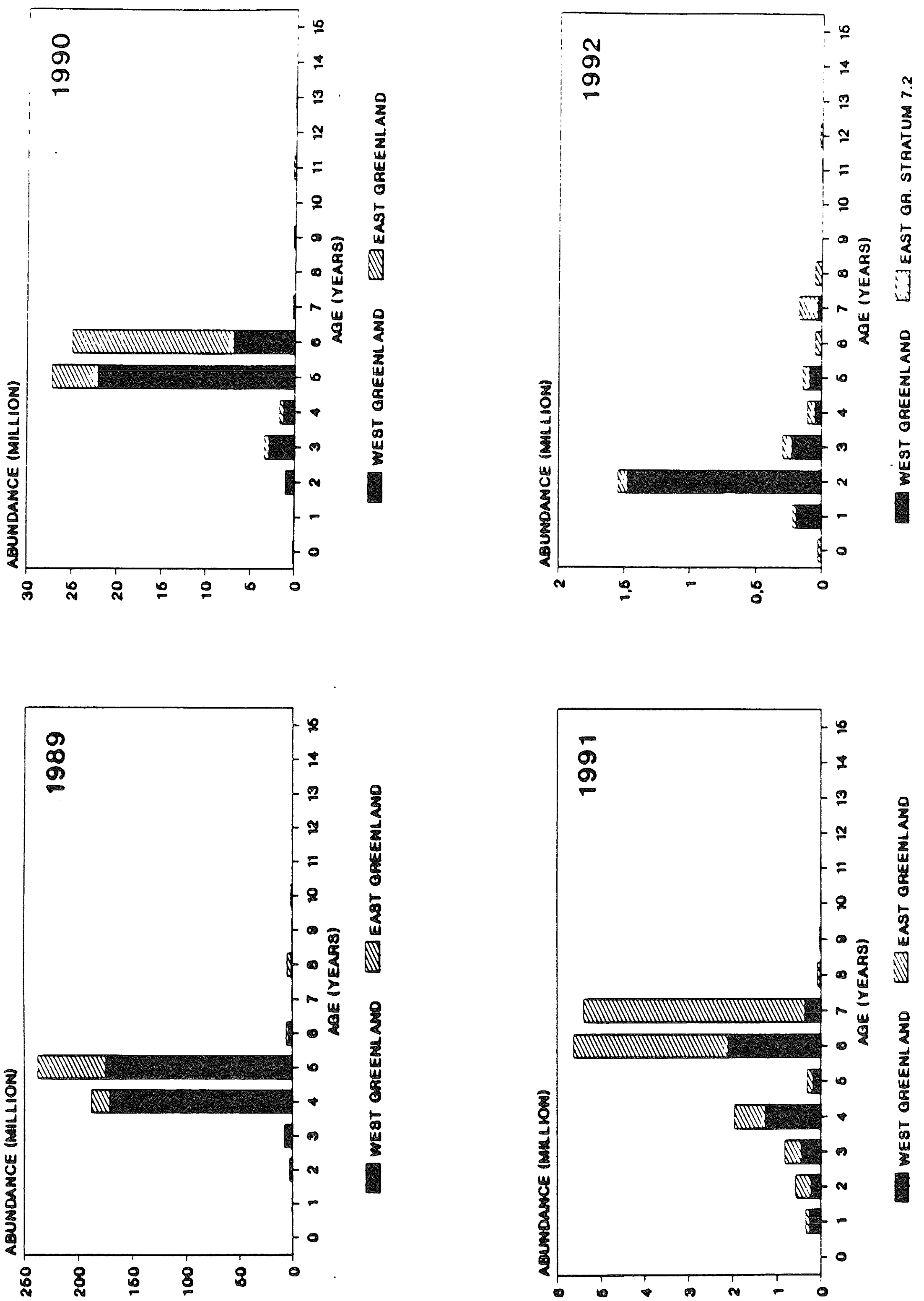


Fig. 5.1.5 Aggregate age composition for West and East Greenland as listed in Tables 5.1.6, 5.1.7 and 5.1.8, 1989-92. Values for East Greenland in 1992 are invalid due to incomplete sampling!

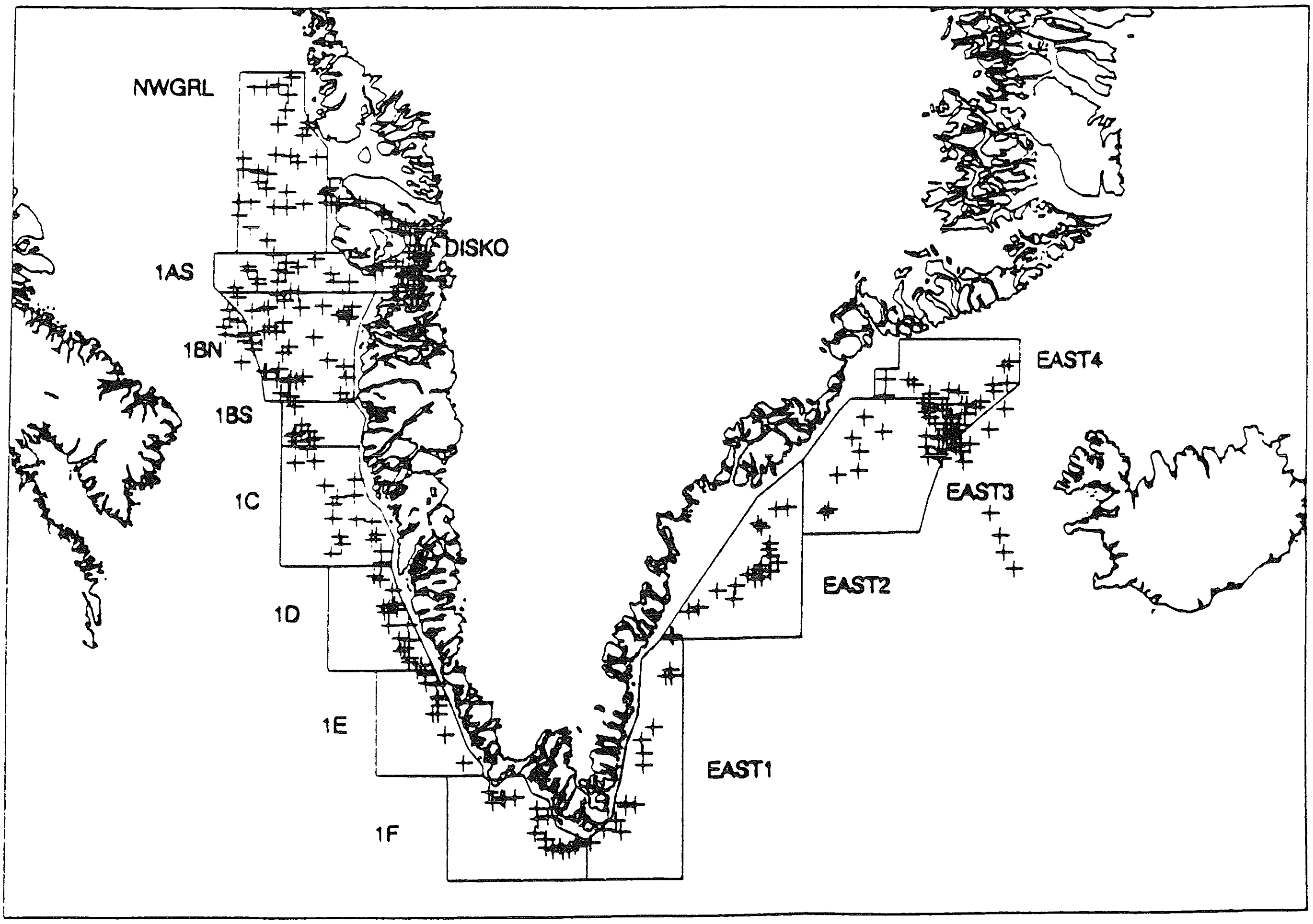
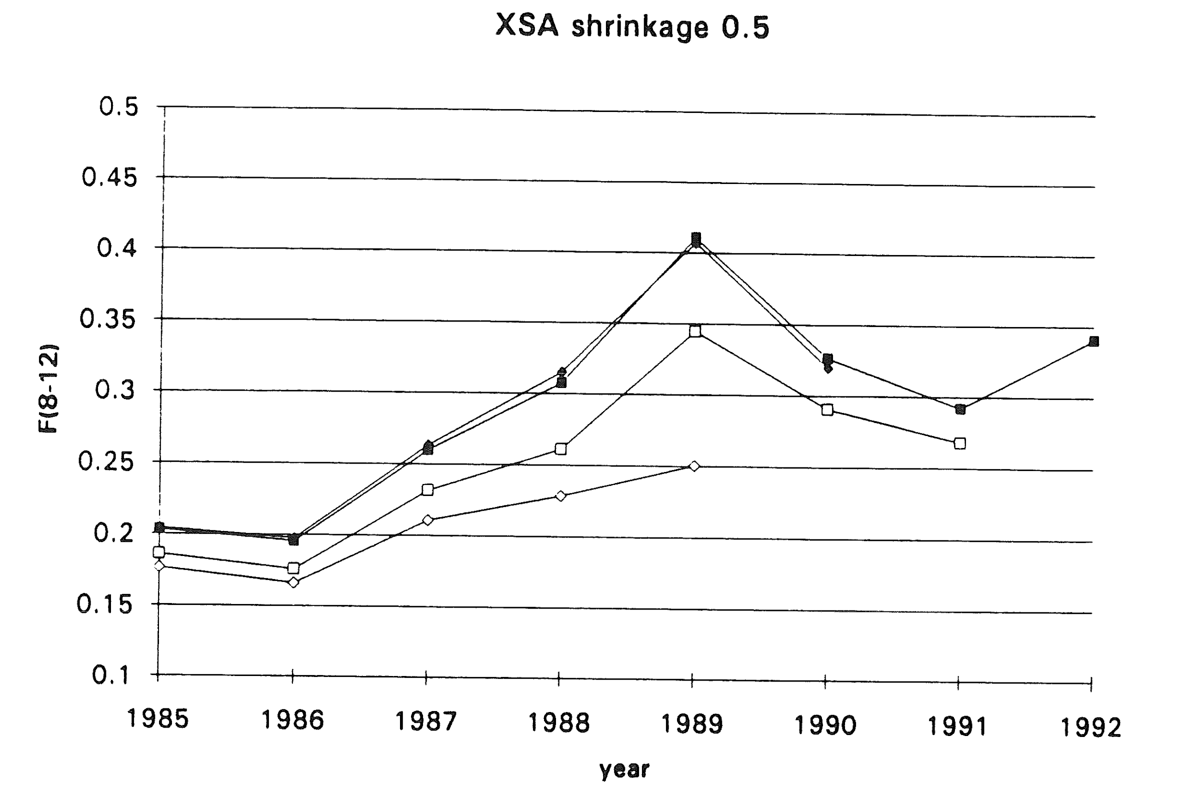
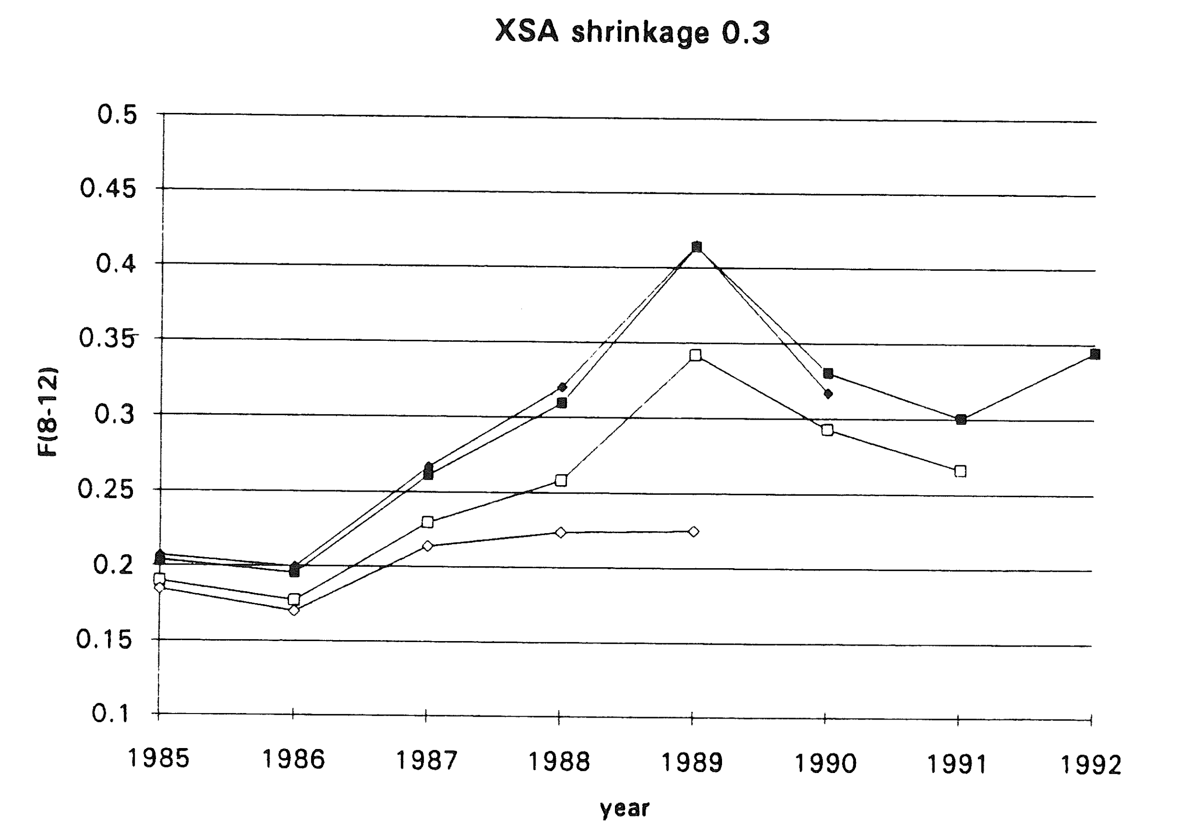


