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2 INTRODUCTION

2.1 Terms of Reference

At the 74th Statutory Meeting of ICES in 1986, it was decided (C.Res.1986/2:5:23) that the Arctic Fisheries Working Group (Chairman: Mr T. Jakobsen) should meet at ICES Headquarters from 14-24 September 1987 to assess the status of and provide catch options for 1988 within safe biological limits for the stocks of cod, haddock, saithe, redfish, and Greenland halibut in Sub-areas I and II.

2.2 Methods Used in the Assessments

For the first time, the ICES VPA tuning program (Anon., 1986) and a program (RCRTINX2) for combining recruitment indices (Anon., 1987) were used in the Arctic Fisheries Working Group. The Working Group found both methods very useful in combining the often seemingly conflicting results of various surveys. The separable VPA was also used for some of the stocks.

3 NORTH-EAST ARCTIC COD

3.1 Status of the Fisheries

3.1.1 Landings prior to 1987 (Tables 3.1-3.3, Figure 3.3A)

Final reports of landings for 1985 totalled 307,920 t which is just above the preliminary reported landings of 302,819 t used at last year's meeting. The landings provisionally reported for 1986 are 426,476 t which are above the agreed TAC of 400,000 t. From Table 3.1, it is seen that the landings have increased in all areas by very much the same quantity. From Table 3.2, it is seen that the trawl is responsible for the increase in the landings from 1985 to 1986. The decline in landings from conventional gears in Division IIA exceeded the increase by conventional gears in Sub-area I, giving a reduction in total landings for these gears.

Table 3.3 shows that all countries except "others" have increased their landings and that the largest increase is by the USSR, having more than doubled its landings from 1985 to 1986.

3.1.2 Expected landings in 1987 (agreed TAC of 560,000 t)

The expected landings in 1987 are given in Table 3.3 as a total. The figure is based on available reports of landings in the first half of 1987. The landings are not expected to reach the TAC level, but are believed to be about 545,000 t. This is well above the landings in 1986, and the main increase is expected to come from the trawl fisheries. The low availability of fish to conventional gears is the main reason for not reaching the TAC level.

3.1.3 Effort and catch per unit effort

The catch-per-unit-effort data available, except for the Lofoten fishery, are given in Table 3.4. Most of the figures show an increase in 1986 compared to the earlier 1980s. The data on catch per unit effort in the Lofoten fishery show lower values in 1987 than in 1986 (Table 3.5). The survey data show that the year classes recruiting to the spawning stock in recent years have to a large extent stayed and spawned outside the traditional fishing grounds in Lofoten and are, therefore, mostly fished outside the area covered by these data. That is the main reason for the declining trend in the CPUE figures.

3.2 Data from Catches

3.2.1 Catch in numbers at age (Table 3.24)

The catch-at-age data for 1985 were revised according to the final landing figures and the updated Norwegian composition. Age compositions for the USSR, the Federal Republic of Germany, and Spain were the same as used in last year's assessment.

For 1986, the catch at age was calculated using the landings by areas from each country for the whole year and reported age compositions from the USSR, Norway, the Federal Republic of Germany, and Spain. The UK reported length compositions which were combined with Norwegian age/length keys for the appropriate areas.

The age compositions in landings from other countries were calculated using the USSR age composition in Sub-area I, the Federal Republic of Germany age composition and the calculated UK age composition in Division IIa, and the Federal Republic of Germany age composition in Division IIb.

For 1987, the USSR, Norway, the UK, the Federal Republic of Germany, and Spain provided age and length data from their catches in the first half of the year.

3.2.2 Weight at age in the landings (Table 3.6)

Weight-at-age data were available from the USSR and Norwegian fisheries in 1986. These figures, together with the figures for 1984 and 1985, are given in Table 3.6. The averages, weighted by the catches by each country, were used as input to the assessment, and these figures are presented in Table 3.22.

3.3 Survey Results

The surveys contributing data on cod are the international O-group survey (Table 3.7), the Norwegian combined bottom trawl and acoustic survey in the Barents sea (Tables 3.7, 3.9, and 3.12), the Norwegian bottom trawl survey in the Svalbard area (Table 3.10), and the USSR combined bottom trawl and acoustic survey (Tables 3.7, 3.11, and 3.13). Also given is the estimated total stock size of cod from the acoustic part of the Norwegian surveys in the Barents Sea and Svalbard area and the Norwegian acoustic survey in the Vesterålen-Lofoten area (Table 3.14).

3.3.1 Recruitment indices

The available recruitment indices are given in Table 3.7 together with the numbers at age 3 in the latest VPA run. These data were analyzed using the ICES program RCRITNX2, and the results of this analysis are given in Table 3.8.

The estimated strengths of the 1983-1987 year classes as 3-year-olds were used as input to the assessment, except that the 1983 year class was set to 1 billion¹. The recruitment of the earlier year classes was left to be estimated by the VPA. The estimation parameters for the 1983-1987 year classes are given in Table 3.8, and the rightmost column gives the weights that were assigned to the various indices and the mean in the final estimate. All the indices are log transformed except the index of the international O-group survey, which is given as a logarithmic index.

Compared to the evaluation of the recruitment made by last year's Working Group, there are some differences. Both the 1982 and 1983 year classes were measured by the bottom trawl surveys and the acoustic surveys as very abundant. The level measured in the acoustic survey was taken to be closest to the true level. New information on the methods of acoustic surveys have indicated that fish in the upper layers of the sea have been overestimated considerably. The tuning of the different recruitment indices to the VPA confirms this information in assessing the 1982 and 1983 year classes to lower levels than previously assumed, but the relative difference in abundance of the 1982 and 1983 year classes is confirmed by this analysis.

The evaluation last year of the 1984 year class as about equal to the 1982 year class was confirmed by the analysis.

The data available on the 1985 and 1986 year classes show that the optimistic impression from the O-group survey is not sustained. The data indicate that high mortality on these year classes may have reduced them. The 1987 year class is estimated only on the basis of the O-group index which indicates that it is a poor year class.

¹Based on a discussion after a preliminary run.

3.3.2 Weight at age in the stock

The length at age from the Norwegian survey in January-February in the Barents Sea is given in Table 3.15 for ages 3-8. This gives a picture of the changes in growth that have occurred in the period 1968-1987. The weights at age from the same survey were taken as the weights at age in the stock. These weights are given in Table 3.23 as input data to the assessment. For inaccurate values, the figures from the old data series were used from the previous year.

3.3.3 Maturity at age in the stock

The available figures of maturity at age from the USSR and Norway for 1984-1987 are given in Table 3.16. The averages of these figures for each year were used as input to the assessment.

3.3.4 Tuning the VPA to survey results

It was decided by the Working Group to use the tuning module of the ICES VPA program to obtain initial VPA results. The age range chosen for tuning was 3-9 years and data from 1982 to 1986 were used. The surveys containing these data are the Norwegian and USSR bottom trawl surveys and the Norwegian acoustic survey in the Barents Sea.

Data on effort and catch at age are available for some trawl fisheries and were also included in the analysis. The data entered were from the USSR fisheries in Sub-area I and Division IIA, the Norwegian trawl fisheries in the same areas, and the Spanish fishery in Division IIB. All input data are given in Table 3.17.

The results of the analysis are presented in Tables 3.18 and 3.19 and in Figure 3.1. The estimated F values from each fleet are given in the rightmost column of Table 3.18 and the final F for that age was estimated using a weighting procedure involving the precision of each of the "fleet" estimates. The resulting input Fs in 1986 and the estimated population sizes are given as the VPA printout in Table 3.19.

3.4 Stock Assessment

3.4.1 Estimation of fishing mortality using separable VPA

From the F values given in Table 3.19 it was decided to use input $F = 0.90$ at age 7 and a selection value of $S = 0.75$ for the 14-year-olds as input to the separable VPA. The results of this are shown in Tables 3.20 and 3.21. It should be noted that age groups 1, 2, and 10-14 have been down weighted, and that only the years 1982-1986 have been assigned a full weight in the analysis. The matrix of residuals does not show any large residuals or pattern in the residuals that should cause any rejection of the results. The F values and the population sizes generated by the separable F pattern are shown in Table 3.21.

3.4.2 Assessing the present state of stock

Following the recommendations of the Methods Working Group, the option of using the final population of the separable VPA as input to an ordinary VPA was chosen. The input F_s in 1986 for age 14 in earlier years were updated with the calculated values, and the results of an ordinary VPA using these values are given in Tables 3.25 and 3.26 and in Figures 3.3A and 3.3B. It should be noted that the input F values for 1986 do not necessarily correspond with the F values generated by the separable VPA for 1986. The latter should be used to analyze any trends in the fishing mortality over the years.

The estimates of the present stock size are shown in Table 3.27 as the ignored parts of Table 3.26 have been substituted by the estimated recruitment and the figures have been recalculated.

3.4.3 Discarding

Members of the Working Group reported that discarding of the 1982 and 1983 year classes had taken place in the first part of 1987. Some data were available from Norway, and some discarding appears to have occurred also in most of the other fleets, but not in the USSR fishery. It was mainly the 1983 year class which suffered by the discarding, initiated by its low growth (Tables 3.15 and 3.23) combined with large catches. The available Norwegian length and age data do not permit any reliable assessment of the age compositions of the discarded fish. However, the data indicate a high level of discarding in 1986 and in the first half of 1987. As many as 80 million fish of the 1983 year class might have been discarded, representing a long-term loss to the fishery of about 80,000 t when fishing at F_{max} with the present fishing pattern.

The discarding rate is expected to be reduced drastically during late 1987 due to increased individual growth of the 1982 and 1983 year classes. In 1988, the discarding should be of minor importance.

The discarding in 1986 and 1987 is not reflected in the stock size in numbers for 1988 (Table 3.25), and the short- and long-term predictions may, therefore, be too optimistic (Tables 3.29 and 3.30).

3.5 Predictions

3.5.1 Input variables to the prediction

The input variables are given in Table 3.28 together with an indication of their origin. The calculation of weight at age in the stock for the years following 1987 was made on the basis of assuming a normal growth of 11 cm per year and using the lengths for 1987 given in Table 3.15 as a basis. The formula: $\text{Weight} = \text{Length}^3 \times K$ was used with $K = 0.008$ for 3- and 4-year-olds and $K = 0.009$ for older fish. The weights in the catches were taken as the average of the weight at age in the stock for a year class and its weight in the stock the year after.

3.5.2 Biological reference points

The analysis of yield per recruit using the data for 1988 in Table 3.28 gave $F_{0.1(5-10)} = 0.17$ and $F_{\max(5-10)} = 0.35$ (Figure 3.3C). From Figure 3.2, showing the recruit/spawning stock relationship, and Figure 3.3C, showing the spawning stock biomass-per-recruit relationship, $F_{\text{med}} = 0.80$ and $F_{\text{high}} = 1.85$ were estimated. The level of fishing mortality in 1987 was estimated to be $F = 0.80$, i.e., at the F_{med} level.

3.5.3 Fishing mortalities in 1987 and stock at 1 January 1988

The estimated landings in 1987 (Table 3.3) and the fishing pattern estimated by the separable VPA were used to predict the landings by age in 1987. These catches, the generated F values, and the stock at the beginning of 1988, using the estimated recruitment, are given in Table 3.27.

3.5.4 Short- and medium-term predictions (Tables 3.29-3.30, Figure 3.3D)

The usual predictions at $F_{0.1}$, $F_{\max}$, and at the continued 1987 level are shown in Table 3.29. In addition, an alternative of achieving $F_{\max}$ in 1989 by constant catches of 530,000 t both in 1988 and 1989 is shown. The stock biomasses and spawning stock biomasses until the beginning of 1990 are also shown.

To indicate the consequences of different fishing mortality levels and aiming at the $F_{\max}$ in different years, projections of catches and stock sizes until 1993 were made. The recruitment of 3-year-olds in the years 1991-1993 was set at 200 million individuals each year. This corresponds to the situation of low recruitment observed in the 1980s.

The alternatives in the order they appear in Table 3.30 are as follows: 1) reaching $F_{\max}$ in 1989 by constant catches in 1988 and 1989, and $F_{\max}$ the rest of the years; 2) reaching $F_{\max}$ in 1990 by a constant catch of 600,000 t each year, and $F_{\max}$ the rest of the years; 3) reducing to $F_{\max}$ in 1990 by a reduction of 0.15 in the fishing mortalities each year; 4) reaching $F_{\max}$ in 1993 by reducing the fishing mortalities by 15% each year; 5) keeping the 1987 fishing mortality level in 1988 and thereafter reducing it by 0.15 each year and reaching $F_{\max}$ in 1991; and 6) keeping the 1987 level all the years.

The rightmost column in Table 3.30 shows the accumulated catch for all the years.

As noted, the results of the predictions may be too optimistic due to the high discard rate of the 1983 year class. However, the estimate of the size of this big year class has a fairly large standard error which may also affect the prediction results.

4 NORTH-EAST ARCTIC HADDOCK

4.1 Status of the Fisheries

4.1.1 Landings prior to 1987 (Tables 4.1-4.3, Figure 4.3A)

The final figure for landings in 1985 was 41,270 t which was very close to the preliminary figure given in last year's report. The preliminary figure for 1986 is 96,458 t which is somewhat lower than the agreed TAC and close to the expected landings given in last year's report. The increase in landings is large for all areas, continuing the trend in Sub-area I and Division IIb and reversing the trend in Division IIa (Table 4.1).

The percentage increase in landings from 1985 to 1986 is at the same level both in trawl and conventional gears (Table 4.2). Landings by country are given in Table 4.3. All countries increased their landings, except Spain.

4.1.2 Expected landings in 1987 (agreed TAC of 250,000 t)

The expected total landings in 1987 are given in Table 4.3. This figure is based on catch data for the first half of 1987 given to the Working Group. The landings are not expected to reach the TAC for 1987, but to be about 210,000 t.

4.1.3 Effort and catch per unit effort

Catch-per-unit-effort data are given in Table 4.4. Data for the USSR fisheries in Sub-area I were available for 1985 and 1986 in addition to the data from the Norwegian fisheries.

4.2 Data from Catches

4.2.1 Catch in number at age (Table 4.19)

The landings by age were revised for 1985 using the final figures for landings and age distributions from the USSR, Norway, the Federal Republic of Germany, and Spain. Norwegian age distributions from trawl catches were used for the UK, the Federal Republic of Germany, and the Faroes in Sub-area I, for the UK, the Faroes, France, and the German Democratic Republic in Division IIa, and for all countries in Division IIb.

For 1986, the available data for calculating the landings at age were landings by area for each country for the whole year and age distributions from the USSR, Norway, and the Federal Republic of Germany. Also available was a length distribution from the UK fishery in Division IIa.

In Sub-area I, the age distribution in the Norwegian trawl fishery was used for the landings by age of the UK and Faroes fisheries. This was also the case in Division IIa for the landings by age for France, the Faroes, and the German Democratic Republic.

The landings by age for the UK were determined using length distributions from the UK fishery and age-length keys from the Norwegian trawl fishery.

For 1987, Norway, the USSR, the UK, and the Federal Republic of Germany provided age distributions from their fisheries in the first half of the year.

4.2.2 Weight at age in the landings (Table 4.5)

Weight data were available from the USSR and Norwegian fisheries for 1986. These figures together with the data for 1984 and 1985 are given in Table 4.5. The means, weighted by the respective landings, were used in the assessment and are given in Table 4.12.

4.3 Survey Results

The surveys contributing data on haddock are the international O-group survey (Table 4.6), the Norwegian combined bottom trawl and acoustic survey in the Barents Sea (Tables 4.6, 4.8, and 4.10), and the USSR combined bottom trawl and acoustic survey in the Barents Sea and Svalbard area (Tables 4.6, 4.9, and 4.11).

4.3.1 Recruitment indices

The available recruitment indices are given in Table 4.6 together with the latest VPA figures. These data were treated with the ICES recruitment analysis program RCRTINX2, and the results are presented in Table 4.7. The sizes of the 1983-1987 year classes were taken from this table, whereas the previous year classes were left to be estimated by the VPA. This table also gives the results of the weighting against the various survey indices for the 1983-1987 year classes.

The recruitment of 3-year-olds in 1986 of 590 million is higher than the 400 million estimated by the 1985 Working Group, but lower than the 700 million estimated last year. The estimate of the 3-year-olds in 1987 of 162 million is below the 200 million estimated last year, but well above the 75 million estimated in 1985. The 31 million estimated as 3-year-olds in 1988 is below both the 50 million estimated in 1985 and the 100 million estimated in 1986. The 30 million estimated for the 3-year-olds in 1989 is far below the estimate of 400 million made last year. All these values were used in the catch prediction. The very low estimate of 12 million for the 3-year-olds in 1990 was not used but was substituted by the geometric mean recruitment of 39 million, since the international O-group index shows a very poor fit to the 3-year-olds in the VPA.

4.3.2 Weight at age in the stock (Table 4.13)

The weights at age from the Norwegian combined bottom trawl and acoustic survey carried out in January-February were taken as the stock weights at age for age groups 3-4 in 1985 and 3-5 in 1986

because these weights differed substantially from the old time series which was used up to 1984.

4.3.3 Maturity at age

The USSR provided maturity ogives for haddock for the years 1981-1986 (Table 4.14). Because of some inconsistencies in the data, the Working Group decided to use the average of the data series as the maturity ogive for the years 1981-1986.

4.3.4 Tuning the VPA to survey results

Using the tuning module in the ICES VPA program, age groups 3-7 from the years 1983-1986 were used to give a first stock-size-at-age estimate of haddock. The surveys used were the Norwegian bottom trawl survey in the Barents Sea (Table 4.8), the USSR bottom trawl survey (Table 4.9), and the Norwegian acoustic survey in the Barents Sea (Table 4.10). The results of the tuning are given in Tables 4.15 and 4.16 showing the tuning results and the fishing mortalities and stock size estimates.

The trends in log catchability at ages 3-6 resulting from the tuning program are shown in Figure 4.1.

4.4 Stock Assessment

4.4.1 Estimation of fishing mortality using separable VPA

From the fishing mortality coefficients in Table 4.16, it was decided to use an F value of $F = 0.30$ on the 4-year-olds and a selection value of $S = 1.0$ on the 13-year-olds as input to a separable VPA. It was also decided to use the years 1982-1986 as high-weighted years in the analysis. The results from the separable VPA are given in Table 4.17 showing the matrix of residuals, the F pattern over the years, and the S pattern over the ages. It should be noted that age groups 1, 2, and 10-13 were assigned a low weight in the analysis. The estimated fishing mortalities and population sizes are shown in Table 4.18.

4.4.2 Assessing the present state of stock

The option of creating the input fishing mortality from the final population in 1986 from the separable VPA was used to perform a traditional VPA. In this way, the VPA was fitted to the pattern from the separable VPA, reducing the effects of errors in the catch-at-age distribution of the final year. The fishing mortalities estimated from this VPA are given in Table 4.20 and Figure 4.3A and the population sizes in Table 4.21 and Figure 4.3B.

The stock sizes in 1986 and 1987, with recruitment at age 3 taken from the recruitment analysis, are shown in Table 4.22.

4.5 Predictions of Catch and Biomass

4.5.1 Input variables to the predictions

The input variables to the prediction are given in Table 4.23. The basis for calculating the different parameters is also shown in the table.

4.5.2 Biological reference points

Yield and spawning stock biomass per recruit were calculated on the basis of the data in Table 4.23, giving $F_{0.1} = 0.15$ and $F_{max} = 0.39$ (Figure 4.3C). F_{med} and F_{high} were estimated to be 0.28 and 1.20, respectively, on the basis of Figures 4.2 and 4.3C. The level of exploitation in 1987 was estimated to be $F = 0.31$.

4.5.3 Fishing mortalities in 1987 and stock at 1 January 1988

Using the fishing pattern estimated by the separable VPA, the expected catch of 210,000 t in 1987 (Table 4.3) was split into numbers at age. This result, together with the generated F values and the resulting stock size at the beginning of 1988, is given in Table 4.22.

4.5.4 Predictions for 1988 and 1989

The results of the projections are given in Figure 4.3D and Table 4.24 with management options for fishing mortality at $F_{0.1}$, F_{max} , and F_{87} . It should be noted that discarding of haddock has also taken place in the same fleets that have discards of cod (see Section 3.4.3). This could mean that especially the 1983 year class will be reduced to a lower level at the beginning of 1988 than assumed in the predictions.