Fig. 5.1.6 Location of sub-areas and hauls in Greenland trawl survey, 1992.

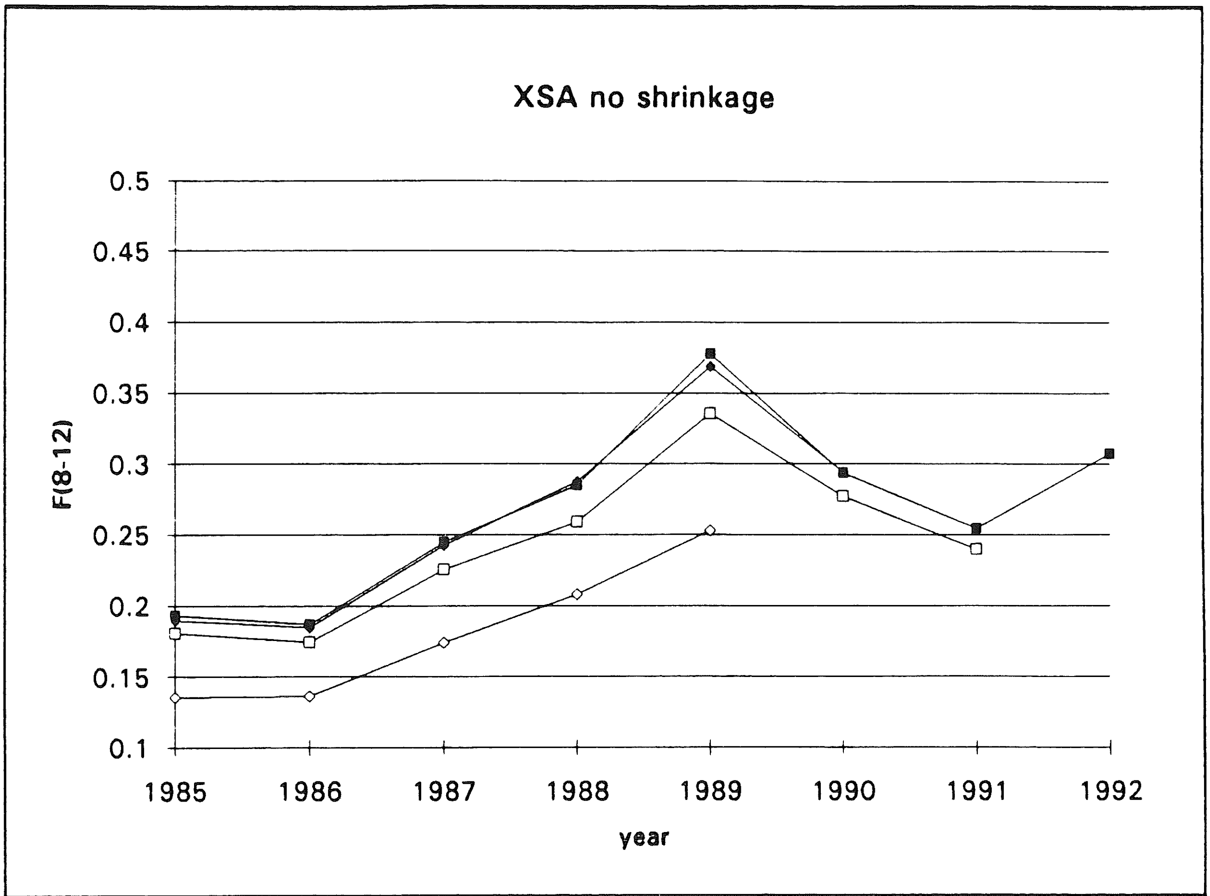
Figure 6.6.1 Retrospective analysis.

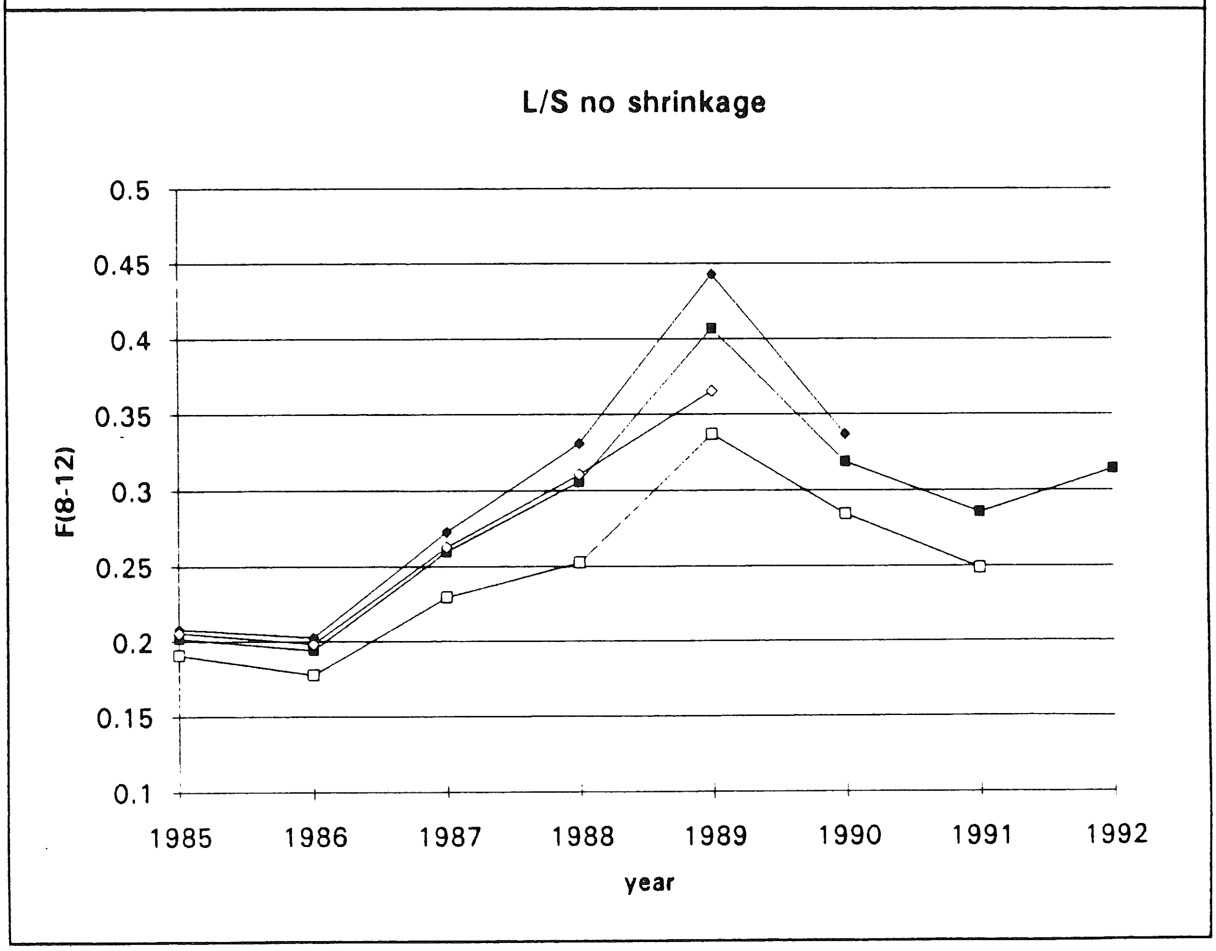




(cont'd)

Figure 6.6.1 (Cont'd).





(cont'd)

Figure 6.6.1 (Cont'd)

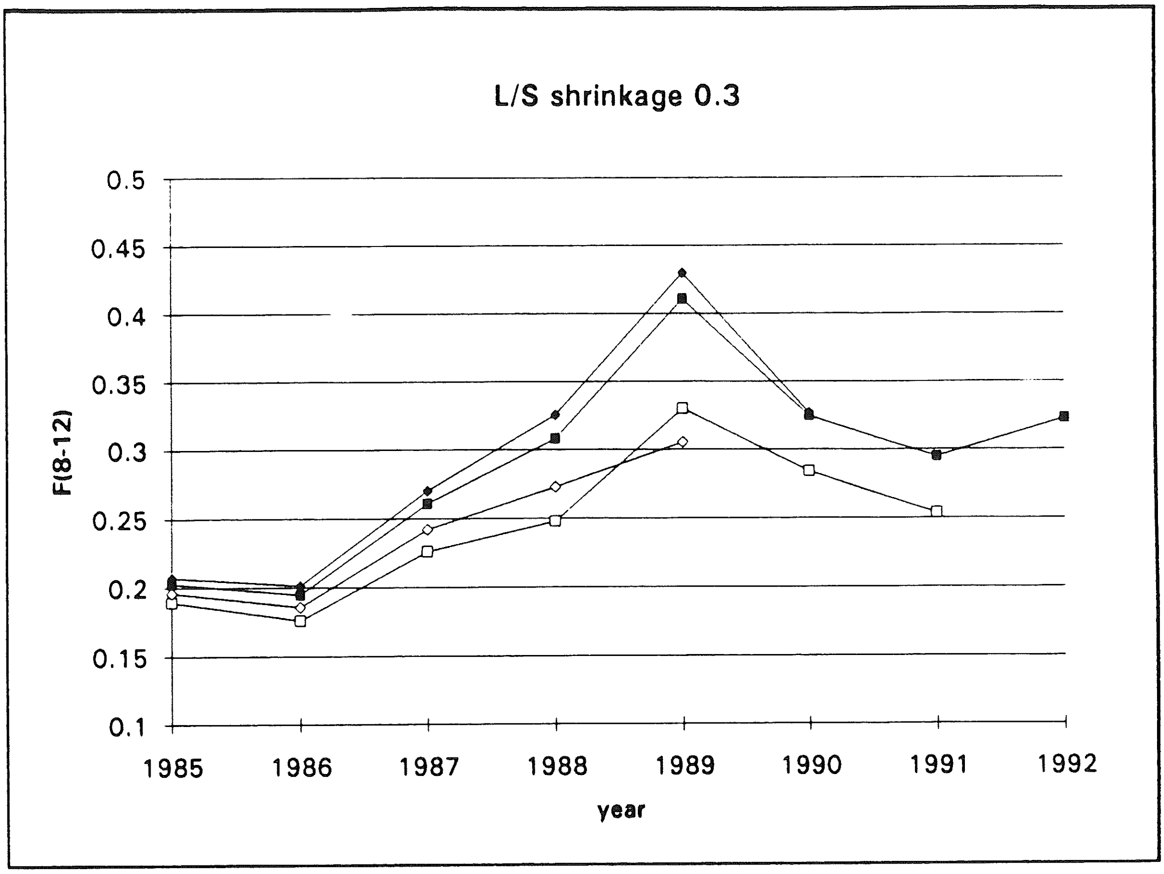
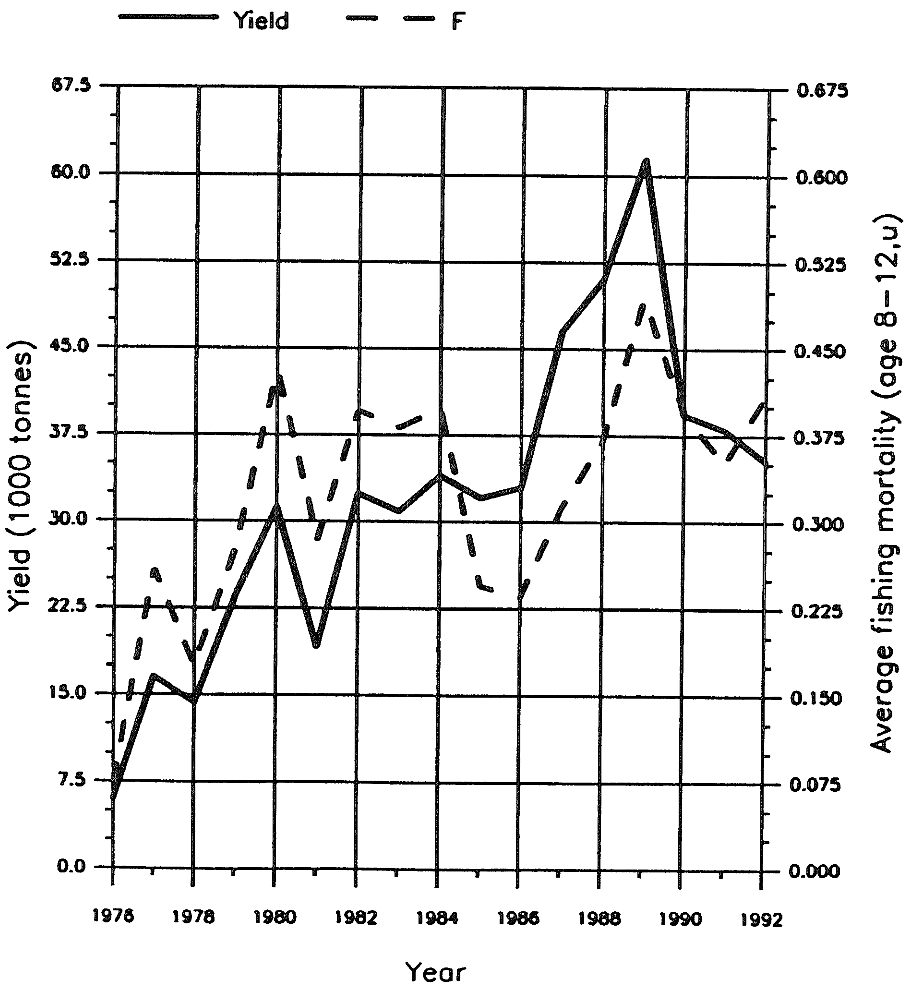


Figure 6.6.2

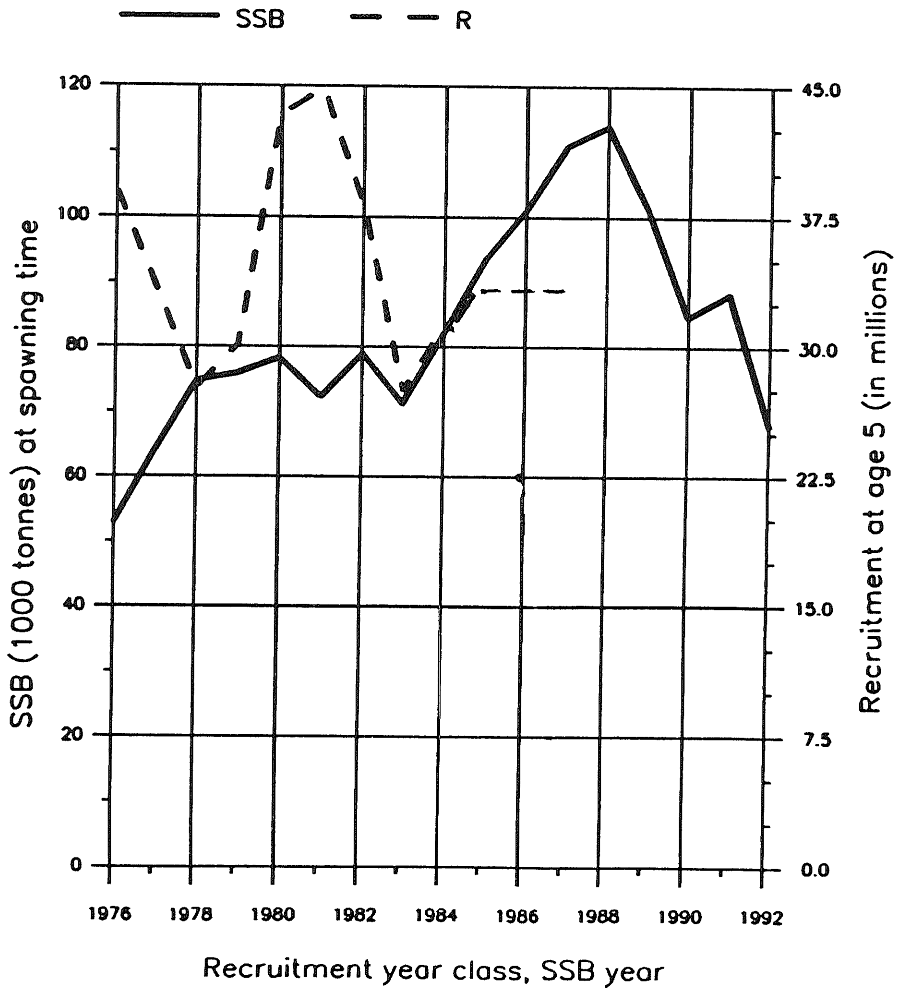
FISH STOCK SUMMARY
STOCK: Greenland halibut in the Iceland and Faroes Grounds and East Green
9–5–1993

Trends in yield and fishing mortality (F)