5 NORTH-EAST ARCTIC SAITHE (SUB-AREAS I AND II)

5.1 Status of the Fisheries

5.1.1 Landings prior to 1987 (Table 5.1, Figure 5.3A)

Revised landings reported to Bulletin Statistique for 1985 were 107,147 t which is nearly 52,000 t less than in 1984. Preliminary figures indicate that landings continued to fall in 1986 to 70,380 t, which was the level expected by last year's Working Group.

5.1.2 Expected landings in 1987

As in earlier years, the Norwegian fishery was not restricted by quotas, although Norwegian authorities have indicated that the fishery may be stopped if 84,000 t is exceeded. Landings by gear

reported from Norway for the first six months of 1987 were compared with corresponding figures from 1985 and 1986. This indicated that total landings would be about 60,000 in 1987. However, the purse seine landings in July and August have increased considerably compared to last year and this will probably bring the total landings up to about 70,000 t, the same as in 1986.

5.1.3 Effort and catch per unit effort

Figure 5.1 shows the landings for the main gear categories since 1977, including estimates for 1987. There has been a large decline in the landings from purse seine and trawl. The purse seiners catch the youngest fish, mainly age groups 2-5. The trawlers catch fish of all ages, but mainly immature fish from age groups 3-6. The gillnet fishery is based on spawning fish, age 6 and older.

Table 5.2 shows the number of vessels of different size groups that have taken part in the purse seine fishery since 1982, with corresponding catch and catch per vessel. On the basis of these data, indices of effort were calculated by weighting the number of vessels in each size group with the catch per vessel in 1982/1983. The indices were scaled to the 1982/1983 level and are given in the text table below.

Year	1982	1983	1984	1985	1986
Index of purse seine effort	1.04	0.96	0.84	0.63	0.54

Although it is difficult to estimate effort by purse seiners, the indices, which reflect the declining number of vessels in the fishery, strongly suggest that the effort by the purse seiners has been considerably reduced in recent years. It should also be noted that the purse seiners in 1986 were severely restricted in their fishing by the closure of areas with too many undersized fish.

Table 5.3 shows catch, effort, and catch per unit effort for the main group of Norwegian trawlers, i.e., stern trawlers of 250-500 GRT. The data include only days with more than 50% saithe on trips with more than 50% saithe in the catches. The effort figures should, therefore, represent effort directed towards saithe. The data, which on average represent about 40% of the Norwegian trawl landings, were used to estimate the total effort by trawlers given in the text table below.

Year	1981	1982	1983	1984	1985	1986
Trawl effort ('000 h)	89.0	68.1	62.5	98.4	66.3	41.8

The trawl effort was clearly reduced in 1986 compared to the earlier years. Combining the effort indices for trawl and purse seine indicates that the fishing effort in 1985 and 1986 was reduced to about 85% and 60%, respectively, of the 1982/1983 level.

5.2 Catch in Numbers at Age (Table 5.7)

Age compositions of landings were available from the Federal Republic of Germany, Norway, and the USSR accounting for 99% of the landings. Data for 1985 were revised and new data were added for 1986.

5.3 Weight at Age (Table 5.6)

A constant set of catch weight-at-age data was used for all years in the period 1960-1979. Subsequently, annual estimates of weight at age were used. Data for 1985 were revised and new data added for 1986. Weight at age in the stock was taken to be the same as weight at age in the catch. The weight-at-age data used in the catch prediction and in the yield-per-recruit calculations were average values for the period 1982-1986 (Table 5.10).

5.4 Age at Maturity

No maturity ogive is available for this stock of saithe. As in previous assessments, fish of age 6 and older are presumed to be mature for calculation of spawning stock biomass.

5.5 Survey Results

An acoustic survey was carried out by Norway in October/November in 1985 and 1986 covering the main trawl fishing grounds for saithe off northern Norway. The results indicated an increase in the biomass from 1985 to 1986, mainly due to the 1983 year class. However, the Working Group felt that a longer time series is needed before the results can be used in the assessment.

5.6 Recruitment

Estimates of recruitment were available from 0-group surveys, but only for the years 1985, 1986, and 1987 (Nedreaas and Smedstad, 1987). The three year classes were estimated to be 828, 545, and 285 millions, respectively, but none of these year classes have yet recruited to the fishery and the reliability of the estimates is unknown. The results were, therefore, not used in the assessment.

5.7 Fishing Mortalities - VPA

The effort indices and catch-at-age data for ages 3-9 for purse seiners and Norwegian trawlers of 250-500 GRT (see Section 5.1.3) were used as input for the ICES VPA tuning programme (to be able to include 1981 in the time series, it was assumed that purse seine effort in 1981 was equal to the 1982/1983 level). The results, which are shown in Tables 5.4 and 5.5, were consistent with the indicated decrease in fishing effort. Trials with separable VPA showed some discrepancy with the results from the tuning method and it was decided that the latter was more reliable. Hence, the results from the tuning method for ages 3-9 were used

directly. F_s at older ages were set equal to age 9. The input F_s at age 14 were adjusted for the whole time series 1960-1985 to be equal to the average F for ages 10-13.

The resultant F -at-age array from the VPA for the last ten years is given in Table 5.8, and the corresponding estimates of stock numbers and biomass in Table 5.9.

5.8 Projection of Stock Biomass and Catch (Figure 5.4D)

Yield- and spawning stock biomass-per-recruit curves were calculated using the same exploitation pattern and weight-at-age data the as were used for the prediction. $F_{0.1}$ and F_{max} are 0.14 and 0.24, respectively (Figure 5.4C). F_{med} and F_{high} were calculated to be 0.32 and 0.38 (Figure 5.3).

Input data for catch projections are given in Table 5.10. Stock size in 1987 was taken from the VPA. For the recruiting year classes, a value of 200 million, the average for 1979-1982, was used for the 1984 and later year classes. The exploitation pattern was the same as that used for the 1986 input for the VPA. Weights at age in the catch and in the stock were averages for the period 1982-1986.

As indicated in Section 5.1.2, landings in 1987 are expected to be about 70,000 t. This implies a reduction of 26% in the level of fishing mortality in 1987 compared to 1986 (when it was at F_{max}), and in the catch prediction, F for 1987 was set to 0.17. In 1988, projections were made for a range of fishing mortality (Table 5.11).

Figure 5.4A shows how fishing mortality increased during the 1970s and was maintained at a high level until 1984. Spawning stock biomass (Figure 5.4B) declined sharply from almost 600,000 t in 1970 to 150,000 t in 1981. In recent years, it has increased to slightly more than 200,000 t, mainly because of the strong 1978 year class and reduced fishing mortalities, and if the estimated level of fishing mortality in 1987 is maintained, a further increase in spawning stock biomass is to be expected.

6 REDFISH IN SUB-AREAS I AND II

6.1 Status of the Fisheries

6.1.1 Landings prior to 1987 (Tables 6.1-6.5, Figure 6.2A)

The redfish landings in Sub-areas I and II have decreased from 131,749 t in 1982 to a provisional figure of 52,979 t in 1986 (Table 6.1). This decrease was mainly caused by a decrease in the USSR fishery, especially in Division IIB and in Division IIA in 1986.

In Sub-area I, the total catch increased to 5,470 t in 1986, the highest since 1977 (Table 6.2). Norway has, since 1983, increased its catches in this area, while the catch figures for the USSR have been varying. In Division IIA, the total catch decreased

from 100,163 t in 1983, the highest since 1977, to 46,360 t in 1986, which was 88% of the total redfish catch in that year (Table 6.3). In Division IIB, there has been a strong decline in the catches in recent years from 49,883 t in 1982 to 1,149 in 1986 (Table 6.4).

Apart from the USSR, the German Democratic Republic, and the Federal Republic of Germany, national landings statistics of redfish do not distinguish between the species. The Working Group has, therefore, split the catch into Sebastes mentella and Sebastes marinus on an area basis or based on reporting schemes from the different fleets to Norwegian fishing authorities. In Sub-area I, 70% of the Norwegian catch in 1986 was assumed to be S. marinus. This percentage for Norway was based on surveys on the main fishing grounds. In Division IIA, all the catches not initially splitted, apart from Portugal's and 67 t taken by the UK, were assumed to be S. marinus in 1986. All catches taken in Division IIB were recorded as S. mentella.

The total landings of S. marinus increased from 16,366 t in 1982 to 30,127 t in 1986 (Table 6.5). The increase since 1982 was due to USSR redfish catches in 1983 in Division IIA (5% S. marinus) and the increasing Norwegian fishery for S. marinus in Division IIA and Sub-area I. The total landings of S. mentella decreased from 115,383 t in 1982 to 22,852 t in 1986, for the first time less than the total landings of S. marinus. This decrease was mainly due to the USSR fishery in Division IIB in the last years and the 68% reduction in its redfish catches in Division IIA from 1985 to 1986.

The recommended TACs for S. marinus and S. mentella in 1986 were 15,000 t and 85,000 t, respectively, which also became the agreed TACs. The provisional catch figure for S. marinus in 1986 shows that the TAC was overfished by more than 15,000 t (100%). For S. mentella, the provisional catch in 1986 was 62,148 t below the TAC.

6.1.2 Expected landings in 1987

Landings by gear reported from Norway for the first six months of 1987 were compared with the corresponding figures from 1986. This indicated that total landings would be about 21,500 t, a slight decrease compared to 1986. France and the Federal Republic of Germany reported 472 t and 3,407 t for the first six months. The half-year figure from the Federal Republic of Germany was nearly equal to their total catch in 1986. The USSR reported 5,900 t for the first five months of 1987, compared to 15,800 t for the first five months in 1986. Assuming the same distribution of the USSR catches over the year in 1987 as in 1986 indicates a total catch of about 7,000 t redfish, a considerable decrease compared to 1986. The bulk of the catches from France, the Federal Republic of Germany, and Norway were S. marinus, while for the USSR, it is S. mentella. Based on this information, the Working Group expects total landings in 1987 of S. mentella and S. marinus of about 9,000 t and 25,000 t, respectively.

6.1.3 Effort and catch per unit effort (Table 6.6)

Catch-per-hour trawling data were available for the USSR S. mentella fishery for the period 1965-1986 for side trawlers (RT) and for 1980-1986 for stern trawlers (PST) (Table 6.6). From these data, the total international effort was derived. For both trawler types, the catch per unit effort has decreased since 1984.

For the German Democratic Republic S. mentella fishery, catch-per-day data for the category "freezer trawlers" were available for 1981-1986. The catch per day decreased from 17.12 t in 1983 to 7.90 t in 1986. The German Democratic Republic fishery accounted for only 3.2 - 5.8% of the total catch of S. mentella in Sub-areas I and II in this period.

No data on effort and catch per unit effort were available for S. marinus.

6.2 Catch in Numbers at Age

Data for 1985 were adjusted to the revised total catch figures. For S. mentella, age compositions of landings in 1986 were available from the German Democratic Republic and the USSR, accounting for 5.8% and 80.3%, respectively, of the total catches. The total age composition was calculated by applying the age composition of the total catches from these countries to the total S. mentella catch in Sub-areas I and II (Table 6.13).

For S. marinus, age compositions of landings in 1986 were available from the Federal Republic of Germany and the USSR, accounting for 11.2% and 7.8%, respectively, of the total catches. Catch in numbers at age for the Norwegian catches (72.6%) and for catches from other countries was calculated by using the age composition from the Federal Republic of Germany (Table 6.19).

6.3 Weight at Age

For S. mentella, weight-at-age data were available from the USSR for ages 8-19 in 1985 and for ages 8-18 in 1986. For ages 6 and 20+, the weights are equal to the 1983-1984 data, while the weights for age 7 were taken as the mean of ages 6 and 8. The average weight-at-age data from 1985 and 1986 were used in the catch prediction and in the yield-per-recruit calculations (Table 6.14).

For S. marinus, weight-at-age data were available from the USSR for 1986 for ages 8-21. However, the USSR catches accounted for less than 8% of the total catch, and the age composition was quite different from the Federal Republic of Germany age data. Although weight-at-age data from earlier assessments may have changed, these weights were used by correcting them to make the sum of products fit the nominal catches.

6.4 Age at Maturity (Table 6.17)

For S. mentella, a new maturity ogive was used for the years from 1981 and onwards. This maturity ogive was developed by the USSR and, for ages 6-10, is a long-term average for the period 1975-1983, while for the other age groups, it is an average from 1981-1985. These data were used in the catch prediction and in the yield-per-recruit calculations.

No maturity ogive was available for S. marinus. Fish of age 15 and older were presumed to be mature for the calculation of spawning stock biomass.

6.5 Survey Results

Since 1981, a stratified random bottom trawl survey has been carried out by Norway in January-February in the Barents Sea. For S. mentella, the results show a reduction of more than 50% in numbers and an even higher reduction in biomass from 1986 to 1987. For S. marinus, the results show a reduction in both numbers and biomass of nearly 40% from 1986 to 1987 (Godø et al., 1987).

Since 1981, a stratified random bottom trawl survey has also been carried out by Norway in September in the Svalbard and Bear Island areas. The results show an overall decrease of both S. mentella and S. marinus from the level in 1984 (Godø et al., 1987). For S. mentella, a reduction in biomass of more than 50% occurred from 1984 to 1985, while a reduction in numbers of more than 30% first occurred from 1985 to 1986. For S. marinus, a reduction both in numbers and biomass occurred from 1984 to 1985, a reduction of about 75% and 50%, respectively. The 1986 survey showed that the S. marinus population in this area had stabilized itself at this lower level.

The USSR carried out a trawl/acoustic survey in March-May in 1986 and 1987 on the spawning grounds of redfish near Bear Island. The results indicate a reduction in biomass from 90,000 t in 1986 to 60,000 t in 1987.

Each year the international O-group survey seems to cover satisfactorily the distribution area of redfish. Nevertheless, the use of these indices is limited due to the fact that the redfish species have not been separated.

6.6 Recruitment (Table 6.7)

From the data of the international O-group fish survey carried out in the Barents Sea since 1965, only two year classes (1967 and 1968) may be considered as very poor. The indices were generally low in 1965-1972, average in 1973-1978, and high in 1979-1987.

It should be noted that there are large discrepancies between the international O-group fish survey data and the data from the USSR survey concerning the 1+ - 6+ age groups. The O-group survey indices for the 1965-1972 year classes were below average, whereas USSR survey data indicate that they are strong or average, which

is confirmed by the age and length composition in the USSR fishery.

USSR trawl surveys indicate that the 1973 year class is below average and that the 1974-1980 year classes at ages 1+ - 6+ are poor. These data were confirmed by age compositions of redfish in the USSR catches in 1980-1987. The 1981 year class turned out to be close in size to the 1973 year class, while the 1982 year class was estimated as strong (this is confirmed by the Norwegian bottom trawl surveys). Thus, after a series of seven poor year classes of redfish, one year class (1981) close to the average and one strong year class (1982) have appeared. The strong year classes of redfish have turned out to be dominated by S. mentella in the trawl surveys as well as in the catches.

Differences in recruitment estimates during the first two years of life apparently occur due to significant variability in natural mortality. Considerable mortality of redfish at ages 2+ - 5+ is caused by large by-catches in the shrimp and capelin fisheries. Reduction in shrimp catches as well as a cessation in capelin fishing would promote the preservation of the 1986-1987 year classes of redfish, although a large cod stock preying on juvenile redfish may outweigh this to a certain extent (Mehl, 1987).

6.7 Assessment of *Sebastes mentella*

6.7.1 Fishing mortalities - VPA

The residuals from the separable VPA indicated that there were significant changes in the exploitation pattern, particularly on the younger age groups in recent years. For this reason, the year-class strengths estimated by separable VPA for year classes later than 1977 were considered to be unreliable. Norwegian survey data give some indication of the abundance of small redfish, but no age compositions are available and the time series is short. The only long series of survey data available is from the USSR trawl surveys. The complete data set was not available at the meeting, but the data given in Table 6.8 were abstracted from *Annales Biologiques*.

An attempt was made to use these data to tune the VPA, but this was unsuccessful, probably because it was only possible to use a short time series of data for the younger age groups estimated by the VPA. It is possible that use of a more complete data set would be more successful, and the Working Group will return to this analysis in the future.

The same data (for ages 2-6) were also used as a basis for estimation of recruitment. Here again, the time series for which both survey estimates and reasonably reliable VPA estimates are available is quite short. It was necessary to relax the usual requirement of five or more years in the regression to obtain results for all year classes of interest. The analysis shows that the standard errors of the predictions are high, and the final estimates are strongly influenced by shrinkage towards the mean. The results are given in Table 6.9, together with the estimates con-

sidered to be most reliable (based on the regressions using as many data points as possible). The estimates for the last few year classes are essentially only the recent running mean, and all are subject to large standard errors. These estimates were, however, considered to be more reliable than those from the VPA for the 1978 and later year classes. They indicate that the 1977 and 1978 year classes were only of moderate size, and that of 1979 was weak. No useful prediction can yet be made for 1980 onwards. The analysis also indicates that the index at age 4 is the first to give estimates of useful precision. This is, however, sufficiently early for catch prediction purposes (with a more complete data set, indices at ages 5 and 6 should also be available and sufficiently timely).

Figure 6.1 shows the total international effort vs. average fishing mortality. Two different curves have been drawn to visualize the effect of the change in mesh size in 1983 to 100 mm (earlier 125 mm) for the redfish fishery in the "Mentella Box".

Table 6.10 shows the residuals from the separable VPA. The fishing mortalities and stock sizes from the separable VPA are shown in Table 6.11 and 6.12, respectively. Taking the information about recruitment described above into consideration, the updated fishing mortalities and stock sizes are shown in Tables 6.15 and 6.16, respectively.

6.7.2 Projection of stock biomass and catch (Figure 6.2D)

Yield- and spawning stock biomass-per-recruit curves were calculated using the same exploitation pattern and weight-at-age data as were used for the prediction (see below). $F_{0.1}$ and F_{max} are 0.14 and 0.27, respectively (Figure 6.2C). Too few points were available for estimates of F_{med} and F_{high} .

Input data for catch projections are given in Table 6.17. Stock size in 1987 was taken from the VPA. The recruitment at age 6 was taken from Table 6.9 with the recent weighted mean as the recruitment in 1988 and 1989. The exploitation pattern was the same as that used for the 1986 input for the VPA. Weights at age in the catch and in the stock were averages for the period 1985-1986. As indicated in Section 6.1.2, landings in 1987 are expected to be about 9,000 t. This implies a reduction of 58% in the level of fishing mortality in 1987 compared to 1986, and in the catch prediction, F for 1987 was set at 0.13. In 1988, projections were made for a range of fishing mortalities (Table 6.18).

6.8 Assessment of *Sebastes marinus*

6.8.1 Estimation of fishing mortality

Visual inspection of the catch-at-age matrix (Table 6.19) shows strange systematic variations in the age compositions, especially for young fish. These are almost certainly an artifact of the method of calculation which had to be used in the absence of complete data in some years.

The majority of the catch is, however, taken at ages 14-21, and to permit further analysis, the age range was truncated to 11-24. Analysis using separable VPA was attempted using 18 as the age for unit selection and a terminal S of 1.0.

A range of terminal F values was tried, from 0.15 to 0.5. There were no effort data to guide the choice of terminal F and no independent basis to select among the alternative interpretations based on different choices. With low terminal F_{sep} ($=0.15$), the fishing mortality (F_{sep}) is estimated to have been below 0.1 between 1981 and 1984, rising to 0.16 in 1986.

With such low F values, the VFA analysis was not at all converged. With high assumed terminal F_{sep} (0.3 to 0.5), the fishing mortality (F_{sep}) is estimated to have been between 0.2 and 0.35 in 1977 and 1978, to fall to low values (about 0.15 or less) between 1979 and 1984, with a sharp rise to a value close to the assumed 1986 value in 1985 (see Tables 6.20A-6.20C).

In all these analyses, there are systematic patterns of blocks of residuals of the same sign since 1982 and high residuals for 1984/1985 in particular. The analysis cannot be considered to be satisfactory, and in the absence of independent data on which to estimate fishing mortality or stock size trends, the level of fishing mortality must be considered to be unknown, but probably low. For documentary purposes only, the results of the separable VPA for F_{sep} (86) = 0.3 are given in Tables 6.21 and 6.22.