(run: ENDIR) **A**

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

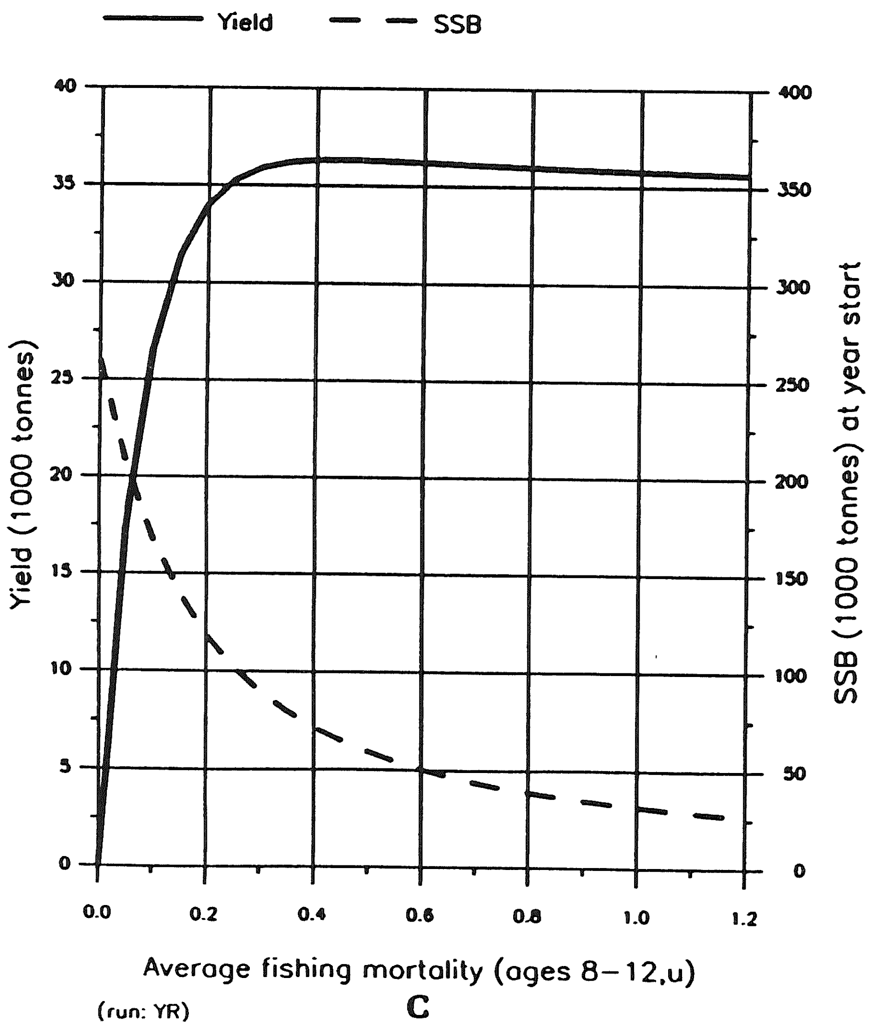


(run: ENDIR) **B**

Figure 6.7.1

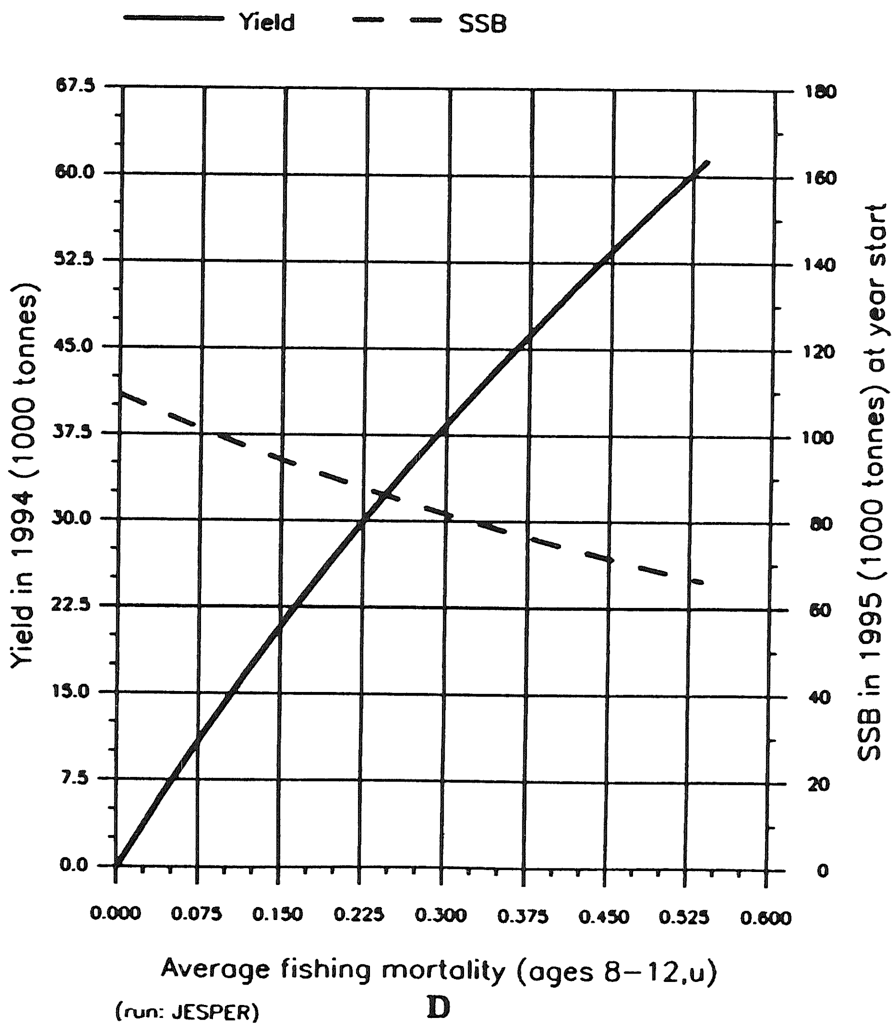
FISH STOCK SUMMARY
STOCK: Greenland halibut in the Iceland and Faroes Grounds and East Green
8–5–1993

Long term yield and spawning stock biomass



C

Short–term yield and spawning stock biomass



D

Figure 7.5.1

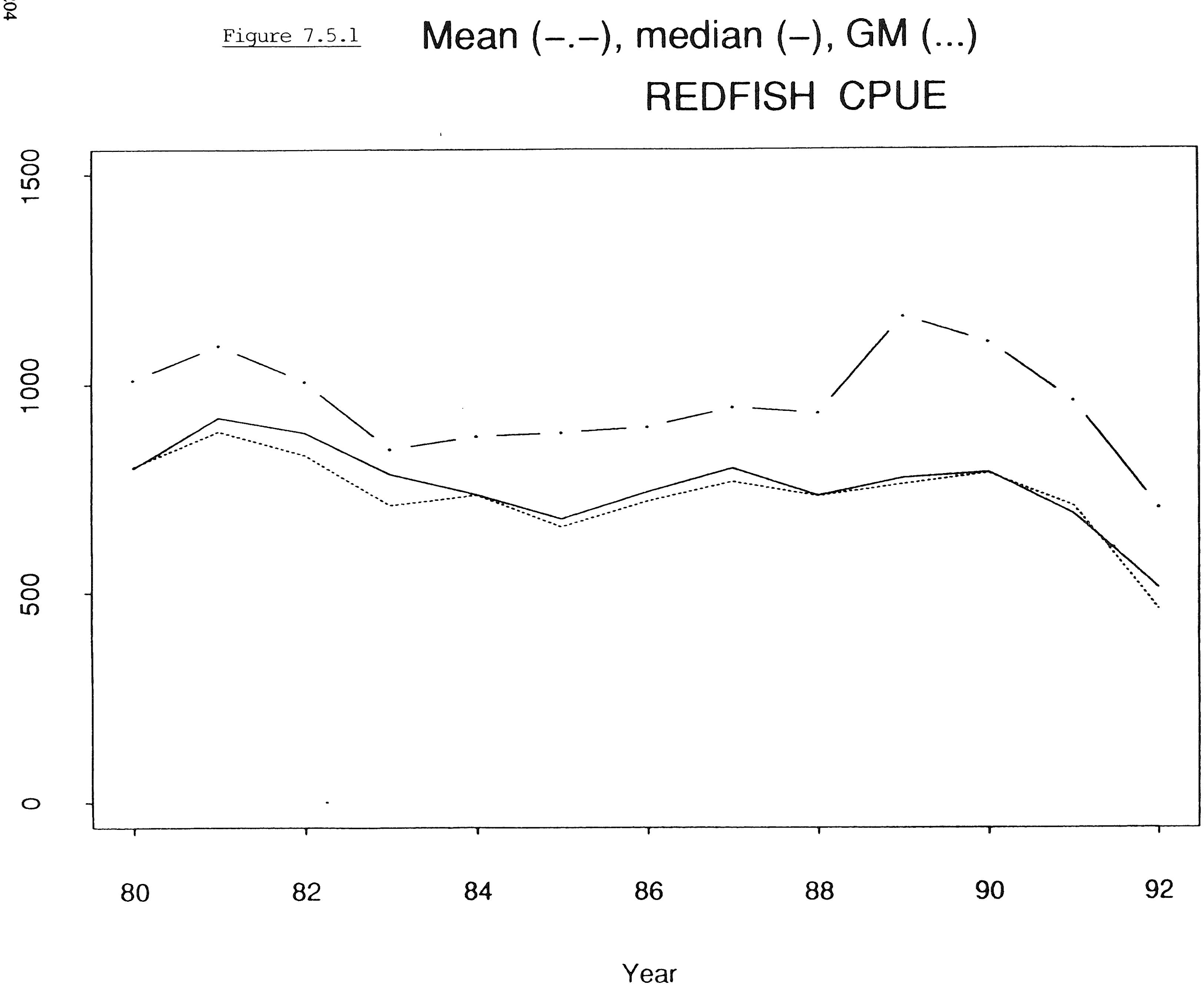

Mean (-.-), median (-), GM (...)
REDFISH CPUE
1500
1000
500
0
80
82
84
86
88
90
92
Year

Figure 7.5.2 **REDFISH Time series of sqrt(CPUE) in each statistical square**

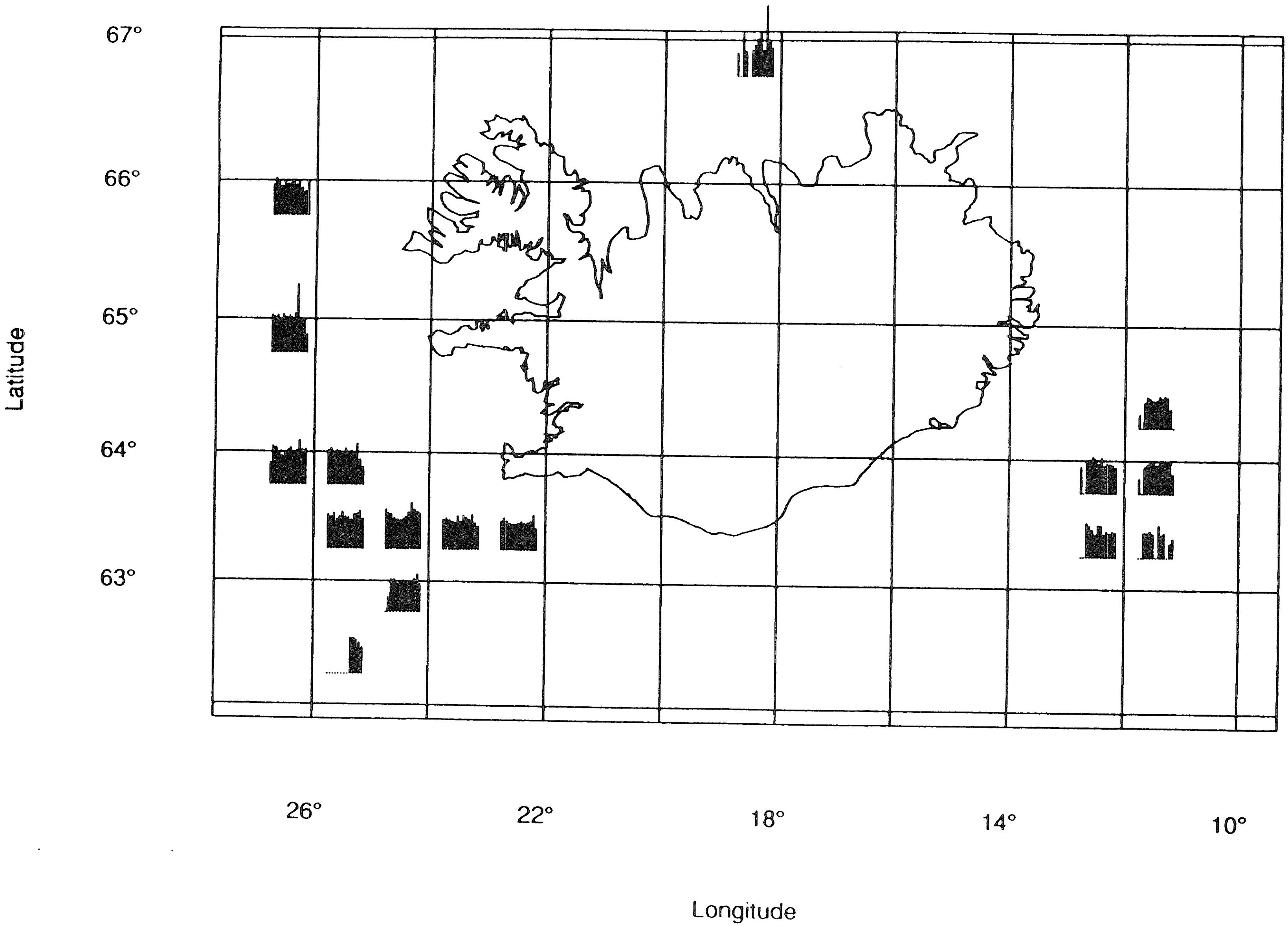


Figure 7.5.3

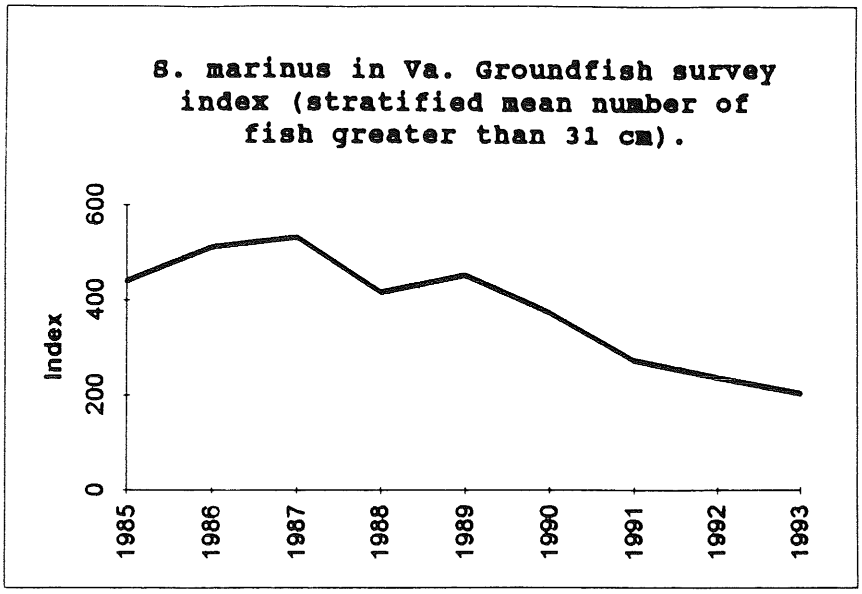
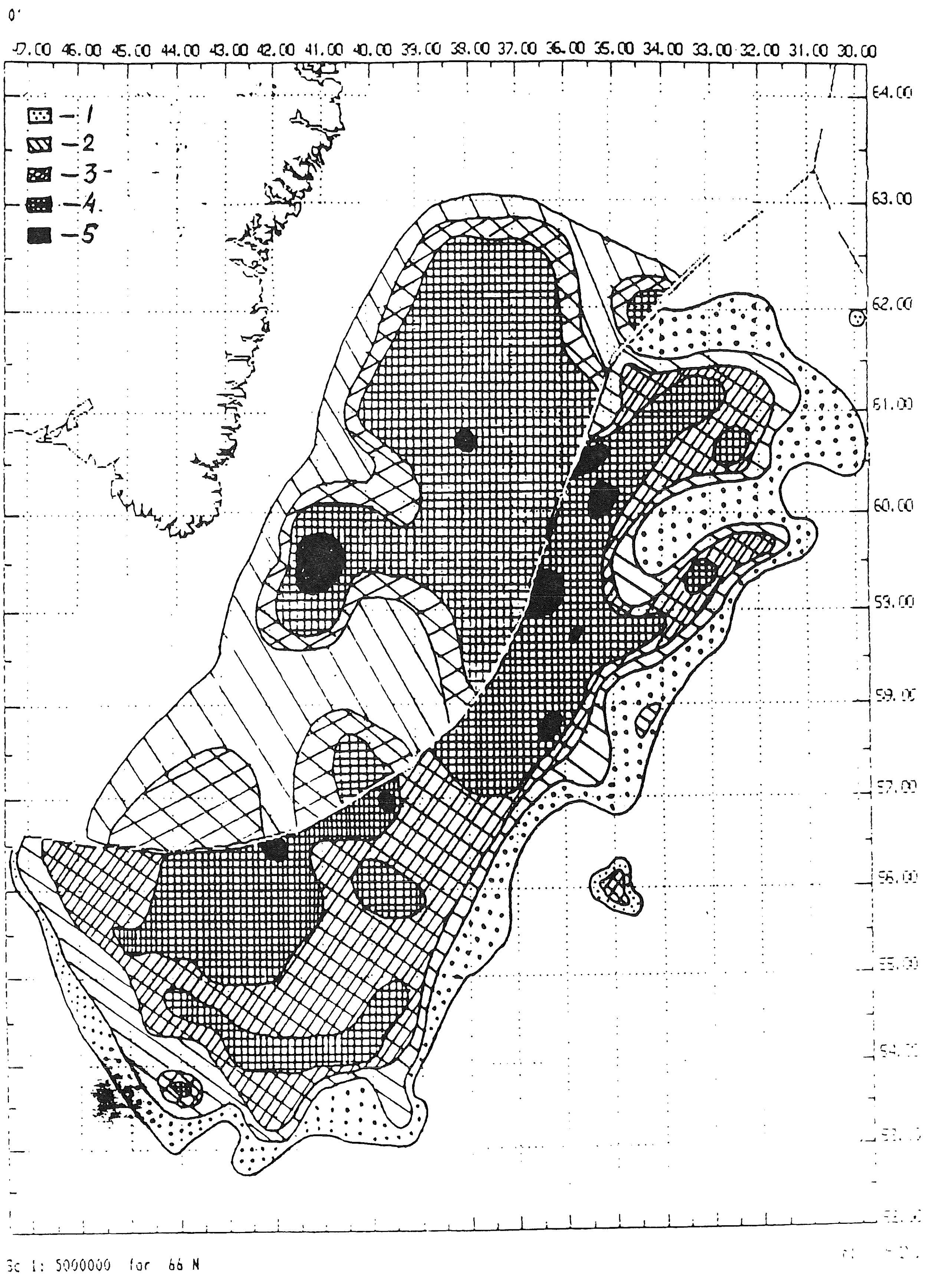

S. marinus in Va. Groundfish survey index (stratified mean number of fish greater than 31 cm).
Index
0
200
400
600
1985
1986
1987
1988
1989
1990
1991
1992
1993

Figure 7.5.4 Distribution of the Irminger Sea *S.mentella* concentrations by results from the TAS 1992.