6.8.2 State of the stock

The state of the stock must be regarded as unknown. However, certain systematic features do appear from the VPA analysis which, if true, give cause for concern. First, all the analyses indicate a sharp proportional increase in F in 1985 and 1986, above former (probably low) levels. Secondly, all the analyses also indicate a decline in recruitment from stable levels before 1981 (at age 11) to much lower levels for the period 1982-1986.

If these features are real and not an artifact of the inadequate data, they would imply a rapidly deteriorating state of this stock.

6.8.3 Short-term forecasts

In the absence of a reliable analysis of the state of the stock, it is not possible to estimate biological reference points or make a conventional catch prediction.

A SHOT forecast is, however, possible. The results, assuming (in the absence of any reliable evidence) a constant yield/biomass ratio of 0.3 and constant recruitment, are given in Table 6.23. They imply that, if the present level of exploitation is maintained, the corresponding catches in 1987 and 1988 should be a little less than the average for 1984 to 1986. This result is not

strongly dependent on the assumed Y/B ratio, but is dependent on the assumed (average) level of recruitment, which may be optimistic, as discussed above.

7 GREENLAND HALIBUT IN SUB-AREAS I AND II

7.1 Status of the Fisheries

7.1.1 Landings prior to 1987 (Tables 7.1-7.4)

Nominal catch by country for Sub-areas I and II is given in Table 7.1. The nominal catches in Sub-area I and Divisions IIa and IIb are given separately in Tables 7.2-7.4. The total catches in 1985 and 1986 were 19,945 and 22,755 t, respectively, compared to the recommended TAC of 20,000 t in both years. The fishery in 1986 was distributed by nations and areas roughly as in previous years. In Division IIb, the reduction in the USSR catch from 9,641 t in 1984 to 3,221 t in 1985 was reversed with an increase to 6,032 t, while the high 1985 level of German Democratic Republic catches was not maintained, as these decreased to 2,604 t.

7.1.2 Expected landings in 1987

Preliminary catch figures for 1987 were reported only from France, the Federal Republic of Germany, Norway, and the USSR. The Norwegian catches show an increasing tendency and indicate a catch for 1987 of 11,500 t. The USSR fishery is expected to reach the same level, and the total landings in 1987 are, therefore, likely to be about 26,000 t.

7.1.3 Effort and catch per unit effort

The time series on CPUE was updated with the Norwegian and USSR observations from 1985 and 1986. The Norwegian data were analyzed with the statistical package GLIM (NAG), as described in the previous report of the Working Group on Redfish and Greenland Halibut in Region 1 (Anon., 1984), and the results are presented in Table 7.5. CPUE and derived total effort were fairly steady during the period 1983 to 1986.

7.2 Catch in Numbers at Age (Table 7.7)

For 1984-1986, age data were available from Norway and the USSR. For 1985 and 1986, the German Democratic Republic also presented age data for their catches. The catch in numbers at age for other countries was raised by the age distribution of the total catches from the German Democratic Republic, Norway, and the USSR.

7.3 Weight at Age (Table 7.8)

For 1984 and 1985, the weights at age used in the assessment were weighted averages of the Norwegian and the USSR weights, while

for 1986, they were the weighted averages of the German Democratic Republic, Norwegian and the USSR weights.

7.4 Age at Maturity (Table 7.14)

In earlier assessments, no maturity ogive has been available for Greenland halibut. Fish at age 9 and older have been presumed to be mature. For this Working Group meeting, the USSR presented maturity ogives for a series of years. The Working Group decided to use an average maturity ogive for the period 1981-1986 on each of the years 1981-1986 as well as for the prediction.

7.5 Survey Results

Norway has conducted yearly stratified random trawl surveys in the Barents Sea and the Svalbard area since 1981. The Svalbard survey covers the main nursery area of Greenland halibut in Sub-areas I and II. The two surveys do not cover the total area of distribution of the stock. Also, the Svalbard surveys do not cover depths exceeding 600 m which (probably) are an important area for adult Greenland halibut. It is, however, believed that the survey results may give valuable information on the immature part of the stock. Special attention should be paid to the possibility of using the Svalbard survey results as recruitment indices. Total abundance indices and indices of fish less than 20 cm are given in Table 7.6. These results indicate an increasing stock size in the period 1981-1985, with a sharp decline in 1986.

7.6 Recruitment

Fish less than 20 cm in the Svalbard survey are almost exclusively age 1. The indices in Table 7.6 of fish less than 20 cm may, therefore, possibly serve as an early recruitment index. A relatively high abundance at age 1 in 1983 and 1984 and a substantial drop in recruitment in the last two years is indicated. The index suggests that the 1985 year class may be very weak. Norway is requested to supply age-distributed indices from the Svalbard survey. These data would make it possible to study the abundance of a year class at ages 1-3, i.e., before it is fully recruited to the commercial trawl fishery.

7.7 Assessment

7.7.1 Estimation of fishing mortality

The catch-at-age data (Table 7.7) were analyzed by separable VPA initially, with the age for unit selection set at 8 (near that contributing most to the catch) and terminal selection of 1.5 (to give a flat selection pattern on the oldest ages). It was found that a terminal F of 0.25 gave approximate stability of F from 1983 to 1986, as suggested by the effort data (Table 7.5). The residuals are given in Table 7.9, and are acceptably small except for the youngest and oldest age groups. The fishing mortalities and population numbers derived from the separable VPA are given

in Tables 7.10 and 7.11. The average F_s (ages 7-11) from this analysis are plotted against the derived total effort indices in Figure 7.1 and show a reasonably satisfactory relationship.

An attempt was made to tune the VPA using USSR effort and catch composition data from 1980 to 1986, but this was not successful. The reasons for this could not be discovered at the meeting, but may be connected with the use of a different basis of calculation before 1983. Detailed Norwegian CPUE data were not available at the meeting, but could also provide a basis for tuning the VPA.

7.7.2 State of the stock

The results of the separable VPA with terminal $F = 0.25$ are, however, sufficiently consistent with the overall effort data from 1983 to 1986 to provide a basis for the assessment. The size of the 1982 and 1983 year classes differ considerably from recent levels, which appear to have been very stable between 25 and 40 million since about 1970. This is consistent with the results of the Norwegian survey, but the time series is too short to be used yet for quantitative prediction. These year classes will recruit substantially to the fishery in 1988 and 1989, but in the absence of reliable estimates of their size, this was assumed to be 30 million, close to the recent historical mean.

The VPA analysis (Tables 7.12 and 7.13) indicates that fishing mortality was high in 1977 and 1978, fell sharply to about 0.2 in 1979, and has since fluctuated without obvious trend between 0.2 and 0.3. The current level is estimated to be within this range. The spawning stock biomass has also fluctuated without apparent trend between 30 and 80 thousand t and is currently at the high end of that range.

7.8 Catch Predictions

7.8.1 Input variables to the predictions

The values used for starting the predictions are given in Table 7.14. These are based on the exploitation pattern and terminal F estimated by separable VPA, and the 1987 populations of Table 7.13, except for the 1982 and later year classes, for which a size of 30 million was assumed, as explained above.

7.8.2 Biological reference points

The yield-per-recruit analysis (Figure 7.3C) shows that $F_{0.1}$ is 0.11 and F_{max} 0.23 (mean for ages 7-11). A plot of spawning stock biomass and recruitment (Figure 7.2) was prepared and used to estimate F_{med} and F_{high} . The values obtained were 0.65 and 0.91, respectively.

7.8.3 Short-term prediction

With an expected catch of 26,000 t in 1987, fishing mortality in that year will increase to 0.32 from the 1986 level of $F_{(7511, U)} = 0.28$ which was close to F_{max} . Catch predictions for 1988 are given in Table 7.15 for options corresponding to $F_{0.1}$, F_{max} , and status quo.

These forecasts of catch and biomass may prove to be pessimistic if the 1982 and 1983 year classes prove to be strong, as suggested by the survey data. These same data, however, also suggest that the subsequent two year classes are weak.

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Table 3.1 North-East Arctic COD.

Total nominal catch (t) by fishing areas (Norwegian coastal cod not included). (As officially reported to ICES.)

Year	Sub-area I	Division IIa	Division IIb	Total catch
1960	357,327	115,116	91,599	622,042
1961	409,694	153,019	220,508	783,221
1962	548,621	139,848	220,797	909,266
1963	547,469	117,100	111,768	776,337
1964	206,883	104,698	126,114	437,695
1965	241,489	100,011	103,430	444,983
1966	292,253	134,805	56,653	483,711
1967	322,798	128,747	121,060	572,605
1968	642,452	162,472	269,254	1,074,084
1969	679,373	255,599	262,254	1,197,226
1970	603,855	243,835	85,556	933,246
1971	312,505	319,623	56,920	689,048
1972	197,015	335,257	32,982	565,254
1973	492,716	211,762	88,207	792,685
1974	723,489	124,214	254,730	1,102,433
1975	561,701	120,276	147,400	829,377
1976	526,685	237,245	103,533	867,463
1977	538,231	257,073	109,997	905,301
1978	418,265	263,157	17,293	698,715
1979	195,166	235,449	9,923	440,538
1980	168,671	199,313	12,450	380,434
1981	137,033	245,167	16,837	399,037
1982	96,576	236,125	31,029	363,730
1983	64,803	200,279	24,910	289,992
1984	54,317	197,573	25,761	277,651
1985	112,605	173,559	21,756	307,920
1986	156,516	201,398	68,562	426,476

¹ Provisional figures.

Table 3.2 North-East Arctic COD.
Total nominal catch ('000 t) by trawl and
other gear for each area.

Year	Sub-area I		Division IIa		Division IIb
	Trawl	Others	Trawl	Others	Trawl
1967	238.0	84.8	38.7	90.0	121.1
1968	588.1	54.4	44.2	118.3	269.2
1969	633.5	45.9	119.7	135.9	262.3
1970	524.5	79.4	90.5	153.3	85.6
1971	253.1	59.4	74.5	245.1	56.9
1972	158.1	38.9	49.9	285.4	33.0
1973	459.0	33.7	39.4	172.4	88.2
1974	677.0	46.5	41.0	83.2	254.7
1975	526.3	35.4	33.7	86.6	147.4
1976	466.5	60.2	112.3	124.9	103.5
1977	471.5	66.7	100.9	156.2	110.0
1978	360.4	57.9	117.0	146.2	17.3
1979	161.5	33.7	114.9	120.5	8.1
1980	133.3	35.4	83.7	115.6	12.5
1981	91.5	45.1	77.2	167.9	17.2
1982	44.8	51.8	65.1	171.0	21.0
1983	36.6	28.2	56.6	143.7	24.9
1984	24.5	29.8	46.9	150.7	25.6
1985	72.4	40.2	60.7	112.8	21.5
1986 ¹	108.3	48.2	114.5	86.9	67.9

¹Provisional.

Table 3.3 North-East Arctic COD.

Nominal catch (t) by countries (Norwegian coastal cod not included) (Sub-area I and Divisions IIA and IIB combined). (As officially reported to ICES.)

Year	Faroe Islands	France	German Dem. Rep.	Germany, Fed. Rep.	Norway	Poland	United Kingdom	USSR	Others	Total all countries
1960	3,306	22,321	-	9,472	231,997	20	141,175	213,400	351	622,042
1961	3,934	13,755	3,921	8,129	268,377	-	158,113	325,780	1,212	783,221
1962	3,109	20,482	1,532	6,503	225,615	-	175,020	476,760	245	909,266
1963	-	18,318	129	4,223	205,056	108	129,779	417,964	-	775,577
1964	-	8,634	297	3,202	149,878	-	94,549	180,550	585	437,695
1965	-	526	91	3,670	197,085	-	89,962	152,780	816	444,930
1966	-	2,967	228	4,284	203,792	-	103,012	169,300	121	483,704
1967	-	664	45	3,632	218,910	-	87,008	262,340	6	572,605
1968	-	-	225	1,073	255,611	-	140,387	676,758	-	1,074,084
1969	29,374	-	5,907	5,543	305,241	7,856	231,066	612,215	133	1,197,226
1970	26,265	44,245	12,413	9,451	377,606	5,153	181,481	276,632	-	933,246
1971	5,877	34,772	4,998	9,726	407,044	1,512	80,102	144,802	215	689,048
1972	1,393	8,915	1,300	3,405	394,181	892	58,382	96,653	166	565,287
1973	1,916	17,028	4,684	16,751	285,184	843	78,808	387,196	276	792,686
1974	5,717	46,028	4,860	78,507	287,276	9,898	90,894	540,801	38,453	1,102,434
1975	11,309	28,734	9,981	30,037	277,099	7,435	101,843	343,580	19,368	829,377
1976	11,511	20,941	8,946	24,369	344,502	6,986	89,061	343,057	18,090	867,463
1977	9,167	15,414	3,463	12,763	388,982	1,084	86,781	369,876	17,771	905,301
1978	9,092	9,394	3,029	5,434	363,088	566	35,449	267,138	5,525	698,715
1979	6,320	3,046	547	2,513	294,821	15	17,991	105,846	9,439	440,538
1980	9,981	1,705	233	1,921	232,242	3	10,366	115,194	8,789	380,434
<u>Spain</u>										
1981	12,825	3,106	298	2,228	277,818	14,500	5,262	83,000	-	399,037
1982	11,998	761	302	1,717	287,525	14,515	6,601	40,311	-	363,730
1983	11,106	126	473	1,243	234,000	14,229	5,840	22,975	-	289,992
1984	10,674	11	686	1,010	230,743	8,608	3,663	22,256	-	277,651
1985	13,418	23	1,019	4,395	211,065	7,846	3,335	62,489	4,330	307,920
1986 ¹	18,159	770	1,543	10,093	228,787	5,497	7,581	150,541	3,505	426,476
1987	EXPECTED LANDINGS									545,000

¹Provisional figures.

Table 3.4 North-East Arctic COD. Catch per unit effort.

Year	Sub-area I			Division IIb			Division IIa		
	Norway ²	UK ³	USSR ⁴	Norway ²	UK ³	USSR ⁴	Norway ²	UK ³	Norway ⁵
1960	-	0.075	0.42	-	0.105	0.31	-	0.067	3.0
1961	-	0.079	0.38	-	0.129	0.44	-	0.058	3.7
1962	-	0.092	0.59	-	0.133	0.74	-	0.066	4.0
1963	-	0.085	0.60	-	0.098	0.55	-	0.066	3.1
1964	-	0.056	0.37	-	0.092	0.39	-	0.070	4.8
1965	-	0.066	0.39	-	0.109	0.49	-	0.066	2.9
1966	-	0.074	0.42	-	0.078	0.19	-	0.067	4.0
1967	-	0.081	0.53	-	0.106	0.87	-	0.052	3.5
1968	-	0.110	1.09	-	0.173	1.21	-	0.056	5.1
1969	-	0.113	1.00	-	0.135	1.17	-	0.094	5.9
1970	-	0.100	0.80	-	0.100	0.80	-	0.066	6.4
1971	-	0.056	0.43	-	0.071	0.16	-	0.062	10.6
1972	0.90	0.047	0.34	0.59	0.051	0.18	1.08	0.055	11.5
1973	1.05	0.057	0.56	0.43	0.054	0.57	0.71	0.043	6.8
1974	1.75	0.079	0.90	1.94	0.106	0.77	1.19	0.028	3.4
1975	1.82	0.077	0.85	1.67	0.100	0.43	1.36	0.033	3.4
1976	1.69	0.060	0.66	1.20	0.081	0.30	1.69	0.035	3.8
1977	1.54	0.052	0.50	0.91	0.056	0.25	1.16	0.044	5.0
1978	1.37	0.062	0.37	0.56	0.044	0.08	1.12	0.037	7.1
1979	0.85	0.046	0.36	0.62	-	0.06	1.06	0.042	6.4
1980	1.47	-	0.36	0.41	-	0.16	1.27	USSR	5.0
					Spain ⁶				
1981	1.42	-	0.41	(0.96)	-	0.07	1.02	0.35	6.2
1982	1.30	-	0.35	-	0.86	0.26	1.01	0.34	6.4
1983	1.58	-	0.31	(1.31)	0.90	0.36	1.05	0.38	7.6
1984	1.40	-	0.45	1.20	0.78	0.35	0.73	0.27	7.0
1985 ¹	1.86	-	1.04	1.51	1.37	0.50	0.90	0.39	5.1
1986 ¹	1.97	-	1.00	2.33	1.74	0.84	1.36	1.14	4.1

¹Preliminary figures.²Norwegian data - t per 1,000 t/hrs fishing.³United Kingdom data - t per 100 t/hrs fishing.⁴USSR data - t per hr fishing.⁵Norwegian data - t per gill net boat week in Lofoten.⁶Spanish Data - t per hr fishing.

Table 3.5 North-East Arctic COD.
Catch per unit effort in the Lofoten
fishery (gutted weight with head off).

Year	Norwegian vessels		
	Catch [kg per man per day worked in the Lofoten fishery (Division IIA)]		
	Gillnet	Longline	Handline
1960	77.8	148.3	56.7
1961	101.5	141.1	75.5
1962	94.9	134.4	57.8
1963	80.8	116.3	56.2
1964	104.5	62.1	51.5
1965	81.8	78.3	68.4
1966	121.8	131.9	72.6
1967	107.9	245.4	120.7
1968	158.0	184.6	61.5
1969	170.6	200.4	142.8
1970	180.3	304.3	127.6
1971	334.3	510.7	192.7
1972	318.7	400.1	110.2
1973	189.7	366.5	112.1
1974	96.3	146.4	63.9
1975	122.0	188.3	96.1
1976	131.4	258.4	134.8
1977	173.2	279.6	143.5
1978	237.6	381.7	134.6
1979	201.3	306.0	125.1
1980	169.9	207.8	100.9
1981	217.0	327.9	109.6
1982	199.1	753.4	252.0
1983	308.0	348.8	134.0
1984	301.0	208.4	95.6
1985	204.7	178.3	75.6
1986	173.7	198.0	61.9
1987	138.6	148.3	58.5

Table 3.6 Weights (kg) in Norwegian and USSR landings of COD.

Age	1984		1985		1986	
	Norway	USSR	Norway	USSR	Norway	USSR
2	1.16	0.22	0.76	0.29	0.87	0.22
3	1.47	0.76	1.47	0.77	1.20	0.63
4	1.97	1.30	1.90	1.23	1.92	1.15
5	2.53	2.04	2.49	1.75	2.52	1.75
6	3.13	2.90	3.32	2.64	3.36	2.44
7	3.82	4.12	4.21	3.93	4.46	4.09
8	4.81	5.56	5.01	5.35	5.42	6.19
9	5.95	8.76	5.94	6.72	5.94	8.15
10	7.19	13.55	7.10	9.87	6.54	10.31
11	7.85	14.95	8.20	9.00	7.99	11.73
12	8.46	14.85	8.92	13.72	8.46	17.29
13	7.99	19.52	9.73	15.10	9.93	-
14	9.78	19.31	9.85	15.30	7.78	27.30
15+	10.64	22.37	9.26	19.25	8.24	-

Table 3.7 North-East Arctic COD. Year class strength.

NORTHEAST ARCTIC COD : recruits as 5 year-olds (inc. data for ages 0,1,2 & 3)
(No. of surveys, No. of years, VPA Column No.)