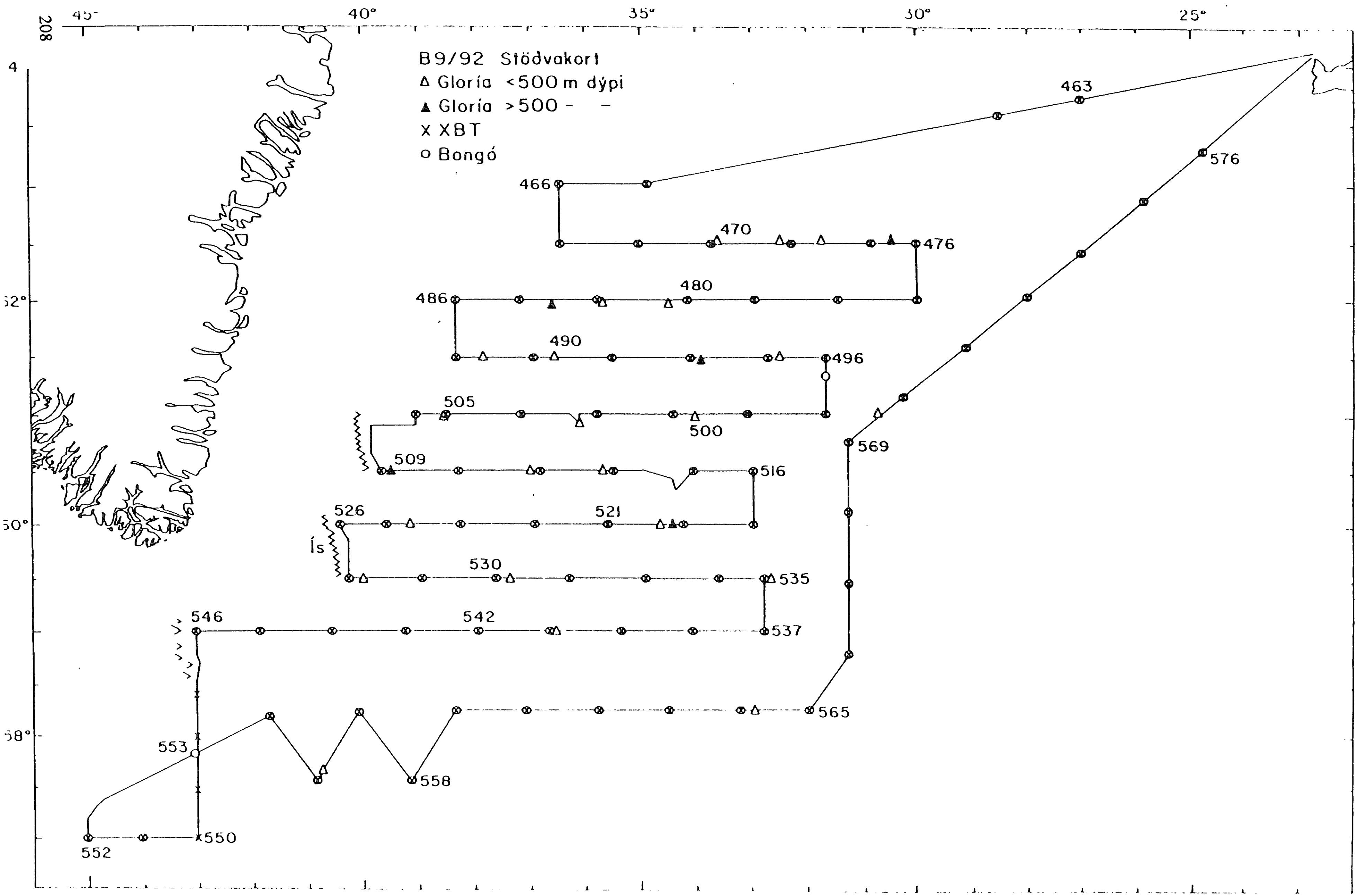


Figure 7.5.5 Cruise tracks

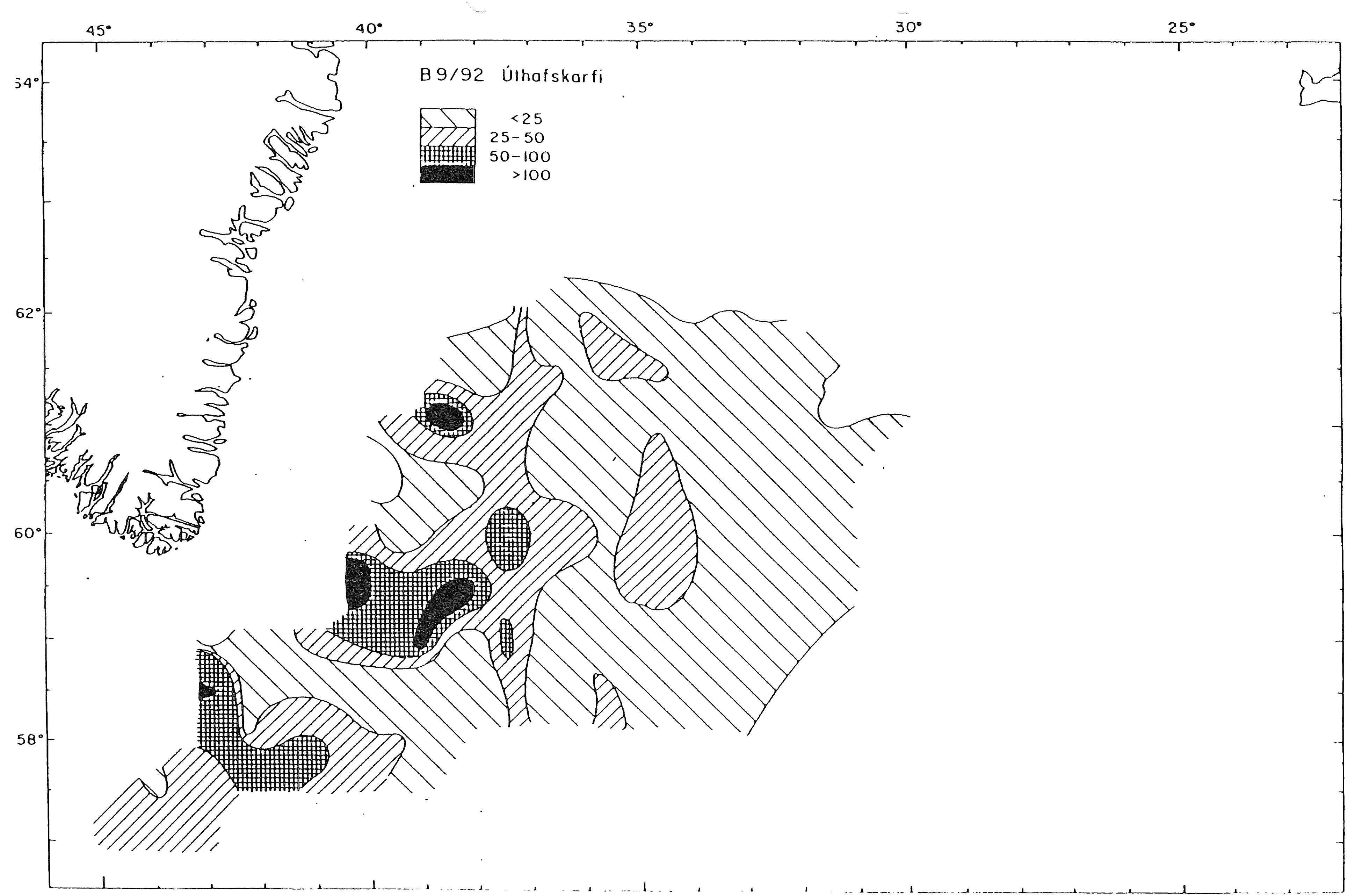


Figure 7.5.6 Relative abundance of oceanic redfish based on echo values.

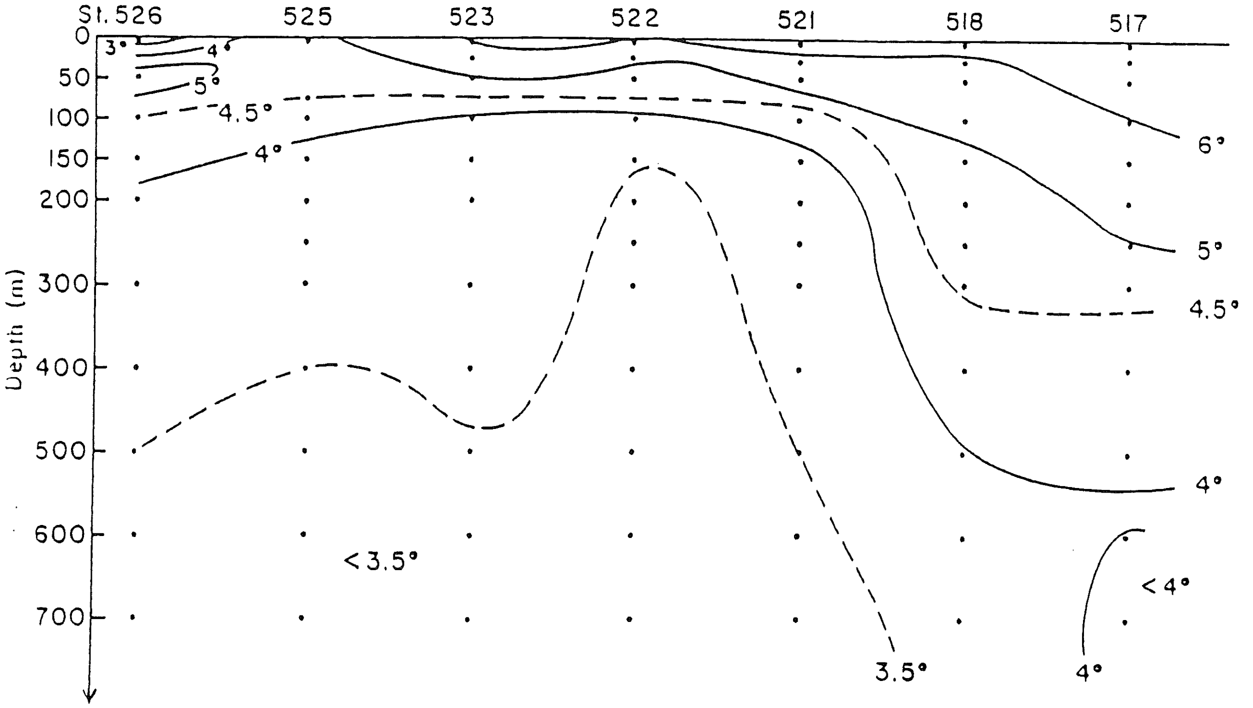


Figure 7.5.7 Vertical temperature distribution (t°C) on a section along the 60°N latitude

Figure 7.5.8 Horizontal temperature (t°C) distribution in 150m depth.