Year class	VPA	R-1-1	R-2H-1	R-1-2	R-2B-2	R-1-3	R-23-2	INTDGP	N-BST1	N-BST2	N-BST3	N-SVT1	N-SVT2	N-SVT3	N-BSA1	N-BSA2	N-BSA3
1957	791	-	-	-	-	12	16	-	-	-	-	-	-	-	-	-	-
1958	919	-	-	-	-	16	24	-	-	-	-	-	-	-	-	-	-
1959	751	-	-	-	-	18	14	-	-	-	-	-	-	-	-	-	-
1960	474	-	-	-	-	9	19	-	-	-	-	-	-	-	-	-	-
1961	359	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-
1962	778	-	-	-	-	7	4	-	-	-	-	-	-	-	-	-	-
1963	1544	-	-	-	-	21	120	-	-	-	-	-	-	-	-	-	-
1964	1293	-	-	-	-	49	45	-	-	-	-	-	-	-	-	-	-
1965	170	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
1966	112	-	-	-	-	2	1	0.02	-	-	-	-	-	-	-	-	-
1967	197	-	-	-	-	1	1	0.04	-	-	-	-	-	-	-	-	-
1968	405	-	-	-	-	7	1	0.02	-	-	-	-	-	-	-	-	-
1969	1016	-	-	-	-	11	6	0.25	-	-	-	-	-	-	-	-	-
1970	1819	25	64	60	42	70	85	2.51	-	-	-	-	-	-	-	-	-
1971	524	7	9	6	3	57	24	0.77	-	-	-	-	-	-	-	-	-
1972	622	5	4	34	15	54	17	0.52	-	-	-	-	-	-	-	-	-
1973	614	16	5	15	2	70	5	1.48	-	-	-	-	-	-	-	-	-
1974	548	1	1	4	1	6	1	0.29	-	-	-	-	-	-	-	-	104
1975	640	60	1	44	1	95	4	0.90	-	-	-	-	-	-	-	892	707
1976	199	1	1	1	1	4	1	0.13	-	-	-	-	-	-	45	255	109
1977	142	1	1	2	1	2	1	0.49	-	-	-	-	-	-	28	14	-
1978	164	1	2	1	1	1	3	3.22	-	-	8.6	-	-	9.0	16	-	58
1979	179	1	1	1	1	1	8	0.40	-	11.0	16.1	-	72.2	22.2	-	73	71
1980	176	1	1	1	1	1	8	3.13	0.7	0.9	10.8	0.1	4.0	6.2	5	4	17
1981	393	1	1	1	1	4	4	0.10	0.1	5.9	60.2	1.5	5.1	5.6	1	15	174
1982	666	1	8	8	13	8	10	0.59	44.6	126.6	90.5	14.6	42.7	74.3	-	576	550
1983	-	4	9	11	7	45	41	1.69	355.3	168.9	356.0	52.2	133.1	154.0	2382	878	1566
1984	-	1	1	2	8	7	15	1.55	7.3	93.0	95.8	27.0	59.1	-	69	726	158
1985	-	3	10	2	3	-	-	2.46	82.5	89.5	-	3.5	-	-	786	59	-
1986	-	1	2	-	-	-	-	1.37	6.5	-	-	-	-	-	1	-	-
1987	-	-	-	-	-	-	-	0.17	-	-	-	-	-	-	-	-	-

R-1-1	USSR bottom trawl survey, area I, age 1
R-2B-1	USSR " " " area Ith, age 1
R-1-2	USSR " " " area I, age 2
R-2B-2	USSR " " " area Ith, age 2
R-1-3	USSR " " " area I, age 3
R-2B-3	USSR " " " area Ith, age 3
INTDGP	International D-group survey
N-BST1	Norwegian Barents Sea, Bottom trawl survey, age 1
N-BST2	Norwegian " " " " " age 2
N-BST3	Norwegian " " " " " age 3
N-SVT1	Norwegian Svalbard area " " " age 1
N-SVT2	Norwegian Svalbard area " " " age 2
N-SVT3	Norwegian Svalbard area " " " age 3
N-BSA1	Norwegian Barents Sea, Acoustic survey, age 1
N-BSA2	Norwegian " " " " " age 2
N-BSA3	Norwegian " " " " " age 3

Table 3.8

Analysis by RCRTINX2 of data from file RCRT-DATA
NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1,2 & 3)

Data for 16 surveys over 31 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .00
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1983

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	1.6094	.905	4.599	.4561	13	6.0560	.82246	.86077	.03709
R-2B-1	2.5026	1.065	4.517	.5624	13	6.9635	.66434	.73781	.05048
R-1-2	2.4849	.674	4.675	.7284	13	6.3508	.45985	.48871	.11505
R-2B-2	2.0794	1.026	4.604	.5491	13	6.7374	.68244	.74108	.05003
R-1-3	3.8286	.608	4.542	.6927	26	6.8695	.50735	.55725	.08849
R-2B-3	3.7377	1.217	3.673	.3767	26	8.2213	.97995	1.17827	.01979
INTUGP	.9895	3.615	4.501	.4388	17	8.0785	.85964	1.03907	.02545
N-BST1	5.8758	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	3.1552	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST3	5.8777	.651	3.548	.9492	5	7.2541	.16659	.28381	.34116
N-SVT1	3.9741	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT2	4.8986	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT3	3.1059	1.040	2.757	.3415	5	8.0684	1.00040	1.60095	.01072
N-BSA1	7.7761	-.434	6.344	.4765	5	2.9718	.48820	1.13654	.02128
N-BSA2	6.7788	.496	3.554	.4383	7	6.9189	.80705	.96923	.02925
N-BSA3	7.3569	.531	3.123	.8071	8	7.0326	.31184	.41552	.19515
MEAN						5.8485	.72652	.72652	.05206

Yearclass = 1984

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	.6931	.923	4.589	.4358	13	5.2280	.84806	.90035	.02446
R-2B-1	.6931	1.113	4.469	.5434	13	5.2403	.68323	.72730	.03748
R-1-2	1.0986	.680	4.675	.7165	13	5.4204	.46886	.49592	.08062
R-2B-2	2.1972	1.052	4.576	.5343	13	6.8875	.69577	.77187	.03328
R-1-3	2.0794	.599	4.565	.6938	26	5.8109	.49989	.52199	.07277
R-2B-3	2.7726	1.291	3.529	.3481	26	7.1079	1.02977	1.12900	.01556
INTUGP	.9361	3.716	4.457	.4299	17	7.9354	.86644	1.04846	.01804
N-BST1	2.1163	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	4.5433	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST3	4.5726	.651	3.546	.9493	5	6.4315	.16720	.21380	.43376
N-SVT1	3.3322	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT2	3.9338	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT3									
N-BSA1	4.2485	-.434	6.340	.4804	5	4.4952	.49150	.64708	.04735
N-BSA2	6.5889	.498	3.558	.4356	7	6.8378	.81432	.96362	.02113
N-BSA3	5.0689	.531	3.126	.8078	8	5.8181	.31346	.33502	.17666
MEAN						5.8242	.71414	.71414	.03888

Table 3.8 (cont'd)

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	1.3863	.950	4.571	.4097	13	5.8877	.88460	.92968	.08801
R-2B-1	2.3979	1.175	4.409	.5216	13	7.2258	.70574	.82492	.11179
R-1-2	1.0986	.689	4.669	.7011	13	5.4261	.48116	.51008	.29237
R-2B-2	1.3863	1.081	4.545	.5181	13	6.0436	.71069	.74750	.13542
R-1-3									
R-2B-3									
INT0GP	1.2413	3.853	4.406	.4177	17	9.1878	.87825	1.29554	.04532
N-BST1	4.4248	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	4.5031	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST3									
N-SVT1	1.5041	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT2									
N-SVT3									
N-BSA1	6.6082	-.435	6.335	.4856	5	3.4342	.49638	1.00249	.07569
N-BSA2	4.0945	.499	3.564	.4329	7	5.6083	.82378	.88626	.09685
N-BSA3									
MEAN						5.7953	.70159	.70159	.15454

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	.6931	.993	4.542	.3764	13	5.2301	.93756	1.00108	.12528
R-2B-1	1.0986	1.251	4.336	.4974	13	5.7104	.73226	.77245	.21041
R-1-2									
R-2B-2									
R-1-3									
R-2B-3									
INT0GP	.8629	4.044	4.345	.4001	17	7.8344	.89972	1.12384	.09940
N-BST1	1.7047	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2									
N-BST3									
N-SVT1									
N-SVT2									
N-SVT3									
N-BSA1	.6931	-.436	6.330	.4918	5	6.0276	.50443	.64740	.29955
N-BSA2									
N-BSA3									
MEAN						5.7614	.68783	.68783	.26536

Table 3.8 (cont'd)

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1									
R-2B-1									
R-1-2									
R-2B-2									
R-1-3									
R-2B-3									
INTUGP	.1570	4.526	4.267	.5741	17	4.9465	.93945	1.02671	.30062
N-BST1									
N-BST2									
N-BST3									
N-SVT1									
N-SVT2									
N-SVT3									
N-BSA1									
N-BSA2									
N-BSA3									
MEAN						5.7254	.67313	.67513	.69938

Yearclass		weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1965	5.80	350.37	.28	.59	5.14 171.00	2.08
1966	5.61	275.39	.28	.39	4.73 115.00	1.39
1967	5.19	178.96	.36	.51	5.29 198.00	1.40
1968	5.77	319.99	.32	.52	6.01 406.00	1.60
1969	6.31	551.85	.32	.22	6.92 1017.00	.69
1970	7.74	2307.31	.39	.79	7.51 1820.00	2.01
1971	7.12	1242.15	.33	.28	6.26 525.00	.85
1972	6.92	1016.85	.37	.41	6.43 625.00	1.11
1973	6.75	852.22	.38	.59	6.42 615.00	1.54
1974	5.66	286.11	.38	.29	5.86 349.00	.74
1975	6.50	543.55	.18	.30	6.46 641.00	1.71
1976	5.66	286.43	.22	.16	5.30 200.00	.71
1977	5.55	257.22	.22	.14	4.96 143.00	.62
1978	5.36	211.78	.25	.18	5.11 165.00	.74
1979	5.34	208.90	.24	.21	5.19 180.00	.88
1980	5.05	152.19	.20	.19	5.18 177.00	.95
1981	5.34	208.83	.18	.12	5.98 394.00	.66
1982	6.20	490.61	.20	.19	6.50 667.00	.95
1983	6.87	965.85	.17	.23		1.38
1984	6.07	432.02	.14	.20		1.39
1985	5.85	345.85	.28	.45		1.64
1986	5.97	391.47	.35	.38		1.08
1987	4.95	140.68	.56	.00		.00

Table 3.9 North-East Arctic COD.

Results from the Norwegian bottom trawl survey in the Barents Sea. Index of number of fish in each year class.

Year	Year class												Total ¹
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
1981	-	-	-	-	-	-	0.7	11.0	8.6	16.9	34.1	37.9	115.3
1982	-	-	-	-	-	0.1	0.9	16.1	20.4	21.4	16.0	15.8	92.3
1983	-	-	-	-	44.6	5.9	10.8	28.0	31.9	14.3	4.7	3.0	143.8
1984	-	-	-	355.3	126.6	60.2	19.2	15.6	9.4	3.0	0.4	0.2	589.9
1985	-	-	7.3	168.9	90.3	78.1	15.7	6.3	2.5	0.2	+	0.1	369.4
1986	-	82.5	93.0	356.0	119.0	62.6	8.3	2.1	0.3	0.1	0.1	-	724.0
1987	4.5	89.3	95.8	229.0	42.0	11.4	1.3	0.4	+	+	-	-	437.7

¹ Includes year classes older than the 1975 year class.

Table 3.10 North-East Arctic COD.

Results from the Norwegian bottom trawl survey in the Svalbard area. Index of number of fish in each year class.

Year	Year class												Total ¹
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
1981	-	-	-	-	-	-	0.1	22.2	9.0	5.5	1.6	6.1	49.8
1982	-	-	-	-	-	1.5	4.0	22.3	9.6	2.8	1.9	2.9	45.6
1983	-	-	-	-	14.6	5.1	6.2	9.5	3.0	2.5	1.3	1.6	44.4
1984	-	-	-	52.2	42.7	5.6	4.2	5.3	2.2	0.5	0.5	0.4	113.8
1985	-	-	27.0	131.1	74.3	27.9	6.5	7.7	1.4	1.4	0.1	0.3	279.7
1986	-	3.5	50.1	164.0	44.0	18.1	3.2	1.3	0.3	0.1	-	-	285.0

¹ Includes year classes older than the 1975 year class.

Table 3.11 North-East Arctic COD.
Results from the USSR bottom trawl/acoustic survey in the Barents Sea
and adjacent waters (numbers per hour trawling).

Year	Year class												Total
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
Sub-area I													
1982	-	-	-	-	1.4	0.2	6.9	13.2	7.4	1.9	2.8	0.4	34.2
1983	-	-	-	4.3	8.0	5.1	4.6	5.4	5.9	2.7	0.7	1.2	37.9
1984	-	-	0.7	12.3	11.6	25.5	13.7	6.5	4.0	1.6	0.6	0.3	76.8
1985	-	3.3	2.9	51.3	35.2	53.1	25.2	4.4	1.8	0.8	0.1	0.1	178.2
1986	0.3	2.2	7.0	60.4	15.8	8.2	1.8	0.6	0.1	0.1	+	-	96.5
Division IIa													
1982	-	-	-	-	0.1	-	11.7	10.6	4.7	1.1	4.1	2.0	34.3
1983	-	-	-	0.7	0.4	0.3	1.5	6.4	5.0	2.1	1.3	1.2	18.9
1984	-	-	0.4	0.7	0.6	3.7	4.0	6.7	4.7	1.1	0.3	0.1	22.3
1985	-	0.2	0.2	1.4	3.7	9.5	12.6	6.4	2.5	0.6	0.1	0.1	37.3
1986	-	+	0.1	2.5	2.9	3.2	1.5	0.5	0.4	+	0.2	-	11.3
Division IIb													
1982	-	-	-	-	9.9	1.7	42.5	17.8	1.1	0.2	1.5	0.5	75.2
1983	-	-	-	9.7	14.9	5.0	9.4	11.0	2.6	0.7	0.8	0.7	54.8
1984	-	-	1.4	7.7	22.7	7.4	2.7	2.4	1.3	0.4	0.2	0.2	46.4
1985	-	9.1	9.4	45.2	32.3	32.8	11.5	5.3	1.8	0.3	-	0.1	147.8
1986	1.6	2.9	14.8	64.2	19.9	16.4	5.4	1.3	0.6	0.1	+	-	127.2
Total													
1982	-	-	-	-	3.7	0.6	18.1	14.1	5.1	1.3	3.6	0.7	46.2
1983	-	-	-	5.4	8.9	4.3	5.6	7.3	4.7	2.0	0.8	1.1	40.1
1984	-	-	0.9	9.2	14.2	16.2	8.6	5.0	3.1	1.1	0.4	0.3	59.0
1985	-	5.0	4.9	43.0	30.3	40.5	18.8	4.9	1.9	0.6	+	0.1	150.0
1986	0.7	2.2	9.1	56.5	16.1	10.6	3.0	0.8	0.3	0.1	+	-	99.4

Table 3.12 North-East Arctic COD.
Results from the Norwegian acoustic survey in the Barents Sea. Stock numbers in millions.

Year	Year class												Total ¹
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
1981	-	-	-	-	-	-	3	73	58	124	243	270	827
1982	-	-	-	-	-	1	4	71	86	93	73	74	408
1983	-	-	-	-	-	15	17	45	65	38	17	10	210
1984	-	-	-	2,382	506	174	80	63	46	16	1	+	3,269
1985	-	-	69	878	550	510	109	48	20	2	1	1	2,187
1986	-	786	726	1,566	533	282	34	10	2	+	+	-	3,941
1987	1	59	158	636	161	47	5	2	1	-	-	-	1,071

¹ Includes year classes older than the 1975 year class.

Table 3.13 North-East Arctic COD.
Results from the USSR acoustic survey in the Barents Sea and adjacent waters. Stock numbers in millions.

Year	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	Total
1985	-	45	105	895	422	255	83	44	50	21	2	16	1,939
1986	60	53	141	980	444	183	56	62	19	1	1	-	2,000

Table 3.14 North-East Arctic COD.
Stock numbers in millions at 1 January.

Year	Year class													
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973
1982 ¹	-	-	-	-	-	1	4	81	105	103	95	154	23	12
1983 ¹	-	-	-	-	-	27	29	81	99	58	43	50	13	5
1984 ¹	-	-	-	2,382	506	121	58	59	54	30	19	12	4	-
1985 ¹	-	-	118	1,534	817	631	100	51	38	8	6	2	-	-
1986 ²	-	435	361	1,717	462	271	56	18	5	2	2	-	-	-
1987 ²	1	62	197	760	215	73	9	4	2	1	-	-	-	-

¹ From Hylen and Nakken (1982, 1983, 1984, 1985).

² Estimates by Hylen (unpublished).

Table 3.15 Length at age from the Norwegian surveys in 1978-1987 in cm. The values for ages 7 and 8 are uncertain.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
3	32.1	33.1	34.2	35.5	37.6	34.8	35.8	40.3	34.4	31.8
4	45.9	42.0	42.5	44.7	46.3	46.8	49.2	50.8	50.4	41.1
5	54.2	53.3	52.5	52.0	54.7	56.0	57.9	62.2	60.0	55.7
6	64.6	64.4	63.5	61.3	63.1	64.5	67.4	71.1	70.2	67.2
7	67.6	74.7	73.6	69.6	70.8	73.3	79.6	81.8	82.3	81.8
8	76.9	83.0	83.6	77.9	82.9	80.4	82.2	88.7	95.2	94.5

Table 3.16 North-East Arctic COD.
Basis for maturity ogives used in the assessment.

Age	Percentage mature							
	1984		1985		1986		1987	
	Norway	USSR	Norway	USSR	Norway	USSR	Norway	USSR
3	-	-	-	-	1	1	5	1
4	1	4	+	1	11	9	12	9
5	18	18	13	10	16	19	21	23
6	32	31	63	33	18	56	47	27
7	69	56	96	59	67	76	72	61
8	100	89	100	85	100	89	91	81
9	100	99	100	92	100	100	74	81
10	100	100	100	100	100	100	100	-

Table 3.17

NORTHEAST ARCTIC COD : SURVEY DATA

112

Nor Bar Sea Trawl

82,86

1,1

3,9

1,	16.1,	20.4,	21.4,	16.0,	15.8,	1.4,	0.2
1,	10.8,	28.0,	31.9,	14.3,	4.7,	3.0,	0.6
1,	60.2,	19.2,	15.6,	9.4,	3.0,	0.4,	0.2
1,	90.3,	78.1,	15.7,	6.3,	2.5,	0.2,	0.03
1,	356.0,	119.0,	62.6,	8.3,	2.1,	0.3,	0.1

Nor Svalbard Trawl

82,86

1,1

3,9

1,	22.2,	9.3,	2.8,	1.9,	2.9,	0.4,	0.1
1,	6.2,	9.5,	3.0,	2.5,	1.3,	1.6,	0.4
1,	5.6,	4.2,	5.3,	2.2,	0.5,	0.5,	0.4
1,	74.3,	27.9,	6.5,	7.7,	1.4,	1.4,	0.1
1,	164.0,	44.0,	18.1,	3.2,	1.3,	0.3,	0.1

Nor Bar Sea Acoustic

82,86

1,1

3,9

1,	71,	86,	93,	73,	74,	5,	1
1,	17,	45,	65,	38,	17,	10,	2
1,	174,	80,	63,	46,	16,	1,	0.3
1,	550,	510,	109,	48,	20,	2,	1
1,	1566,	533,	282,	34,	10,	2,	0.3

USSR I Trawl/Acoustic

82,86

1,1

3,9

1,	13.2,	7.4,	1.9,	2.8,	0.4,	0.1,	0.1
1,	4.6,	5.4,	5.9,	2.7,	0.7,	1.2,	0.1
1,	25.3,	13.7,	6.5,	4.0,	1.6,	0.6,	0.3
1,	35.2,	53.1,	25.2,	4.4,	1.8,	0.8,	0.1
1,	60.4,	15.8,	8.2,	1.8,	0.6,	0.1,	0.1

USSR 2A Trawl/Acoustic

82,86

1,1

3,9

1,	10.6,	4.7,	1.1,	4.1,	2.0,	0.2,	0.3
1,	1.5,	6.4,	5.0,	2.1,	1.3,	1.2,	0.1
1,	3.7,	4.0,	6.7,	4.7,	1.1,	0.3,	0.1
1,	3.7,	9.5,	12.6,	6.4,	2.5,	0.6,	0.1
1,	2.5,	2.9,	3.2,	1.5,	0.5,	0.4,	0.1

Table 3.17 (cont'd)

USSR Eff Catch I

82,86

1,1

3,9

50.5,	295,	633,	1407,	1723,	2968,	302,	15
21.0,	16,	175,	824,	770,	454,	395,	21
19.0,	592,	973,	1408,	711,	372,	135,	38
53.0,	2615,	16310,	10047,	3062,	1307,	379,	138
67.6,	5559,	6079,	18879,	7172,	1278,	371,	82

USSR Eff Catch IIa

82,86

1,1

3,9

19.4,	83,	356,	593,	548,	869,	184,	27
21.1,	0,	102,	704,	711,	547,	482,	141
14.2,	22,	106,	342,	446,	197,	47,	60
12.0,	52,	282,	432,	515,	370,	97,	39
41.1,	1510,	5719,	15211,	4557,	1510,	406,	87

Norway Eff Catch I

82,86

1,1

3,9

14.5,	459,	1352,	1737,	2345,	1539,	161,	35
13.0,	29,	809,	2332,	2068,	1212,	436,	71
08.7,	227,	972,	1713,	1415,	425,	50,	23
21.3,	772,	2232,	1575,	946,	454,	34,	18
13.8,	4128,	3998,	1315,	805,	154,	0,	33

Norway Eff Catch IIa

82,86

1,1

3,9

48.2,	251,	2069,	3379,	4375,	5392,	951,	232
39.9,	101,	1031,	3994,	4204,	2620,	1819,	276
45.1,	217,	322,	2063,	2661,	2063,	1309,	788
14.0,	1779,	4623,	3268,	3536,	7322,	510,	249
38.8,	710,	6626,	8397,	3754,	2051,	471,	90

Spanish Eff Catch IIb

82,86

1,1

3,9

16.9,	1778,	3084,	1740,	479,	1073,	356,	114
15.8,	1179,	7331,	1070,	196,	46,	155,	53
11.0,	908,	2080,	1697,	168,	13,	5,	6
05.7,	1891,	1778,	1161,	384,	42,	4,	0
05.2,	266,	1302,	765,	99,	59,	8,	0

Table 3.18

Module run at 16.05.28 21 SEPTEMBER 1987

PILAGGRATED DS

Fleet 1 (Nor Bar Sea Trawl) has q fixed as the mean
 Fleet 2 (Nor Svalbard Trawl) has q fixed as the mean
 Fleet 3 (Nor Bar Sea Acoustic) has q fixed as the mean
 Fleet 4 (USSR 1 Trawl/Acoustic) has q fixed as the mean
 Fleet 5 (USSR 2A Trawl/Acoustic) has q fixed as the mean
 Fleet 6 (USSR Eff Catch 1) has variable q
 Fleet 7 (USSR Eff Catch 11a) has variable q
 Fleet 8 (Norway Eff Catch 1) has variable q
 Fleet 9 (Norway Eff Catch 11a) has variable q
 Fleet 10 (Spanish Eff Catch 11) has variable q

LOG TRANSFORMATION

NO explanatory variate (Mean used)

FLEETS COMBINED BY ** VARIANCE **

Terminal Fs estimated using Laurec/Shepherd method

Regression weights

1.000 1.000 1.000 1.000 1.000

Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions

NORTH-EAST ARCTIC COD

LOG CATCHABILITY

1982	1983	1984	1985	1986	EST'D	Fleet	Age	LSE (Q)	EST F
-9.0021	-9.4655	-8.8555	-8.8704	-8.5471	-8.956	1	3	.336	.0059
-8.7168	-10.0216	-11.2304	-9.0654	-9.3222	-9.671	2	3	.994	.0073
-7.3542	-8.0129	-7.7941	-7.0636	-7.0658	-7.698	3	3	.18	.0055
-9.2857	-10.32	-9.7145	-9.8125	-10.3211	-9.881	4	3	.457	.0162
-9.456	-11.4406	-11.6449	-12.0652	-13.5058	-11.62	5	3	1.455	.0684
-10.0519	-12.118	-9.5452	-9.486	-10.0492	-10.25	6	3	1.078	.0085
-10.3633	-13.4138	-12.5154	-12.3927	-10.8182	-11.9	7	3	1.264	.0055
-8.4050	-11.0428	-9.6916	-9.7832	-8.7212	-9.529	8	3	1.037	.0046
-10.1668	-10.9174	-11.3822	-8.5707	-11.5152	-10.51	9	3	1.206	.0204
-7.1609	-7.5337	-8.5398	-7.5691	-10.0017	-8.161	10	3	1.148	.0556
-8.5681	-8.1549	-8.6158	-8.33	-8.3225	-8.398	1	4	.191	.1091
-8.2536	-9.2356	-10.1356	-9.3593	-9.3175	-9.48	2	4	.37	.1
-9.1299	-7.6804	-7.1887	-6.4535	-6.8231	-7.055	3	4	.456	.0933
-9.5821	-9.8007	-8.9533	-8.7158	-10.3416	-9.479	4	4	.555	.2789
-10.0361	-9.6308	-10.1844	-10.4367	-12.0369	-10.46	5	4	.926	.5668
-9.0531	-9.3668	-7.6658	-6.97	-8.3182	-8.275	6	4	.984	.1229
-8.674	-9.9114	-9.5605	-9.531	-8.1661	-9.169	7	4	.722	.0432
-7.0484	-7.3562	-6.6547	-8.035	-7.4328	-7.346	8	4	.451	.1284
-7.8242	-8.2052	-8.6578	-6.9302	-7.9613	-7.924	9	4	.642	.1222
-8.1477	-5.3472	-6.3285	-6.9452	-7.0931	-6.418	10	4	.687	.2311
-8.0296	-7.6788	-8.2918	-8.3575	-8.1214	-8.098	1	5	.267	.3673
-10.0224	-10.0428	-9.3713	-9.2393	-9.3622	-9.618	2	5	.405	.2779
-8.5774	-6.9671	-6.8959	-6.4198	-6.6162	-6.694	3	5	.23	.332
-10.4613	-9.3665	-9.1672	-7.8843	-10.154	-9.407	4	5	1.006	.7575
-11.5027	-9.532	-9.1369	-8.5774	-11.055	-9.87	5	5	1.131	1.2215
-7.7758	-7.4718	-6.7646	-5.8776	-6.626	-6.903	6	5	.747	.2719
-7.6831	-7.5239	-7.8575	-7.5276	-6.3444	-7.409	7	5	.607	.1237
-6.3172	-5.9519	-5.7564	-6.8078	-7.7012	-6.507	8	5	.778	1.1844
-6.852	-6.5353	-7.216	-5.7002	-6.8809	-6.637	9	5	.576	.4578
-6.4687	-6.926	-6.0003	-5.7946	-6.7814	-6.394	10	5	.488	.5284
-9.1178	-7.8698	-8.2943	-8.5533	-8.1491	-8.197	1	6	.251	.9213

Table 3.18 (cont'd)

NORTH-EAST ARCTIC COD - LOG CATCHABILITY

1982	1983	1984	1985	1986	EST'D	Fleet	Age	LSE (Q)	EST F
-10.2986	-9.6138	-9.7465	-8.3526	-9.1022	-9.413	2	6	.719	.7084
-8.5999	-6.8925	-6.7064	-6.5227	-6.739	-6.692	3	6	.141	1.0128
-9.8608	-9.5366	-9.1487	-8.9123	-9.6775	-9.427	4	6	.389	1.2413
-9.4794	-9.7881	-8.9876	-8.5376	-9.8598	-9.33	5	6	.561	1.6408
-7.3606	-6.9282	-6.9439	-6.3486	-5.601	-6.636	6	6	.682	.3431
-7.5494	-7.0127	-7.0879	-6.6346	-5.5569	-6.768	7	6	.751	.2878
-5.8045	-5.4607	-5.4434	-6.6003	-6.1991	-5.902	8	6	.498	1.3013
-6.3831	-5.8727	-6.4574	-4.9041	-5.6932	-5.862	9	6	.627	.8153
-7.546	-8.012	-7.8089	-6.1837	-6.8333	-7.277	10	6	.756	.6293
-8.2659	-8.5398	-8.5305	-8.7364	-8.643	-8.544	1	7	.176	1.1807
-9.9622	-9.925	-10.3222	-9.3162	-9.1245	-9.71	2	7	.487	.5941
-6.7222	-7.2542	-6.8565	-6.6569	-7.0843	-6.915	3	7	.25	1.2539
-11.9432	-10.4441	-9.1591	-9.0649	-9.8977	-10.1	4	7	1.174	.87
-10.3437	-9.822	-9.5338	-8.7364	-10.0801	-9.702	5	7	.615	1.5975
-6.9532	-7.0138	-6.6857	-6.4587	-6.4475	-6.712	6	7	.266	.8191
-7.2249	-7.2873	-6.3991	-6.2241	-5.7831	-6.704	7	7	.667	.4249
-6.3621	-5.5573	-5.7403	-6.5933	-6.9746	-6.245	8	7	.592	2.2142
-6.3096	-5.9028	-5.8061	-3.4351	-5.4192	-5.375	9	7	1.13	1.1157
-6.876	-9.0189	-9.462	-7.6555	-6.4725	-7.897	10	7	1.307	.2568
-9.0426	-9.0155	-9.9534	-10.0526	-9.8196	-9.585	1	8	.515	.9947
-10.2954	-9.6441	-9.7702	-8.1067	-9.8196	-9.527	2	8	.832	1.0536
-7.7696	-7.8112	-8.0771	-7.75	-7.9224	-8.066	3	8	.569	.6812
-11.6817	-9.9317	-9.5879	-8.6663	-10.9182	-10.16	4	8	1.173	1.5834
-10.9825	-9.9317	-10.2811	-8.954	-9.5319	-9.937	5	8	.767	.5843
-7.9906	-7.1797	-7.1474	-6.4871	-6.913	-7.064	6	8	.404	.6755
-7.1294	-6.3854	-7.8802	-6.3533	-6.3252	-6.935	7	8	.641	.4276
-6.9713	-6.6014	-7.3284	-7.9755	-9.9593	-7.767	8	8	1.326	7.0417
-6.3669	-6.2944	-5.709	-4.8897	-6.1192	-5.882	9	8	.614	.9971
-6.3315	-7.8307	-9.8656	-8.7973	-7.6993	-8.105	10	8	1.319	.5243

Table 3.19 VIRTUAL POPULATION ANALYSIS.

NORTH-EAST ARCTIC COD

FISHING MORTALITY COEFFICIENT

UNIT: Year⁻¹

	1982	1983	1984	1985	1986	1982-86
1	.000	.000	.000	.000	.001	.000
2	.001	.000	.001	.001	.001	.001
3	.066	.022	.017	.030	.010	.029
4	.195	.201	.134	.118	.117	.153
5	.291	.297	.302	.407	.358	.331
6	.523	.472	.541	.622	.966	.625
7	.691	.707	1.014	.873	1.065	.870
8	.709	.742	.955	.944	.785	.827
9	.482	.484	.589	.593	.659	.562
10+	.482	.484	.589	.593	.659	.562
(5-9)U	.539	.540	.680	.688	.767	

STOCK SIZE IN NUMBERS

UNIT: thousands

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1982	1983	1984	1985	1986	1987
1	701089	1083075	3259428	118650	11039	0
2	190216	574001	886735	2668589	97141	9029
3	154402	155651	469875	725164	2183521	79453
4	127934	118339	124630	378355	576305	1770310
5	34012	87533	79247	89271	275221	419877
6	75387	51393	53263	47950	48669	157454
7	92919	36571	26251	25389	21070	15168
8	18024	38122	14759	7796	8686	5949
9	8237	7261	14855	4650	2482	3242
10+	5652	2944	2989	3463	2638	2168
TOTAL NO	1457870	2154890	4932032	4069275	3226574	
SPS NO	126936	105427	83451	172114	175554	

Table 3.20

Title : NORTH-EAST ARCTIC COD
 At 19.45.34 22 SEPTEMBER 1987
 from 76 to 86 on ages 1 to 14
 with Terminal F of .900 on age 7 and Terminal S of .750

Initial sum of squared residuals was 630.705 and
 final sum of squared residuals is 310.528 after 71 iterations

Matrix of Residuals

Years Ages	76/77	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	WTS
1/ 2	-2.807	-6.789	-4.918	-8.569	-2.176	-4.678	-4.104	-4.397	-5.850	-4.648	-19.298
2/ 3	.400	1.420	.496	.346	1.087	-.403	-.365	-1.064	.231	.885	-.279
3/ 4	.729	1.193	.877	.523	.345	-.472	.361	-.168	-.416	.217	.026
4/ 5	.230	.947	-.101	.191	.077	-.327	.216	.442	-.322	-.320	.026
5/ 6	.422	.745	.486	-.004	.204	-.241	-.035	.094	-.066	.017	.026
6/ 7	.173	.068	.189	.098	.170	.072	-.003	-.144	.039	.127	.026
7/ 8	-.456	-.764	-.680	-.315	-.479	.017	-.279	-.157	.291	.197	.026
8/ 9	-.605	-.882	-1.125	-.588	-.806	.002	-.237	-.052	.214	.141	.026
9/10	-.653	-.351	-.658	-.359	-.531	.412	-.095	-.112	.320	-.065	.026
10/11	-.799	-.931	-.823	-.296	.035	.499	-.150	.047	.424	-.273	.026
11/12	-.144	-.744	.708	.770	.965	.478	.361	-.295	.534	-.595	.026
12/13	.310	-2.182	.425	.420	-.224	.534	.441	-.539	.192	-.061	.026
13/14	-.300	.055	1.677	.057	1.370	1.409	-.482	1.027	-.417	-.144	.026
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-44.531
WTS	.010	.010	.010	.010	.010	.010	1.000	1.000	1.000	1.000	

Fishing Mortalities (F)

76
 F-values 1.1444

	77	78	79	80	81	82	83	84	85	86
F-values	1.3512	1.4925	.9970	.9324	.8846	.9450	.8203	.8755	.8732	.9000

Selection-at-age (S)

	1	2	3	4						
S-values	.0010	.0010	.0327	.1561						
	5	6	7	8	9	10	11	12	13	14
S-values	.3270	.5997	1.0000	1.2000	1.1723	.8659	.6909	.7101	.6352	.7500

Table 3.21 NORTH-EAST ARCTIC COD. At 19.43.35 22 September 1987.
SEPARABLE FISHING MORTALITIES.

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001
2	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001
3	.037	.044	.049	.033	.030	.029	.031	.027	.029	.029	.029
4	.179	.211	.233	.156	.146	.138	.148	.128	.137	.136	.141
5	.374	.442	.488	.326	.305	.289	.309	.268	.286	.286	.294
6	.686	.810	.895	.598	.559	.530	.567	.492	.525	.524	.540
7	1.144	1.351	1.492	.997	.932	.885	.945	.820	.876	.873	.900
8	1.373	1.621	1.791	1.196	1.119	1.061	1.134	.984	1.051	1.048	1.080
9	1.342	1.584	1.750	1.169	1.093	1.037	1.108	.962	1.026	1.024	1.055
10	.991	1.170	1.292	.865	.807	.766	.818	.710	.758	.756	.779
11	.791	.934	1.031	.689	.644	.611	.653	.567	.605	.603	.622
12	.813	.960	1.060	.708	.662	.628	.671	.583	.622	.620	.639
13	.727	.858	.948	.633	.592	.562	.600	.521	.556	.555	.572
14	.854	1.013	1.119	.748	.699	.663	.709	.615	.657	.655	.675

SEPARABLE POPULATION NUMBERS Units: thousands

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	859696	321667	211996	237407	278864	256295	588412	994462	1042287	129307	12279
2	598952	686699	263003	173309	194179	228102	207651	481297	813530	852607	10577
3	577108	326245	561464	215008	141752	158832	186589	171486	393730	665480	697447
4	648728	297410	255561	437792	170387	112572	126333	148118	136685	313261	529511
5	817692	444239	197189	165748	306770	120604	80278	89246	106693	97612	223791
6	433688	460491	233814	99102	97951	185160	73942	48255	55878	65606	60067
7	241063	178755	167657	78214	44622	45846	89186	34347	24156	27061	31816
8	17273	62348	37894	50860	23629	14380	15498	28381	12382	8240	9252
9	6197	3582	10168	5175	7638	6319	4073	4083	8683	3545	2366
10	4198	1327	632	1447	1317	2096	1834	1101	1278	2547	1043
11	2312	1276	337	135	500	481	798	663	443	490	979
12	658	859	411	98	56	215	214	340	308	198	220
13	570	239	269	117	40	23	94	89	155	135	87
14	49	146	85	85	51	18	11	42	43	73	64

Table 3.22 North-East Arctic COD.

Input data to the assessment. Weight (kg) in catch at age.

Year	Age												
	3	4	5	6	7	8	9	10	11	12	13	14	15+
1982	0.65	1.00	1.55	2.35	3.45	4.70	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1983	0.90	1.46	2.19	2.78	3.45	4.70	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1984	1.04	1.68	2.52	3.20	3.97	4.70	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1985	1.25	1.56	2.14	3.19	4.18	5.06	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1986	0.97	1.61	2.21	2.99	4.31	5.73	6.82	7.70	9.25	10.85	12.50	13.90	15.00

Table 3.23 North-East Arctic COD.

Input data to the assessment. Weight (kg) in stock at age.

Year	Age												
	3	4	5	6	7	8	9	10	11	12	13	14	15+
1982	0.65	1.00	1.55	2.35	3.45	4.70	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1983	0.36	1.01	1.63	2.35	3.45	4.70	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1984	0.53	1.20	1.90	2.91	3.97	4.70	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1985	0.67	1.07	2.23	3.65	4.92	5.06	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1986	0.39	1.09	1.85	3.11	4.32	5.50	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1987	0.23	0.49	1.38	2.30	3.97	5.50	6.17	7.70	9.25	10.85	12.50	13.90	15.00

Table 3.24 VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC COD

CATCH IN NUMBERS

UNIT: thousands

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
5	5298	15725	55937	34467	5709	2307	7164	7754	35536	294262	91855	45282
4	45912	25999	55644	160048	174585	24545	10792	13739	45431	131493	437377	59798
3	97950	78299	34676	69235	267961	238511	25813	11831	26832	61000	203772	226646
2	58575	68511	42539	22061	107051	181239	137829	9527	12089	20569	47006	118567
1	19642	25444	37169	26295	26701	29363	96420	59290	7918	7248	12630	29522
8	9162	8438	18500	25139	16399	26989	31920	52003	34885	8328	4370	9353
9	6196	3569	5077	11323	11597	13463	8933	12093	22315	19130	2523	2617
10	3553	1467	1495	2329	3657	5092	5249	2434	4572	4499	5607	1555
11	785	1161	380	687	657	1913	1232	762	1215	677	2127	1928
12	172	131	403	316	122	414	260	418	353	195	322	575
13	387	67	77	225	124	121	106	149	315	81	151	231
14	264	91	9	40	70	23	39	42	121	59	83	15
15+	131	179	70	14	46	46	35	25	40	55	62	37
TOTAL	248025	229081	251976	352179	612679	574026	323792	170067	191622	547596	807885	496126
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
5	85337	39594	78822	8600	3911	3407	8948	5108	7027	19282	19090	
4	114341	168609	45400	77484	17086	9466	20933	19594	14165	38322	57634	
3	79993	136335	88495	43677	81986	20803	19345	20473	18839	27216	75590	
2	118236	52925	56823	31943	40061	63433	28084	17656	20350	20342	27754	
1	47872	61821	25407	16815	17664	21783	42496	17004	15415	13588	12730	
8	13962	23338	31921	8274	7442	9933	4395	18329	8359	4385	4339	
9	4031	3639	9408	10974	3508	4267	2878	2545	6054	1904	1098	
10	939	1521	1227	1785	3196	1311	708	646	764	1062	503	
11	535	610	913	427	678	882	271	229	221	163	467	
12	442	271	446	103	79	109	260	74	153	59	138	
13	139	127	748	59	24	37	27	58	56	51	26	
14	26	92	43	38	26	3	5	20	12	45	32	
15+	33	54	51	45	8	1	5	5	12	38	1	
TOTAL	465946	490951	339609	200224	175669	135440	132355	99741	91427	126457	199472	