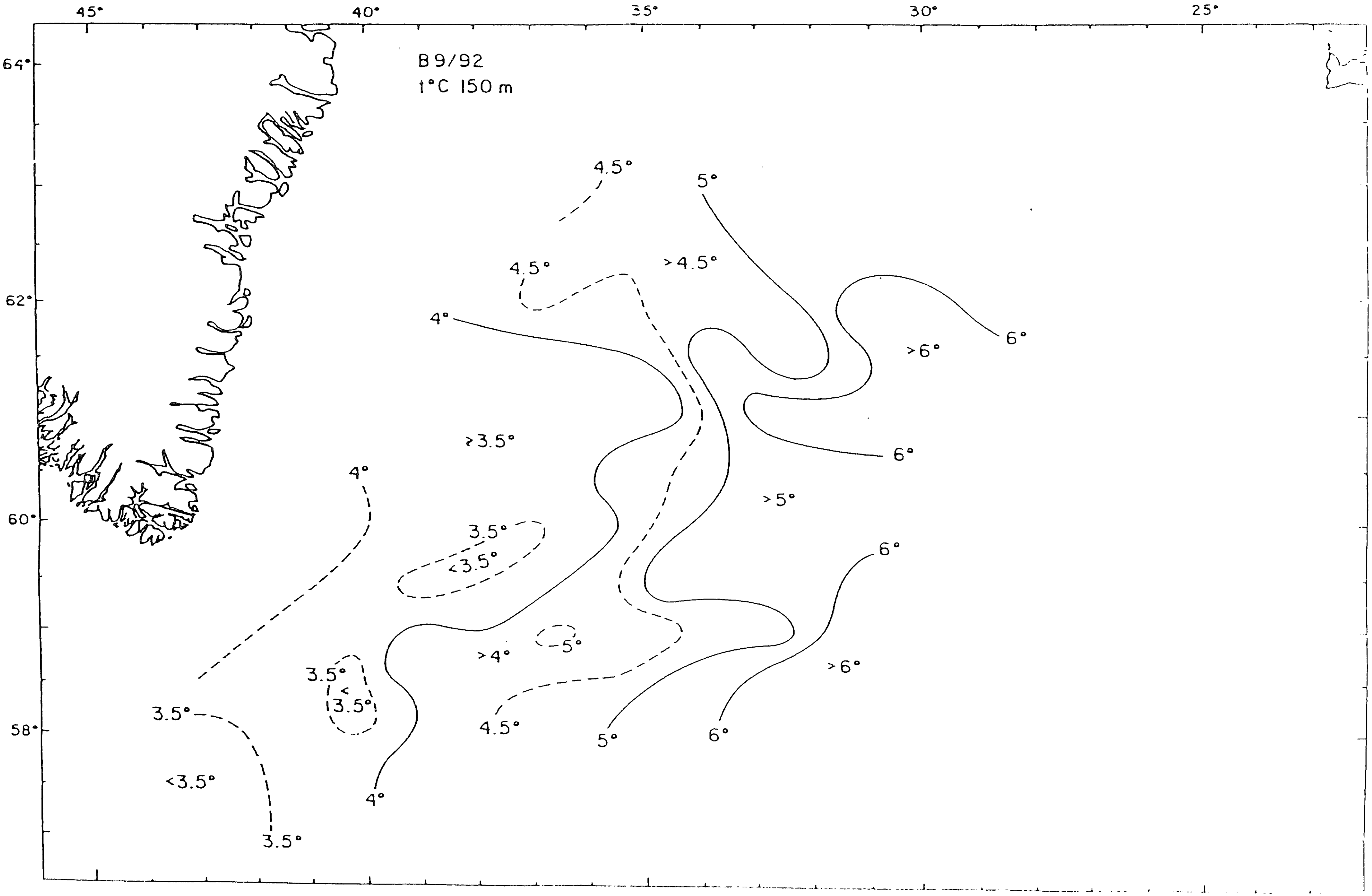


Figure 7.5.9

Catch curve for oceanic S.mentella

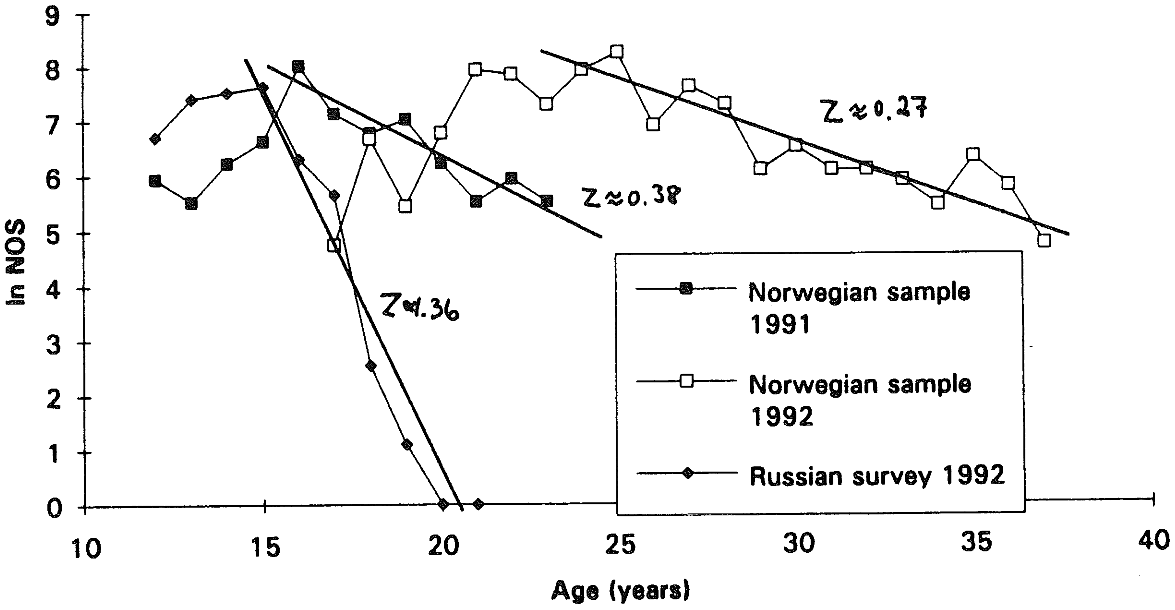


Figure 7.5.10a

Selection pattern created by the model

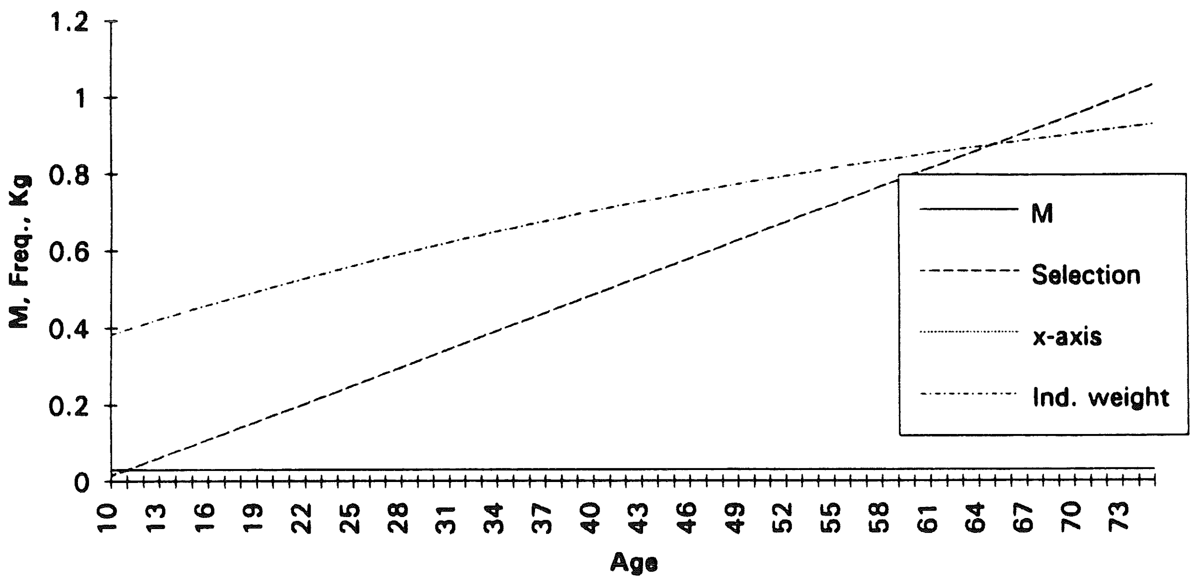


Figure 7.5.10b

Selection pattern created by the model

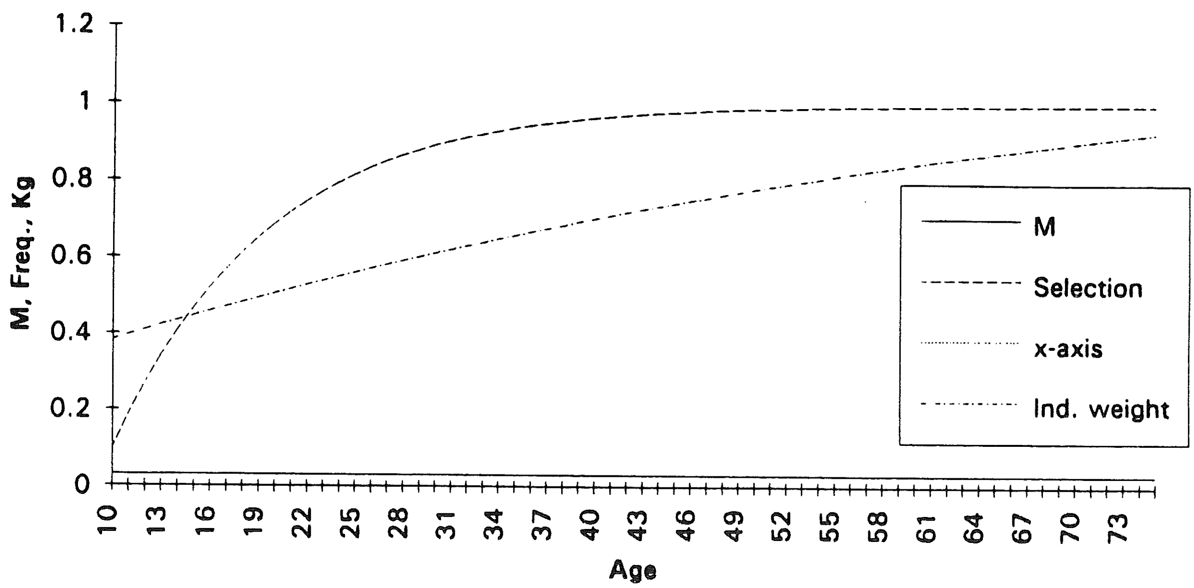


Figure 7.5.11

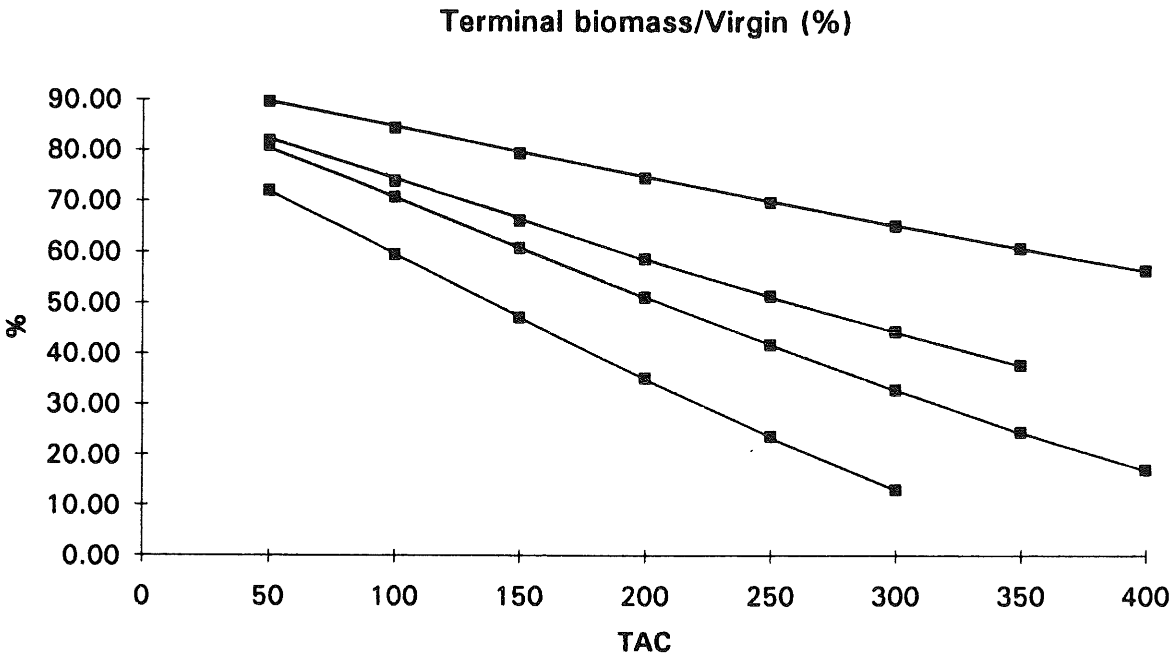
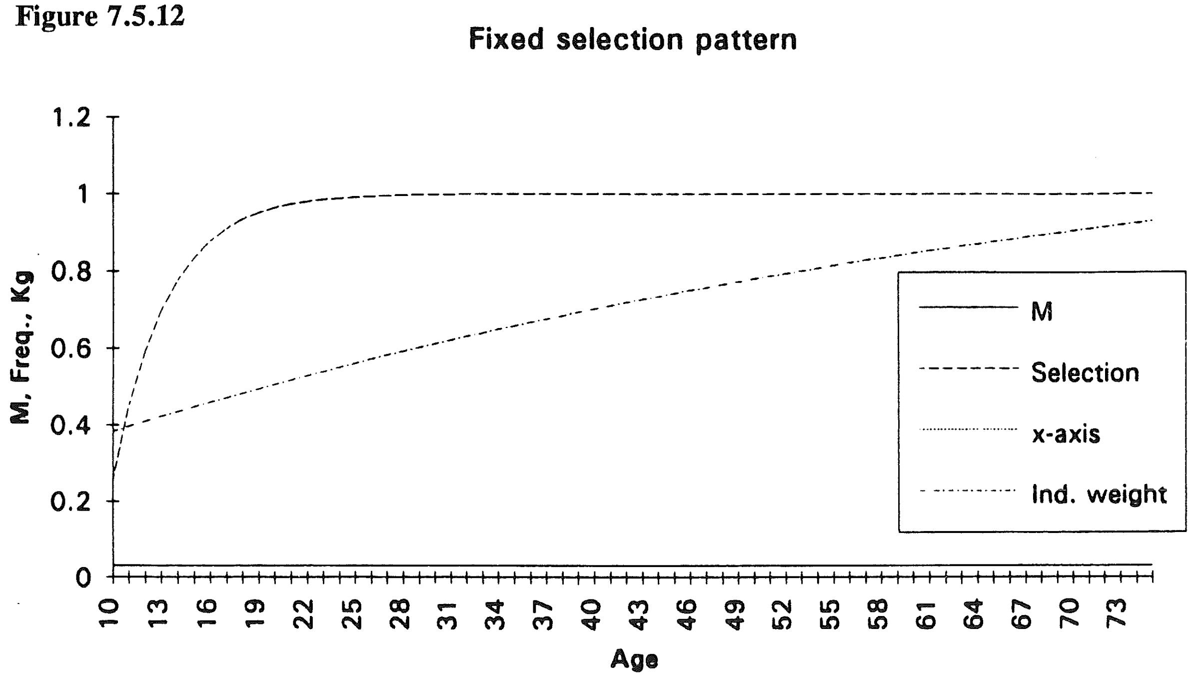