Table 3.25 VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC COD

FISHING MORTALITY COEFFICIENT

UNIT: Year-1

NATURAL MORTALITY COEFFICIENT = .20

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
3	.017	.023	.040	.030	.024	.023	.041	.021	.039	.196	.214	.084
4	.144	.111	.104	.153	.207	.221	.142	.103	.167	.200	.496	.210
5	.352	.389	.212	.181	.409	.481	.382	.228	.297	.353	.537	.521
6	.481	.445	.379	.202	.467	.539	.571	.236	.385	.391	.507	.702
7	.569	.597	.465	.427	.401	.769	.622	.519	.315	.471	.445	.703
8	.715	.515	.566	.668	.520	.927	.840	.836	.669	.640	.486	.702
9	1.047	.690	.680	.835	.764	1.132	.959	.937	1.144	1.007	.475	.610
10	.833	.770	.709	.788	.725	.949	.970	.771	1.249	.754	.974	.470
11	1.052	.734	.460	.862	.535	1.128	.636	.639	1.216	.605	1.043	1.173
12	.864	.491	.616	.889	.355	.782	.432	.461	.704	.635	.659	.935
13	1.145	1.052	.506	.864	1.151	.721	.466	.474	.768	.340	1.739	1.637
14	.810	.960	.370	.750	.740	.680	.540	.340	.910	.310	.700	.860
15+	.810	.960	.370	.750	.740	.680	.540	.340	.910	.310	.700	.860
(5-10)U	.666	.534	.502	.517	.548	.800	.724	.588	.676	.594	.559	.618
(11-14)U	.942	.801	.552	.831	.701	.852	.609	.537	.969	.529	1.023	1.015
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1983-86
3	.166	.134	.146	.049	.031	.023	.057	.020	.020	.032	.051	.026
4	.312	.567	.223	.208	.129	.097	.193	.169	.117	.144	.128	.139
5	.479	.753	.669	.348	.355	.229	.293	.293	.244	.341	.462	.335
6	.572	.682	.847	.546	.623	.514	.547	.474	.530	.452	.701	.539
7	.696	.678	.849	.659	.673	.848	.791	.768	1.026	.837	.572	.801
8	.886	.909	.934	.761	.702	1.064	.986	1.003	1.169	.973	.716	.965
9	.771	1.213	1.291	1.048	.889	1.225	1.111	.973	1.187	.965	.705	.957
10	.459	.762	.989	.952	1.073	1.058	.677	.824	.925	.678	.746	.793
11	.306	.620	1.742	1.253	1.323	1.047	.649	.484	.766	.510	.734	.623
12	.985	.239	1.416	1.065	.842	.788	1.094	.366	.705	.473	1.162	.672
13	.615	.838	2.157	.713	.785	1.382	.454	.784	.523	.541	.395	.561
14	.858	1.144	.990	.664	.818	.203	.688	.728	.361	1.103	.794	.747
15+	.858	1.144	.990	.664	.818	.203	.688	.728	.361	1.103	.794	.747
(5-10)U	.644	.833	.930	.710	.719	.823	.734	.722	.847	.708	.650	
(11-14)U	.645	.720	1.459	.929	.968	.895	.712	.637	.656	.661	.762	

Table 2.26 VIETNAM POPULATION ANALYSIS

FOUR-INTERPOLATED CDD

BLOCK SIZE IN NUMBERS UNIT: THOUSANDS

GROSS TOTALS JAIL: TOMES

ALL VALUES ARE GIVEN FOR 1 JANUARY

1
Ignored.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
3	333963	471765	1532016	1292840	169937	112065	197147	474905	1015570	1314537	524450	622082
4	573367	272757	622745	1244759	1027369	155424	87668	154976	324572	720407	1225918	565973
5	592441	266503	193456	459637	374894	635974	49715	55540	114494	224337	551112	411102
6	165000	211775	147502	152415	514001	475777	546246	47991	51457	39621	122235	253439
7	19443	51157	177425	52825	43551	161126	227375	150147	52192	23124	34540	63741
8	19433	26740	46485	59228	44226	43547	41123	49225	28017	19242	12631	27229
9	19557	1315	11224	21765	23657	21522	15728	21678	55473	57702	3517	3262
10	5641	2777	5211	4654	2750	2725	5621	4955	6935	9255	7770	4540
11	1573	2454	1127	1294	1734	3055	2859	1762	1864	1627	5533	3023
12	325	507	257	545	447	851	812	1252	762	455	728	1023
13	612	112	135	425	196	257	511	437	640	319	197	398
14	515	167	82	85	146	51	132	169	229	244	17	28
15+	257	315	244	29	96	172	92	95	73	225	154	79

TOTAL	1534513	1644012	2725691	5297658	2553055	1652257	1035273	265745	1652325	2299542	2467435	1736871
SFS	59745	57122	62791	85159	78233	83591	86714	150152	125986	54765	55523	35497
TOTAL	1930179	2139105	3027176	5854548	5977512	2416241	2424019	186192	2047519	2297416	3065559	2752759
SFS	242057	212625	341250	460039	440163	473221	477036	677740	676628	524124	252859	214075

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
3	614514	561322	654391	199442	141981	164031	175752	176680	329937	656555	687664 ¹	91
4	490465	460762	249357	452744	153527	112713	151271	157275	141685	515451	525157	547472 ¹
5	651167	253531	197256	165245	300964	111934	35745	51585	25569	175251	225735	587452
6	292014	116755	105391	85097	94401	172783	72923	51774	54123	61272	50721	115390
7	134722	127529	46515	58015	25586	47471	84667	54564	26073	26071	51041	24502
8	236625	46477	56777	16944	16077	16442	14343	51410	15151	7655	2255	14759
9	5211	3714	14324	14355	6475	6554	4649	4444	9429	3552	2557	5702
10	2726	3102	2121	3157	5256	2178	1571	1253	1576	2354	1345	958
11	2325	1442	1115	646	203	1474	619	654	459	444	977	405
12	720	1470	555	170	151	218	424	265	450	171	229	345
13	525	234	202	126	48	55	91	115	150	133	87	57
14	47	146	45	85	51	11	11	42	43	75	54	48
15+	101	55	23	171	16	6	11	11	43	62	2	24

TOTAL	1734074	1535555	1517516	975021	761342	649862	575176	527275	755584	1176537	1547556 ¹	
SFS	43591	37622	76714	52547	29192	20231	113568	10561	79402	72076	111453 ¹	
TOTAL	221352	215074	179535	159757	124053	107534	961598	722111	962254	1455267	1677246 ¹	
SFS	22632	51227	43222	227171	165569	151475	373814	529417	216664	522059	222275 ¹	

Table 3.27 NORTH-EAST ARCTIC COD.
Present and expected stock size and catches.

Age	1986		1987			1988
	Stock numbers	Catch numbers	Stock numbers	Expected catch numbers	Expected F values	Expected stock numbers
3	1,000,000	19,090	430,000	11,835	0.03	346,000
4	528,139	57,634	799,641	98,506	0.15	341,368
5	223,703	75,590	380,452	91,213	0.31	565,922
6	60,071	27,754	115,390	45,229	0.56	229,508
7	31,940	12,730	24,399	13,630	0.93	53,992
8	9,253	4,339	14,759	9,181	1.12	7,850
9	2,367	1,098	3,702	2,272	1.09	3,939
10	1,043	503	958	488	0.81	1,014
11	979	467	405	176	0.65	349
12	220	138	385	171	0.66	173
13	87	26	57	23	0.59	162
14	64	32	48	22	0.70	25
15+	2	1	24	11	0.70	29
Total stock Numbers	1,857,868	199,402	1,770,220	272,760	$F_{5-10} =$	1,550,331
Weight	1,791,295		1,499,064	545,000	0.80	1,960,510
Spawning stock Numbers	114,772		195,139			226,393
Weight	293,419		350,901			540,146

Table 3.28 NORTH-EAST ARCTIC COD.
Input data for the catch and stock projections.

Age	Fishing pattern	Maturity ogive		Weight in catches			Weight in stock			
	1987-1989	1987	1988-1990	1987	1988	1989	1987	1988	1989	1990
3	0.033	0.03	0.01	0.44	0.49	0.49	0.23	0.30	0.30	0.30
4	0.156	0.07	0.04	0.88	1.02	1.09	0.49	0.64	0.68	0.68
5	0.327	0.15	0.15	2.04	1.76	1.94	1.38	1.27	1.41	1.50
6	0.599	0.35	0.34	3.13	3.34	2.95	2.30	2.71	2.25	2.47
7	1.000	0.50	0.63	4.18	4.18	4.18	3.97	3.97	3.97	3.65
8	1.200	0.76	0.88	5.06	5.06	5.06	5.50	5.50	5.50	5.50
9	1.172	0.95	0.95	6.17	6.17	6.17	6.17	6.17	6.17	6.17
10	0.866	1.00	1.00	7.70	7.70	7.70	7.70	7.70	7.70	7.70
11	0.691	1.00	1.00	9.25	9.25	9.25	9.25	9.25	9.25	9.25
12	0.710	1.00	1.00	10.85	10.85	10.85	10.85	10.85	10.85	10.85
13	0.635	1.00	1.00	12.50	12.50	12.50	12.50	12.50	12.50	12.50
14	0.750	1.00	1.00	13.90	13.90	13.90	13.90	13.90	13.90	13.90
15+	0.750	1.00	1.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00

Natural mortality is set to $M = 0.20$.

The fishing pattern is estimated by separable VPA.

The maturity ogive is data for 1987 and for 1988-1990, the average of data for 1984-1987.

The weights in catches are calculated up to 6 years, weights at older ages are from the data series.

The weights in stock are data for 1987, and for 1988-1990, they are calculated up to age 6 for 1988-1989, and age 7 for 1990. Older figures are from the data series.

The reference F in the projections is the mean F of ages 5-10.

The yield-per-recruit analysis gives $F_{\max} = 0.35$ and $F_{0.1} = 0.17$.

Recruitment is for 1986: 1,000 million

(Age 3)	1987:	430	"
	1988:	346	"
	1989:	391	"
	1990:	155	"

Table 3.29 NORTH-EAST ARCTIC COD.
Stock size and catch predictions.

1988				1989				1990	
Stock biomass (3+)	Spawn. stock biomass	F ₅₋₁₀	Catch	Stock biomass (3+)	Spawn. stock biomass	F ₅₋₁₀	Catch	Stock biomass (3+)	Spawn. stock biomass
1,961	540	0.17	197	2,592	1,052	0.17	331	3,074	1,690
		0.35	383	2,385	933	0.35	569	2,557	1,318
		0.51	530	2,219	840	0.35	530	2,410	1,210
		0.80	759	1,966	703	0.80	869	1,728	752

Table 3.30 NORTH-EAST ARCTIC COD.
Long-term perspectives for stock size and catches.

1988				1989				1990			
Stock Spawn. biom. stock (3+) biom.	F ₅₋₁₀	Catch		Stock Spawn. biom. stock (3+) biom.	F ₅₋₁₀	Catch		Stock Spawn. biom. stock (3+) biom.	F ₅₋₁₀	Catch	
1,961	540	0.51	530	2,219	840	0.35	530	2,410	1,210	0.35	646
		0.59	600	2,141	797	0.44	600	2,237	1,091	0.36	600
		0.65	643	2,093	771	0.50	652	2,122	1,012	0.35	550
		0.70	682	2,049	747	0.60	735	1,976	915	0.53	705
		0.80	759	1,966	703	0.65	744	1,868	841	0.50	628
		0.80	759	1,966	703	0.80	869	1,728	752	0.80	808
Recruitment 346 million				391 million				155 million			

1991				1992				1993				Sum of catches
Stock Spawn. biom. stock (3+) biom.	F ₅₋₁₀	Catch		Stock Spawn. biom. stock (3+) biom.	F ₅₋₁₀	Catch		Stock Spawn. biom. stock (3+) biom.	F ₅₋₁₀	Catch		
2,323	1,368	0.35	632	2,040	1,275	0.35	563	1,805	1,175	0.35	484	3,385
2,183	1,252	0.36	600	1,934	1,180	0.35	530	1,735	1,107	0.35	464	3,394
2,111	1,191	0.35	560	1,906	1,151	0.35	518	1,721	1,092	0.35	458	3,381
1,770	928	0.46	565	1,546	852	0.40	451	1,420	824	0.35	368	3,506
1,735	896	0.35	441	1,649	928	0.35	436	1,548	930	0.35	408	3,416
1,372	631	0.80	621	1,063	478	0.80	481	871	381	0.80	380	3,918
Recruitment 200 million				200 million				200 million				

Table 4.1 North-East Arctic HADDOCK.

Total nominal catch (t) by fishing areas (Norwegian coastal haddock not included). (As officially reported to ICES.)

Year	Sub-area I	Division IIa	Division IIb	Total
1960	125,657	27,925	1,854	155,434
1961	165,165	25,642	2,427	193,234
1962	160,972	25,189	1,727	187,888
1963	124,774	21,031	939	146,744
1964	79,056	18,735	1,109	98,900
1965	98,505	18,640	939	118,079
1966	124,115	34,892	1,614	160,621
1967	108,066	27,980	440	136,486
1968	140,970	40,031	725	181,726
1969	88,960	40,208	1,341	130,509
1970	59,493	26,611	497	86,601
1971	56,300	21,567	435	78,302
1972	221,183	41,979	2,155	265,317
1973	283,728	23,348	2,989	320,065
1974	159,037	47,033	5,068	221,138
1975	121,686	44,330	9,726	175,742
1976	94,065	37,566	5,649	137,279
1977	72,159	28,452	9,547	110,158
1978	63,965	30,478	979	95,422
1979	63,841	39,167	615	103,623
1980	54,205	33,616	68	87,889
1981	36,834	39,864	455	77,153
1982	17,948	29,005	2	46,955
1983	7,550	13,872	185	21,607
1984	4,000	13,247	71	17,318
1985	30,385	10,774	111	41,270
1986 ¹	69,479	26,251	728	96,458

¹Provisional figures.

Table 4.2 North-East Arctic HADDOCK.
Total nominal catch ('000 t) by trawl and
other gear for each area.

Year	Sub-area I		Division IIa		Division IIb
	Trawl	Others	Trawl	Others	Trawl
1967	73.8	34.3	20.5	7.5	0.4
1968	98.1	42.9	31.4	8.6	0.7
1969	41.3	47.7	33.1	7.1	1.3
1970	36.7	22.8	20.2	6.4	0.5
1971	27.3	29.0	15.0	6.6	0.4
1972	193.4	27.8	34.4	7.6	2.2
1973	241.2	42.5	13.9	9.4	13.0
1974	133.1	25.9	39.9	7.1	15.1
1975	103.5	18.2	34.6	9.7	9.7
1976	77.7	16.4	28.1	9.5	5.6
1977	57.6	14.6	19.9	8.6	9.5
1978	53.9	10.1	15.7	14.8	1.0
1979	47.8	16.0	20.3	18.9	0.6
1980	30.5	23.7	14.8	18.9	0.1
1981	19.0	17.9	21.8	18.7	0.5
1982	9.0	8.9	18.5	10.5	-
1983	3.7	3.8	7.6	6.3	0.2
1984	1.6	2.4	6.4	6.9	0.1
1985	24.4	6.0	4.5	6.3	0.1
1986 ¹	51.3	18.2	13.1	13.2	0.7

¹ Provisional.

Table 4.3 North-East Arctic HADDOCK.

Nominal catch (t) by countries (Norwegian coastal haddock not included) (Sub-area I and Divisions IIa and IIb combined). (As officially reported to ICES.)

Year	Faroe Islands	France	German Dem. Rep.	Germany, Fed. Rep.	Norway	Poland	United Kingdom	USSR	Others	Total
1960	172	-	-	5,597	46,263	-	45,469	57,025	125	155,651
1961	285	220	-	6,304	60,862	-	39,650	85,345	558	193,234
1962	83	409	-	2,895	54,567	-	37,486	91,910	58	187,438
1963	17	363	-	2,554	59,955	-	19,809	63,526	-	146,224
1964	-	208	-	1,482	38,695	-	14,653	43,870	250	99,158
1965	-	226	-	1,568	60,447	-	14,345	41,750	242	118,578
1966	-	1,072	11	2,098	82,090	-	27,723	48,710	74	161,778
1967	-	1,208	3	1,705	51,954	-	24,158	57,346	23	136,397
1968	-	-	-	1,867	64,076	-	40,129	75,654	-	101,726
1969	2	-	309	1,490	67,549	-	37,234	24,211	25	130,820
1970	541	-	656	2,119	37,716	-	20,423	26,802	-	87,257
1971	81	-	16	896	45,715	43	16,373	15,778	3	78,905
1972	137	-	829	1,433	46,700	1,433	17,166	196,224	2,231	266,153
1973	1,212	3,214	22	9,534	86,767	34	32,408	186,534	2,501	322,626
1974	925	3,601	454	23,409	66,164	3,045	37,663	78,548	7,348	221,157
1975	299	5,191	437	15,930	55,966	1,080	28,677	65,015	3,163	175,758
1976	536	4,459	348	16,660	49,492	986	16,940	42,485	5,358	137,265
1977	213	1,510	144	4,798	40,118	-	10,878	52,210	287	110,158
1978	466	1,411	369	1,521	39,955	1	5,766	45,895	38	95,422
1979	343	1,198	10	1,948	66,849	2	6,454	26,365	454	103,623
1980	497	226	15	1,365	61,886	-	2,948	20,706	246	87,889
1981	381	414	22	2,398	58,856	<u>Spain</u>	1,682	13,400	-	77,153
1982	496	53	-	1,258	41,421	-	827	2,900	-	46,955
1983	428	-	1	729	19,371	139	259	680	-	21,607
1984	297	15	4	400	15,186	37	276	1,103	-	17,318
1985	424	21	20	395	17,490	77	153	22,690	-	41,270
1986	881	54	75	1,079	48,178	22	431	45,738	-	96,458
1987	Expected Landings									210,000

¹ Provisional figures.

Table 4.4 North-East Arctic HADDOCK.
Catch per unit effort.

Year	Sub-area I			Division IIb		Division IIa	
	Norway ²	USSR ⁴	UK ³	Norway ²	UK ³	Norway ²	UK ³
1960	-	-	33	-	2.8	-	34
1961	-	-	29	-	3.3	-	36
1962	-	-	23	-	2.5	-	42
1963	-	-	13	-	0.9	-	33
1964	-	-	18	-	1.6	-	18
1965	-	-	18	-	2.0	-	18
1966	-	-	17	-	2.8	-	34
1967	-	-	18	-	2.4	-	25
1968	-	-	19	-	1.0	-	50
1969	-	-	13	-	2.0	-	42
1970	-	-	7	-	1.0	-	31
1971	-	-	8	-	3.0	-	25
1972	0.06	-	14	0.02	23.0	0.09	18
1973	0.35	-	22	0.18	20.0	0.39	20
1974	0.27	-	20	0.09	15.0	0.51	74
1975	0.26	-	15	0.06	4.0	0.44	60
1976	0.27	-	10	+	3.0	0.24	38
1977	0.11	-	4	+	0.2	0.14	16
1978	0.13	-	5	+	4.0	0.14	15
1979	0.36	-	-	0.07	-	0.18	-
1980	0.45	-	-	+	-	0.22	-
1981	0.64	-	-	-	-	0.37	-
1982	0.51	-	-	-	-	0.38	-
1983	0.27	-	-	0.04	-	0.17	-
1984	0.13	-	-	0.01	-	0.12	-
1985 ¹	0.27	1.00	-	0.01	-	0.11	-
1986 ¹	0.57	1.05	-	0.02	-	0.19	-

¹ Preliminary figures.

² Norwegian data - t per 1,000 t/hrs fishing.

³ United Kingdom data - t per 100 t/hrs fishing.

⁴ USSR data - t per hour fishing.

Table 4.5 North-East Arctic HADDOCK.
Weight at age (kg) in Norwegian and USSR
landings.

Age	1984		1985		1986	
	Norway	USSR	Norway	USSR	Norway	USSR
2	1.17	0.66	0.81	0.25	0.62	0.27
3	1.58	1.35	1.32	0.81	1.17	0.54
4	1.99	1.90	1.91	1.46	1.52	0.98
5	2.42	2.48	2.35	2.51	2.25	1.50
6	2.64	3.13	2.66	2.84	2.57	2.25
7	2.89	3.12	2.85	3.23	2.70	2.63
8	3.16	3.57	3.14	3.29	3.05	3.03
9	3.41	3.86	3.38	3.90	3.19	3.65
10	3.51	3.98	3.72	4.03	3.50	3.80
11	4.04	4.77	3.81	6.75	3.72	-
12	4.04	-	3.22	(5.20)	3.97	-
13	3.84	-	3.72	4.78	4.06	-
14	4.19	-	4.19	-	4.12	-
15+	4.36	5.37	4.06	-	4.06	6.45

Table 4.6 North-East Arctic HADDOCK. Year class strength.

NORTHEAST ARCTIC HADDOCK : recruits as 3 year-olds (inc. data for ages 0,1,2 & 3)											
(No. of surveys, No. of years, VPA Column No.)											
Year class	VPA	R-T-1	R-T-2	R-T-3	INTUGP	N-BST1	N-BST2	N-BST3	N-BSA1	N-BSA2	N-BSA3
1957	242	38	9	14	-	-	-	-	-	-	-
1958	109	2	4	5	-	-	-	-	-	-	-
1959	241	7	14	33	-	-	-	-	-	-	-
1960	274	30	40	72	-	-	-	-	-	-	-
1961	320	32	50	34	-	-	-	-	-	-	-
1962	100	5	3	4	-	-	-	-	-	-	-
1963	243	16	9	12	-	-	-	-	-	-	-
1964	291	11	12	15	-	-	-	-	-	-	-
1965	20	0.3	0.3	0.3	0.01	-	-	-	-	-	-
1966	17	0.3	0.3	0.3	0.01	-	-	-	-	-	-
1967	164	3	13	8	0.08	-	-	-	-	-	-
1968	97	0.3	0.3	3	0.003	-	-	-	-	-	-
1969	1025	31	69	120	0.29	-	-	-	-	-	-
1970	270	10	33	31	0.64	-	-	-	-	-	-
1971	54	3	3	9	0.26	-	-	-	-	-	-
1972	49	2	9	3	0.16	-	-	-	-	-	-
1973	56	13	8	5	0.26	-	-	-	-	-	-
1974	114	15	35	14	0.51	-	-	-	-	-	198
1975	171	163	96	59	0.60	-	-	-	-	755	737
1976	138	6	13	4	0.38	-	-	-	267	149	181
1977	19	1	1	0.3	0.33	-	-	-	111	11	-
1978	6	0.3	0.3	0.3	0.12	-	-	2.3	17	-	14
1979	9	0.3	0.3	0.3	0.20	-	4.8	1.8	-	25	7
1980	5	0.3	0.3	-	0.15	0.3	0.9	4.1	2	4	7
1981	7	0.3	0.3	8	0.03	0.5	5.7	15.2	3	10	53
1982	355	23	59	63	0.38	314.5	355.8	380.2	-	1002	1187
1983	-	40	79	239	0.62	663.2	616.2	314.0	2148	1972	2161
1984	-	9	19	18	0.78	167.8	135.0	149.3	1034	630	220
1985	-	5	2	-	0.27	77.9	31.9	-	434	36	-
1986	-	1	-	-	0.39	15.2	-	-	47	-	-
1987	-	1	-	-	0.10	-	-	-	-	-	-

R-T-1	USSR Bottom trawl survey, age 1
R-T-2	USSR " " " age 2
R-T-3	USSR " " " age 3
INTUGP	International 0-group survey
N-BST1	Norwegian Barents Sea, Bottom trawl survey, age 1
N-BST2	Norwegian " " " age 2
N-BST3	Norwegian " " " age 3
N-BSA1	Norwegian Barents Sea, Acoustic survey, age 1
N-BSA2	Norwegian " " " age 2
N-BSA3	Norwegian " " " age 3

Table 4.7

Analysis by RCRTINX2 of data from file RCRT-DATA
 NORTHEAST ARCTIC HADDOCK : recruits as 3 year-olds (inc. data for ages 0,1,2 & 3

Data for 10 surveys over 31 years

REGRESSION TYPE = C

TAPERED TIME WEIGHTING APPLIED

POWER = 3 OVER 20 YEARS

PRIOR WEIGHTING NOT APPLIED

FINAL ESTIMATES SHRUNK TOWARDS MEAN

ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED

MINIMUM S.E. FOR ANY SURVEY TAKEN AS .00

MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1983

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	3.7136	1.249	1.754	.6730	26	6.3917	1.14309	1.27730	.07775
R-T-2	4.3820	1.021	1.849	.8393	26	6.3216	.71763	.81142	.19267
R-T-3	5.4806	1.224	1.510	.6607	25	8.2162	1.13263	1.43751	.06139
INTUGP	.4824	16.139	-.027	.4588	18	7.7591	1.78081	2.06798	.02966
N-BST1	6.4986	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	6.4252	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST3	5.7526	.914	.496	.8670	5	5.7533	.78634	1.06449	.11195
N-BSA1	7.6728	.748	.409	.7584	5	6.1482	.84901	1.36702	.06788
N-BSA2	7.5873	.824	.257	.9168	7	6.5114	.56208	.71879	.24553
N-BSA3	7.6788	.929	-.470	.8760	8	6.6612	.71000	.88681	.16131

MEAN 3.8087 1.56419 1.56419 .05185

Yearclass = 1984

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	2.3026	1.224	1.750	.6956	26	4.5673	1.09914	1.15763	.07832
R-T-2	2.9957	1.006	1.840	.8595	26	4.8543	.67182	.71505	.20528
R-T-3	2.9444	1.232	1.458	.6538	25	5.0870	1.17030	1.24999	.06717
INTUGP	.5766	15.672	.004	.5080	18	9.0410	1.63484	2.10665	.02365
N-BST1	5.1287	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	4.9127	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST3	5.0126	.915	.491	.8675	5	5.0757	.78974	.99165	.10673
N-BSA1	6.9422	.744	.425	.7574	5	5.5924	.85165	1.27291	.06479
N-BSA2	6.4473	.825	.252	.9180	7	5.5754	.56211	.66203	.23948
N-BSA3	5.3982	.929	-.473	.8755	8	4.5397	.71760	.78033	.17237

MEAN 3.7417 1.57676 1.57676 .04222

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	1.7913	1.199	1.750	.7202	26	3.8978	1.05061	1.10236	.11163
R-T-2	1.0980	.992	1.836	.8797	26	2.9249	.62346	.65995	.31146
R-T-3									
INTUGP	.2390	15.192	.054	.5616	18	3.6850	1.48950	1.56170	.05562
N-BST1	4.3682	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	3.4435	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST3									
N-BSA1	6.0753	.740	.446	.7561	5	4.9396	.85656	1.17334	.09853
N-BSA2	3.5109	.827	.245	.9196	7	3.2304	.56238	.60627	.36912
N-BSA3									

MEAN 3.6685 1.59011 1.59011 .05365

Table 4.7 (cont'd)

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	.6931	1.177	1.753	.7453	26	2.5685	1.00235	1.07378	.31499
R-T-2									
R-T-3									
INTUGP	.3293	14.776	.109	.6125	18	4.9746	1.36363	1.47288	.16741
N-BSI1	2.7850	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BSI2									
N-BSI3									
N-BSA1	3.8712	.734	.471	.7546	5	3.3126	.86507	.98206	.37657
N-BSA2									
N-BSA3									
MEAN						3.5901	1.60476	1.60476	.14103

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	.0931	1.101	1.755	.7685	26	2.5599	.96152	1.03601	.51847
R-T-2									
R-T-3									
INTUGP	.0953	14.519	.149	.6528	18	1.5329	1.27769	1.43449	.27043
N-BSI1									
N-BSI2									
N-BSI3									
N-BSA1									
N-BSA2									
N-BSA3									
MEAN						3.5114	1.62360	1.62360	.21110

Year	class	Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1965	4.33	77.62	.25	.48	3.04 21.00	1.93
1966	3.52	33.82	.33	.44	2.89 18.00	1.34
1967	4.78	119.54	.30	.32	5.11 165.00	1.07
1968	3.66	38.78	.32	.42	4.58 98.00	1.31
1969	6.61	742.95	.37	.53	6.93 1026.00	1.43
1970	3.98	397.20	.33	.55	5.60 271.00	1.67
1971	4.71	111.52	.31	.19	4.01 55.00	.60
1972	4.42	82.78	.34	.29	3.91 50.00	.83
1973	4.85	128.15	.35	.33	4.04 57.00	.95
1974	3.50	244.86	.37	.36	4.74 115.00	.97
1975	6.60	732.67	.41	.60	5.15 172.00	1.47
1976	4.42	85.17	.44	.28	4.93 139.00	.63
1977	3.42	30.61	.47	.50	3.00 20.00	1.06
1978	3.05	21.21	.47	.43	1.95 7.00	.92
1979	2.79	16.23	.52	.41	2.30 10.00	.80
1980	2.50	10.02	.49	.42	1.79 6.00	.87
1981	3.22	25.01	.33	.42	2.08 8.00	1.26
1982	3.92	372.41	.44	.34	5.87 356.00	.78
1983	6.38	590.93	.36	.31		.87
1984	3.09	162.22	.32	.29		.91
1985	3.43	30.78	.37	.30		.80
1986	3.40	29.83	.60	.57		.94
1987	2.48	11.98	.75	.69		.92

Table 4.8 North-East Arctic HADDOCK.

Results from the Norwegian bottom trawl survey in the Barents Sea. Index of number of fish in each year class.

Year	Year class												Total ¹
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
1981	-	-	-	-	-		0.3	4.8	2.3	9.5	2.0	6.1	25.7
1982	-	-	-	-		0.5	0.0	1.8	2.1	2.2	5.5	2.7	15.9
1983	-	-	-		314.5	5.7	4.1	3.8	1.9	2.3	3.9	1.6	379.0
1984	-	-		663.2	355.8	15.2	1.6	0.7	0.2	0.3	0.4	1.8	1,037.4
1985	-		167.8	616.2	380.2	7.2	0.4	0.2	0.3	0.3	-	-	1,172.6
1986	-	77.9	135.0	314.0	123.0	0.4	0.1	0.1	0.2	-	-	-	651.5
1987	15.2	31.9	149.3	312.8	62.0	0.1	0.2	+	-	-	-	-	571.5

¹Includes year classes older than the 1975 year class.

Table 4.9 North-East Arctic HADDOCK.

Results from the USSR bottom trawl survey in the Barents Sea and adjacent waters (numbers per hour trawling).

Year	Year class												Total
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
Sub-area I													
1983	-	-	-	39.9	97.3	16.5	0.8	0.7	+	+	0.8	0.2	156.2
1984	-	-	9.7	100.2	110.6	2.8	0.4	0.2	+	+	0.5	0.2	224.6
1985	-	3.9	19.1	213.4	168.8	0.8	0.2	0.1	-	+	0.3	-	406.8
1986	0.2	2.3	16.6	58.1	27.6	0.1	+	+	+	+	-	-	105.0
Division IIA													
1983	-	-	-	5.4	5.5	0.1	0.2	0.3	0.1	+	0.9	+	12.5
1984	-	-	4.9	14.4	5.6	0.1	0.1	0.1	-	+	0.1	0.1	25.4
1985	-	3.8	7.0	11.7	4.1	0.1	-	+	-	-	0.1	-	26.8
1986	0.4	0.3	3.5	10.4	2.9	0.1	+	+	-	-	-	-	17.6
Division IIB													
1983	-	-	-	22.1	9.9	0.2	0.1	+	+	-	+	+	32.3
1984	-	-	2.2	14.3	1.8	-	-	-	-	-	+	-	18.3
1985	-	1.4	10.2	61.4	5.1	+	+	+	-	+	-	-	78.1
1986	+	0.2	3.1	7.2	1.4	-	-	+	+	-	-	-	12.0
Total													
1983	-	-	-	29.8	59.2	9.5	0.5	0.4	+	+	0.6	0.1	100.1
1984	-	-	6.4	58.6	58.4	1.5	0.2	0.1	+	+	0.2	0.1	125.5
1985	-	3.0	14.4	134.3	90.0	0.4	0.1	0.1	-	+	0.2	-	242.7
1986	0.2	1.4	10.7	36.3	16.4	0.1	+	+	+	+	-	-	65.1

Table 4.10 North-East Arctic HADDOCK.

Results from the Norwegian acoustic survey in the Barents Sea. Stock numbers in millions.

Year	Year class												Total ¹
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
1981	-	-	-	-	-	-	2	25	14	66	160	50	320
1982	-	-	-	-	-	3	4	7	10	12	29	14	80
1983	-	-	-	-	-	10	7	9	5	4	10	5	50
1984	-	-	-	2,148	1,002	53	15	7	2	2	2	-	3,231
1985	-	-	1,034	1,972	1,187	33	2	1	1	1	1	-	3,254
1986	-	434	630	2,161	944	3	1	2	+	+	+	-	3,770
1987	47	36	220	804	209	+	+	+	-	+	-	-	1,318

¹ Includes year classes older than the 1975 year class.

Table 4.11 North-East Arctic HADDOCK.

Results from the USSR acoustic survey in the Barents Sea and adjacent waters. Stock numbers in millions.

Year	Year class												Total
	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	
1985	-	194	434	1,468	836	3	1	+	-	+	-	-	2,738
1986	34	37	208	917	910	2	+	+	+	+	+	-	2,109

Table 4.12 North-East Arctic HADDOCK.

Input data to the assessment. Weight at age (kg) in the catch.

Age	Age											
	3	4	5	6	7	8	9	10	11	12	13	14+
1982	0.66	1.03	1.79	2.38	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1983	1.52	1.86	2.10	2.38	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1984	1.57	1.99	2.42	2.68	2.93	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1985	0.92	1.66	2.39	2.89	2.71	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1986	0.86	1.25	1.88	2.41	2.66	3.04	3.70	4.41	5.40	6.40	7.40	8.00

Table 4.13 North-East Arctic HADDOCK.

Input data to the assessment. Weight at age (kg) in the stock.

Year	Age											
	3	4	5	6	7	8	9	10	11	12	13	14+
1982	0.66	1.03	1.79	2.38	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1983	0.66	1.03	1.79	2.38	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1984	0.66	1.03	1.79	2.38	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1985	0.47	0.74	1.79	2.38	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1986	0.30	0.96	1.30	2.38	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1987	0.21	0.51	0.89	1.82	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00

Table 4.14 North-East Arctic HADDOCK.

Maturity at age from USSR data and average used in the assessment.

Age	Maturity at age in percent						Average ¹
	1981	1982	1983	1984	1985	1986	
3	1	9	17	7	2	+	6
4	12	55	70	14	8	22	30
5	64	73	100	35	80	53	68
6	73	93	99	47	93	86	82
7	96	96	99	74	96	86	91
8	100	100	100	82	91	100	95
9	100	93	-	89	96	83	100
10	-	-	-	-	-	100	100

¹ Average not used for age 9.

TABLE 4.15

NORTHEAST ARCTIC HADDOCK

Module run at 12.34.54 19 september 1987

DISAGGREGATED Os

Fleet 1 (Norw Bar Sea Trawl) has q fixed as the mean

Fleet 2 (Norw Bar Sea Acousti) has q fixed as the mean

Fleet 3 (USSR 1 Trawl/Acoust1) has q fixed as the mean

LOG TRANSFORMATION

NO explanatory variate (mean used)

FLEETS COMBINED BY** VARIANCE**

Regression weights

1.000 1.000 1.000 1.000

Oldest age F=1.000*average of 5 younger ages. Fleets combined by variance of predictions

LOG CATCHABILITY

1983	1984	1985	1986	EST'D	AGE	Fleet	LSE (Q)	EST F
-7.2513	-5.8996	-6.6565	-6.6177	-6.606	3	1	.553	.1103
-6.7163	-4.6506	-5.518	-4.6888	-5.393	3	2	.969	.0539
-8.8854	-7.5912	-7.4684	-8.3049	-8.063	3	3	.661	.1389
-7.4573	-7.8295	-6.26	-7.3885	-7.234	4	1	.678	.3582
-6.541	-5.5914	-4.7375	-5.3506	-5.555	4	2	.749	.2501
-9.0949	-9.2157	-8.4572	-8.8829	-8.913	4	3	.333	.2978
-7.5624	-8.6298	-8.8091	-8.5615	-8.391	5	1	.562	.581
-6.5949	-6.3272	-7.1996	-6.5466	-6.667	5	2	.374	.4342
-10.5069	-9.8826	-9.5022	-9.9478	-9.96	5	3	.414	.4839
-8.224	-9.4273	-9.4359	-9.7861	-9.218	6	1	.684	.3799
-7.6706	-7.1247	-7.8264	-7.4835	-7.526	6	2	.302	.2063
-11.3595	-10.1205	-10.129	-9.7861	-10.35	6	3	.692	.1227

Table 4.16

VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC HADDOCK

FISHING MORTALITY COEFFICIENT

UNIT: Year-1

	1983	1984	1985	1986	1983-86
1	.000	.000	.000	.001	.000
2	.022	.001	.007	.001	.008
3	.120	.081	.098	.106	.101
4	.309	.205	.301	.300	.279
5	.242	.213	.199	.478	.283
6	.160	.124	.285	.209	.195
7	.171	.126	.181	.224	.175
8+	.171	.126	.181	.224	.175
(4-7)U	.221	.167	.242	.303	

STOCK SIZE IN NUMBERS

UNIT: thousands

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1983	1984	1985	1986	1987
1	520112	419898	935708	108180	0
2	8055	425831	343784	766092	88482
3	8862	6449	348414	279400	626596
4	7960	4984	4868	253609	205661
5	4524	4782	3323	2950	156870
6	10215	2908	3163	2229	1497
7	22951	7126	2104	1947	1480
8+	8091	23959	16482	6382	5448
TOTAL NO	588769	900937	1657845	1425788	
SPS NO	42824	41514	44791	106015	

Table 4.17

Title : NORTH-EAST ARCTIC HADDOCK

At 19.40.22 22 SEPTEMBER 1987

from 76 to 86 on ages 1 to 13

with Terminal F of .300 on age 4 and Terminal S of 1.000

Initial sum of squared residuals was 563.468 and

final sum of squared residuals is 222.288 after 95 iterations

Matrix of Residuals

Years Ages	76/77	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	WTS	
1/ 2	.768	-.326	2.311	2.207	-4.025	-.908	-2.336	-5.511	-7.474	-4.095	-19.416	.001
2/ 3	.876	1.612	.681	.134	-5.499	.385	-.623	1.799	-1.694	.533	.003	.001
3/ 4	.055	1.319	.846	.185	-.664	.077	-.438	.463	-.058	.018	.003	1.000
4/ 5	-.056	.756	.041	-.127	-.255	-.626	-.673	.491	.321	-.134	.003	1.000
5/ 6	-.058	.400	.219	.373	.145	-.041	-.078	.449	-.215	-.164	.003	1.000
6/ 7	-.058	-.846	-.326	.810	.459	.738	.310	-.046	-.423	.154	.003	1.000
7/ 8	.267	-.170	.280	-.397	-.103	.492	.128	-.181	-.136	.188	.003	1.000
8/ 9	.015	-1.070	-.594	-.370	.252	-.186	.589	-.315	-.128	-.123	.003	1.000
9/10	.408	-.417	.367	-.126	.810	.284	-.051	-.662	.047	.637	.003	.200
10/11	-.656	-1.148	-1.150	-.504	.212	-1.040	-.102	-.310	-.131	.589	.003	.200
11/12	-.477	1.761	-.069	-.697	.014	-.876	.256	-.993	1.068	-.324	.003	.200
12/13	-.114	-2.149	-1.491	-1.052	-.157	-.637	.703	-2.324	2.258	-.573	.003	.200
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-28.182	
WTS	.010	.010	.010	.010	.010	.010	1.000	1.000	1.000	1.000		
Fishing Mortalities (F)												
F-values	76 .6556											
F-values	.77 .6685	.78 .4741	.79 .4435	.80 .3583	.81 .3870	.82 .4024	.83 .2799	.84 .2533	.85 .2920	.86 .3000		
Selection-at-age (S)												
S-values	1 .0010	2 .0138	3 .3301									
S-values	4 1.0000	5 1.2922	6 1.3507	7 1.4000	8 1.6119	9 1.3003	10 1.8341	11 2.0566	12 2.2696	13 1.0000		

Table 4.18

Title : NORTH-EAST ARCTIC HADDOCK
At 19.40.23 22 SEPTEMBER 1987
SEPERABLE FISHING MORTALITIES

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	.001	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000
2	.009	.009	.007	.006	.005	.005	.006	.004	.003	.004	.004
3	.216	.221	.157	.146	.118	.128	.133	.092	.084	.096	.099
4	.056	.068	.474	.443	.358	.387	.402	.280	.253	.292	.300
5	.847	.864	.613	.573	.463	.500	.520	.362	.327	.377	.388
6	.885	.903	.640	.599	.484	.523	.544	.378	.342	.394	.405
7	.918	.936	.664	.621	.502	.562	.563	.392	.355	.409	.420
8	1.057	1.078	.764	.715	.578	.624	.649	.451	.408	.471	.484
9	.852	.869	.617	.577	.466	.503	.523	.364	.329	.380	.390
10	1.202	1.226	.870	.813	.657	.710	.738	.513	.465	.536	.550
11	1.348	1.375	.975	.912	.737	.796	.828	.576	.521	.601	.617
12	1.488	1.517	1.076	1.006	.813	.878	.913	.635	.575	.663	.681
13	.656	.668	.474	.443	.358	.397	.402	.280	.253	.292	.300