Figure 7.5.12



APPENDIX A

MEDIUM-TERM PREDICTIONS FOR THE ICELANDIC COD STOCK

by

Gunnar Stefánsson

Some medium-term simulations for the Icelandic cod were presented to the group. These are based on the same input data as other results in this report, but the methodology used included the following set of assumptions and models:

- Weight at age and maturity at age in 1993 was set to the same values as in the assessment, as was the baseline stock size.

- A stock estimate is simulated at the start of the year. This is done by assuming the overall fishing mortality to be known with a (log-scale) standard error 15% from the true value.

- Catches in future years were set according to one of the management rules in Figure A1. Thus, the catch level depends on the SSB estimate in the given year. It is assumed that there is a certain minimum acceptable catch level, which efforts will be taken to obtain. The 200,000 t catch minimum scenario is closest to the current state of affairs (although it should be noted that currently the TAC is set so that with all allowances the catches could rise to almost 250,000 t without any illegal activity).

- In the simulations, the SSB is estimated based on the fishing mortality (with an average selection pattern) and the catches are removed from the stock using the same average selection pattern as is used in the assessment in this report.

- The stock is then projected forward in numbers using the usual catch equations. The weights and maturities at age have been quite variable in recent years and therefore these are changed incrementally by taking at random one of the annual increments in the historical time series. The same year is used for computing the incrementa for all age groups in each of these forward projections.

- Recruitment in the new year is predicted based on a Beverton-Holt relationship with a=2.59 and K=88.51.

- 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 SSB is very low, 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.

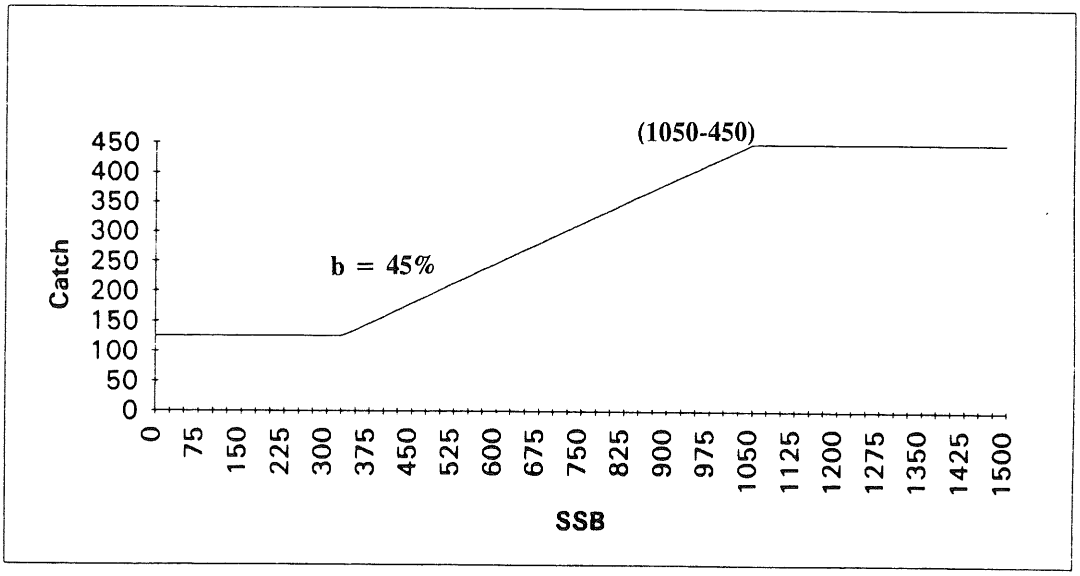
Results of these simulations are presented in Figure A2. These represent 10 out of 100 simulated stock and catch trajectories for minimum catch levels ranging from 125,000 to 200,000 t. The full simulation indicated only one instance in 100 in which the 175,000 t catch level lead to a stock crash but there is considerable probability of this occurring in the 200,000 t scenario.

It would seem therefore that continued fishing at current TAC levels is outside any reasonable definition of a safe biological limit.

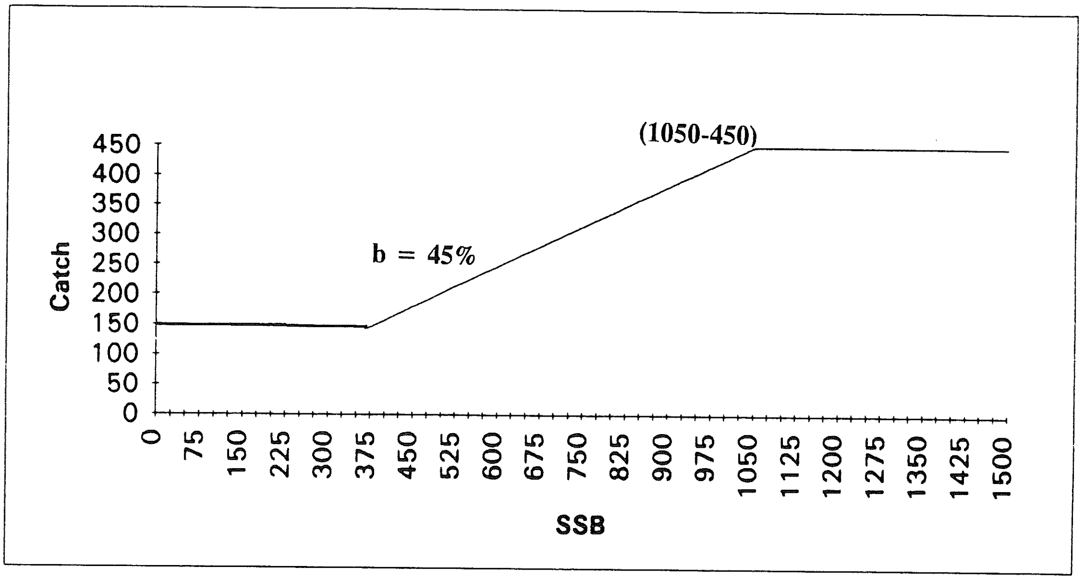
Comparing the 150,000 t and 175,000 t minimum catch levels, it is seen that the build up of the stock is much more rapid if the 150,000 t option is taken.

It should be noted that if maturity at age is not changed incrementally from one year to the next, by chosen random from the historical series of maturities, then there is a higher probability of stock collapse when the minimum catch level is set at 175,000 t.

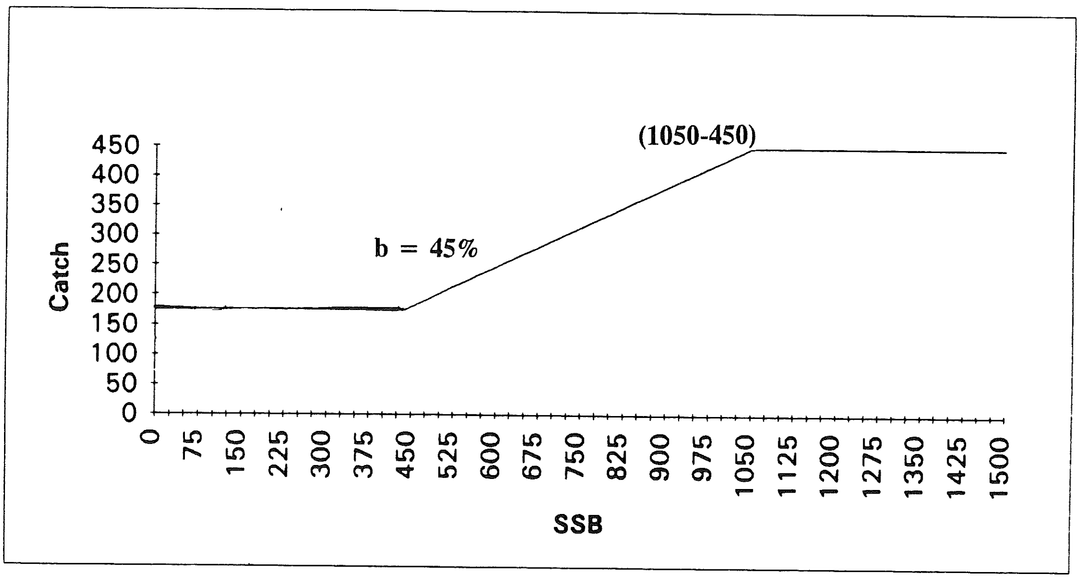
Figure A1 Catch control laws.



min = 125



min = 150



min = 175

Figure A2 Icelandic cod. Medium-term simulations.