SEPERABLE POPULATION NUMBERS Units: thousands

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	104524	201466	38187	9244	13096	8272	10202	525164	445361	29274	360520
2	27755	85521	164836	31250	7565	10718	6770	8350	428211	364538	23961
3	15217	22520	69377	134078	25430	6163	8729	5512	6810	349368	297260
4	15157	10034	14786	48571	94824	18497	4441	6257	4114	5128	259748
5	170576	6443	4210	7535	25523	54256	10284	2431	3372	2615	3135
6	105913	57863	2224	1868	3478	13152	26940	5006	1386	2285	1468
7	352957	35773	19869	960	840	1755	6384	12808	2808	806	1261
8	6612	108881	11488	8376	422	417	836	2976	7086	1613	439
9	8167	1882	30348	4380	3355	194	183	358	1552	3857	825
10	353	2851	646	13413	2015	1724	96	89	204	914	2160
11	2841	87	685	222	4869	855	694	38	43	105	438
12	998	604	18	211	73	1908	316	248	17	21	47
13	751	184	108	5	63	26	649	104	108	8	9

Table 4.19

VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC HADDOCK

CATCH IN NUMBERS

UNIT: thousands

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
3	22505	5911	26157	15918	657	1520	25004	1979	230229	70204	2634	10037
4	49162	46161	22469	41373	67652	1963	2408	24359	22246	258773	41701	14089
5	50592	40032	62724	13505	41267	44526	1870	1258	42849	24018	88111	33871
6	5800	12578	28340	25736	7748	18956	21995	918	3196	6872	5827	49712
7	5519	1672	5711	8878	15599	3611	7948	9279	1606	418	4138	2135
8	2709	970	578	1677	5292	4925	1974	5056	6736	422	382	1236
9	832	893	435	218	655	1624	1978	826	2630	1680	617	92
10	104	122	188	176	182	315	776	1043	896	525	2043	131
11	206	204	186	155	101	43	166	369	988	146	935	500
12	234	123	25	76	115	43	26	130	538	340	276	147
13	121	14	8	27	18	14	52	27	53	68	458	53
14+	67	205	7	7	19	2	19	4	42	13	143	92
TOTAL	115651	108885	147328	107686	139285	77542	62166	43248	312009	363479	154315	112095
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
3	15989	55967	47311	17540	627	486	883	704	456	29548	25609	
4	15449	22043	18812	55290	22878	2561	900	1930	841	1153	61035	
5	6808	7568	4776	10645	21794	22124	3372	884	836	546	1024	
6	20789	2586	1589	1429	2971	10685	12203	1374	307	715	383	
7	40044	7731	1626	812	250	1034	2625	5282	765	316	356	
8	1247	11043	2596	546	504	162	344	906	2250	634	163	
9	1549	311	6215	1466	230	162	75	52	499	1312	315	
10	195	588	162	2310	842	72	80	37	70	416	522	
11	279	96	258	181	1299	330	91	29	25	50	123	
12	652	101	3	87	111	564	320	21	36	5	34	
13	551	34	74	2	35	27	204	21	44	1	2	
14+	46	98	65	53	15	42	34	91	185	57	8	
TOTAL	99175	107866	82587	70361	51556	38249	21131	9331	6314	34753	89574	

Table 4.20 VIRTUAL POPULATION ANALYSIS
NORTH-EAST ARCTIC HADDOCK

FISHING MORTALITY COEFFICIENT				UNIT: Year-1		NATURAL MORTALITY COEFFICIENT = .20							
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	
3	.080	.067	.127	.062	.038	.102	.168	.023	.285	.336	.220	.258	
4	.517	.235	.388	.303	.403	.154	.233	.269	.386	.598	.342	.571	
5	.690	.462	.575	.427	.560	.507	.215	.184	1.065	.956	.418	.517	
6	.859	.690	.722	.494	.467	.546	.509	.155	.963	.471	.649	.443	
7	.770	.655	.800	.510	.639	.415	.466	.419	.441	.303	.583	.526	
8	.848	.497	.497	.554	.660	.425	.420	.328	.616	.197	.500	.342	
9	.820	.772	.436	.353	.457	.433	.302	.311	.522	.302	.498	.213	
10	.235	.261	.359	.315	.562	.417	.351	.258	.656	.184	.734	.179	
11	.780	.990	.798	.568	.301	.247	.405	.303	.414	.206	.574	.394	
12	1.953	1.883	.295	.937	1.160	.202	.232	.645	.979	.244	.741	.162	
13	.600	.600	.600	.600	.600	.400	.400	.400	.400	.600	.300	.600	
14+	.600	.600	.600	.600	.600	.400	.400	.400	.400	.600	.300	.600	
(4-7)U	.659	.511	.621	.434	.517	.406	.356	.257	.714	.582	.498	.514	
(3-13)U	.873	.834	.498	.554	.623	.354	.352	.374	.631	.239	.606	.265	
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1985-86	
3	.523	.768	.363	.150	.037	.097	.112	.153	.078	.096	.100	.107	
4	.650	1.280	.644	.506	.297	.210	.263	.379	.275	.286	.293	.308	
5	.606	.942	.892	.973	.685	.523	.468	.445	.280	.288	.443	.364	
6	.705	.490	.451	.958	.827	.884	.620	.353	.273	.411	.337	.343	
7	.787	.632	.661	.522	.425	.792	.559	.334	.339	.408	.370	.385	
8	.679	.518	.447	.487	.729	.541	.676	.381	.402	.524	.522	.457	
9	.777	.354	.628	.492	.391	.548	.522	.198	.373	.435	.541	.387	
10	.920	.535	.315	.506	.590	.203	.581	.532	.445	.615	.308	.475	
11	.706	2.292	.848	.696	.601	.486	.424	.430	.859	.668	.368	.581	
12	1.416	.606	.429	.800	1.370	.575	1.317	.162	1.607	.408	1.509	.921	
13	.656	.687	1.335	.572	.919	2.000	.422	.252	.591	.149	.283	.319	
14+	.656	.687	1.335	.572	.919	2.000	.422	.252	.591	.149	.283	.319	
(4-7)U	.687	.836	.662	.740	.558	.602	.477	.378	.292	.371	.361		
(3-13)U	.859	.832	.667	.592	.767	.726	.657	.326	.713	.466	.589		

Table 4.21 VIRTUAL POPULATION ANALYSIS
NORTH-EAST ARCTIC NAUDBOOK

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

¹Ignored.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
3	520508	100064	241505	290718	19250	17204	165798	95179	1014593	269829	51846	48555
4	198714	242173	76591	173984	225655	15167	12714	115384	76139	627781	157453	35384
5	56979	113516	156738	42541	105260	122425	11649	8243	70425	42370	282523	91784
6	10943	27515	61147	72202	22716	49245	60347	7035	5616	20025	15350	152267
7	7142	5794	11294	24318	36055	11653	25349	24706	4933	1756	11234	5706
8	5154	2709	1675	4155	11958	15576	6301	11992	15097	2509	1062	4678
9	1619	1808	1349	804	1954	5061	8335	3382	7073	7074	1748	527
10	545	544	484	714	463	1015	2687	5046	2032	3435	4282	879
11	413	353	369	591	427	216	547	1549	3193	864	2340	1682
12	292	155	107	136	181	254	138	209	936	1728	575	1079
13	293	34	19	65	44	47	173	90	128	288	1109	224
14+	162	496	17	17	46	7	65	15	102	55	346	390
TOTAL NO	912652	498204	551233	610045	422008	257872	282102	275924	1276666	977803	522270	345136
SPS NO	45807	65377	86353	84350	93994	37138	73735	52572	56578	69283	100385	117967
TOT. BIOM	615715	627423	712911	712218	641967	475098	420006	381018	1019461	1022012	821204	655980
SPS BIOM	102472	150802	190291	202079	226756	219952	203844	177729	165252	148067	225297	288221

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
3	55652	115778	170604	154623	18874	5763	2164	5474	6724	354830	295421 ¹	n ¹
4	53709	52995	43251	97198	97690	14837	4280	5706	5094	263861	215964 ²	
5	10566	15123	7505	18581	47967	59417	9883	2605	3759	2394	5134	161164
6	44810	7509	4190	2519	5748	19875	24835	5069	1414	2325	1469	1647
7	30038	18125	5667	2135	791	2059	0702	12696	2916	881	1262	850
8	2760	29862	7884	1550	1062	424	764	5138	7446	1700	438	714
9	2720	1145	14559	4127	779	420	202	319	1756	4077	824	213
10	349	1024	659	6363	2066	452	198	98	213	989	2142	593
11	601	114	491	394	3140	934	299	91	47	112	438	1301
12	923	243	9	172	161	1409	472	155	44	16	47	248
13	751	184	104	5	63	35	649	104	108	8	0	0
14+	104	215	95	135	27	52	108	449	453	453	36	27
TOTAL NO	235836	218118	253906	271850	178360	105650	61544	36901	28731	372981	571072 ¹	
SPS NO	117684	55682	52984	25194	26937	67016	47941	24777	17625	34426	105360 ¹	
TOT. BIOM	470001	515324	278350	289941	249131	198556	130496	81460	64065	212389	377488 ¹	
SPS BIOM	502875	173471	106610	74111	64200	141128	101850	65924	52371	50110	107251 ¹	

Table 4.22 NORTH-EAST ARCTIC HADDOCK.
Present and expected stock sizes and catches.

Age	1986		1987			1988
	Stock numbers	Catch numbers	Stock numbers	Expected catch numbers	Expected F values	Stock numbers
3	591,000	25,609	162,000	11,363	0.080	31,000
4	263,861	61,035	485,108	95,500	0.244	122,382
5	3,134	1,024	161,164	39,676	0.315	311,253
6	1,469	383	1,647	421	0.329	96,296
7	1,262	356	859	226	0.341	970
8	438	163	714	211	0.393	499
9	824	315	213	52	0.317	394
10	2,162	522	393	129	0.447	127
11	438	123	1,301	468	0.501	205
12	47	34	248	96	0.553	645
13	9	2	9	1	0.244	116
14+	36	8	27	5	0.244	23
Total stock						
Numbers	864,681	89,666	813,683	148,153	$F_{4-7} =$	563,914
Biomass	458,862	96,458	444,183	210,000	0.307	534,142
Spawning stock						
Numbers	123,035		269,845			332,060
Biomass	112,541		192,245			363,807

Table 4.23 NORTH-EAST ARCTIC HADDOCK.
Input variables for the stock size and catch projections.
Input variables by age group.

Age	Fishing pattern	Maturity ogive	Weight in catches	Weight in stock
	1987-1989	1987-1990	1987-1989	1987-1990
3	0.33	0.06	0.86	0.21
4	1.00	0.30	1.25	0.51
5	1.29	0.68	1.88	0.89
6	1.35	0.82	2.41	1.82
7	1.40	0.91	2.66	2.86
8	1.61	0.95	3.04	3.33
9	1.30	1.00	3.70	3.70
10	1.83	1.00	4.41	4.41
11	2.06	1.00	5.40	5.40
12	2.70	1.00	6.70	6.70
13	1.00	1.00	7.40	7.40
14+	1.00	1.00	8.00	8.00

Natural mortality is set to $M = 0.20$.

The fishing pattern is as estimated by the separable VPA.

The maturity ogive is the average used for 1984-1986.

The weights in catches are from 1986.

The weights in stock are from 1987.

The reference F in the projections is the mean F for ages 4-7.

The yield-per-recruit analysis gives $F_{\max} = 0.39$ and $F_{0.1} = 0.15$.

Recruitment is for 1986: 591 million

(Age 3)	1987: 162	"
	1988: 31	"
	1989: 30	"
	1990: 37	"

Table 4.24

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

NORTH EAST ARCTIC HADDOCK

Year 1988					Year 1989					Year 1990	
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
.1	.15	534	364	128	.1	.15	696	567	125	744	656
					.2	.31			233	633	556
					.3	.39			287	578	507
.2	.31	534	364	240	.1	.15	595	484	107	641	563
					.2	.31			200	546	477
					.3	.39			247	499	435
.3	.39	534	364	296	.1	.15	547	443	99	590	517
					.2	.31			184	503	433
					.3	.39			227	460	400

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F for the age group range from 4 to 7

Table 5.1 North-East Arctic SAITHE.

Nominal catch (tonnes) by countries in Sub-area I and Divisions IIa and IIb combined. (As officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Faroe Islands	270	809	1,117	532	236
France	5,658	4,345	2,601	1,016	194
German Dem.Rep.	7,164	6,484	2,435	-	-
Germany, Fed.Rep.	19,985	18,190	14,823	12,511	8,413
Norway	139,705	121,069	141,346	128,878	166,139
Poland	1	35	-	-	-
Portugal	783	203	-	-	-
Spain	1,327	121	685	780	-
UK (Engl. & Wales)	6,853	2,790	1,170	794	395
UK (Scotland)	82	37	-	-	-
USSR	989	381	3	43	121
	182,817	154,464	164,180	144,554	175,498

Country	1982	1983	1984	1985	1986 ¹
Faroe Islands	339	539	503	490	426
France	82	418	431	657	256
German Dem.Rep.	-	-	6	11	-
Germany, Fed.Rep.	7,224	4,933	4,532	1,837	3,470
Norway	159,643	149,556	152,818	103,899	66,152
Poland	-	-	-	-	-
Portugal	-	-	-	-	-
Spain	-	33	-	-	-
UK (Engl. & Wales)	731	1,251	335	202	28
UK (Scotland)	1	-	-	+	21
USSR	14	206	161	51	27
Total	168,034	156,936	158,786	107,147	70,380

¹ Provisional figures.

Table 5.2 Arctic SAITHE. Norwegian purse seiners taking part in the saithe fishery.

Year	Vessel size					Total
	<12.9m	13.0-16.9m	17.0-20.9m	21.0-24.9m	>25.0m	
<u>Number of vessels</u>						
1982	163	51	87	50	22	373
1983	112	53	83	54	12	314
1984 ¹	78	46	64	49	15	252
1985 ¹	35	35	35	43	16	164
1986 ¹	20	19	22	37	21	119
<u>Catch (tonnes)</u>						
1982	4,596	5,960	28,139	23,116	9,302	71,113
1983	3,226	4,922	19,431	20,694	5,524	53,797
1984 ¹	1,077	1,809	8,883	17,733	6,713	36,215
1985 ¹	492	1,962	3,794	16,230	8,391	30,868
1986 ¹	186	673	1,050	2,904	2,442	7,455
<u>Catch per vessel (t)</u>						
1982	28.2	116.9	323.4	462.3	422.8	190.7
1983	28.8	92.9	234.1	383.2	460.3	171.3
1984 ¹	13.8	39.3	138.8	361.9	447.5	143.7
1985 ¹	14.1	56.1	108.4	377.4	524.4	188.2
1986 ¹	9.3	35.4	47.7	78.4	116.3	62.6

¹Preliminary figures.

Table 5.3 North-East Arctic SAITHE. Catch, effort, and catch per unit effort for Norwegian stern trawlers (250-500 GRT)¹.

Year	Catch (t)	Effort (h)	CPUE (kg/h)
1981	24,736	30,415	813
1982	24,520	27,079	905
1983	28,408	26,647	1,066
1984	35,600	40,952	869
1985	20,173	26,757	754
1986 ²	11,186	11,140	1,004

¹Only including days with more than 50% saithe on trips with more than 50% saithe in the catches.

²Preliminary figures.

Table 5.4

NORTHEAST ARCTIC SAITHE

Module run at 09.51.02 21 september 1987

DISAGGREGATED Qs

Fleet 1 (Norw Purse Seine) has q fixed as the mean

Fleet 2 (Norw Trawl 250-500 G) has q fixed as the mean

LOG TRANSFORMATION

NO explanatory variate (mean used)

FLEETS COMBINED BY** VARIANCE**

Regression weights

1.000 1.000 1.000 1.000 1.000

Oldest age F=1.000*average of 5 younger ages. Fleets combined by variance of predictions

LOG CATCHABILITY

1981	1982	1983	1984	1985	1986	EST'D	AGE	Fleet	LSE (Q)	EST F
-1.2169	-1.5323	-1.958	-.8644	-.6446	-1.3569	-1.262	3	1	.471	.3176
-14.9288	-15.2778	-14.2353	-12.8409	-13.1931	-13.599	-14.01	3	2	.97	.1911
.3417	-1.0034	-2.0274	-2.3957	-1.9016	-3.736	-1.787	4	1	1.37	1.7551
-12.4362	-13.3931	-12.968	-12.0897	-12.5667	-12.4184	-12.65	4	2	.463	.1992
-2.807	-4.2521	-1.4242	-2.9289	-2.6669	-3.8316	-2.985	5	1	.989	.8093
-12.4364	-11.505	-12.1775	-13.3393	-12.9089	-12.0287	-12.4	5	2	.653	.2396
-3.9692	-4.81	-2.7282	-2.7237	-4.0699	-4.3364	-3.773	6	1	.862	.425
-12.6749	-12.0783	-12.1407	-12.6638	-13.1331	-12.3942	-12.51	6	2	.394	.2146
-5.1467	-6.8381	-3.8573	-5.127	-4.5308	-5.4472	-5.158	7	1	.999	.1642
-12.9902	-13.3521	-12.5606	-13.2859	-12.78	-12.9596	-12.99	7	2	.299	.1195
-7.7887	-6.5109	-3.1822	-6.2888	-3.9673	-5.0742	-5.469	8	1	1.719	.1152
-11.7993	-13.3389	-12.5183	-13.3546	-12.8108	-12.815	-12.77	8	2	.579	.1782

Table 5.5 VIRTUAL POPULATION ANALYSIS
NORTH-EAST ARCTIC SAITHE
FISHING MORTALITY COEFFICIENT UNIT: Year-1
NATURAL MORTALITY COEFFICIENT = .20

	1981	1982	1983	1984	1985	1986
1	.00	.00	.00	.00	.00	.00
2	.06	.13	.11	.10	.02	.01
3	.38	.27	.19	.68	.56	.29
4	.55	.56	.31	.66	.42	.25
5	.01	.77	.62	.25	.29	.35
6	.46	.50	.44	.45	.17	.24
7	.43	.24	.34	.27	.27	.12
8	.87	.39	.45	.35	.30	.17
9	.53	.49	.43	.40	.29	.23
10+	.58	.49	.43	.40	.29	.23
(3-8)U	.55	.46	.39	.44	.33	.24

STOCK SIZE IN NUMBERS UNIT: thousands

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1981	1982	1983	1984	1985	1986	1987
1	188177	155186	206264	139743	444305	0	0
2	205380	153951	125295	168437	114390	363767	0
3	293593	158705	110519	92088	124717	91654	294864
4	56126	165007	98704	74957	38353	58328	56247
5	51538	26410	76377	59451	31674	20659	37226
6	10717	22944	9981	33705	37822	19470	11960
7	8014	5530	11427	5279	17550	26211	12520
8	3772	4274	3579	6654	3301	11005	18982
9	912	1300	2376	1875	3856	2006	7598
10+	2244	2005	3149	4868	3667	4516	4257
TOTAL NO	820472	693320	648171	587057	819636	597615	
SPS NO	25058	36952	30512	52381	66197	65208	

Table 5.6 SUM OF PRODUCTS CHECK

NORTH-EAST ARCTIC SAITHE
CATEGORY: TOTAL

	UNIT: kilogram									
MEAN WEIGHT AT AGE IN THE CATCH	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	.25	.25	.25	.18	.29	.36	.18	.18	.18	.18
2	.34	.34	.34	.45	.43	.51	.60	.53	.38	.33
3	.71	.71	.71	.79	.73	.77	1.05	.71	.75	.58
4	1.11	1.11	1.11	1.27	1.40	1.12	1.33	1.26	1.33	1.26
5	1.63	1.63	1.63	2.03	2.05	2.02	1.86	2.02	2.07	2.05
6	2.33	2.33	2.33	2.55	2.76	2.61	2.80	2.70	2.63	2.47
7	3.16	3.16	3.16	3.29	3.30	3.27	4.00	3.88	3.28	3.21
8	4.03	4.03	4.03	4.34	4.38	3.91	4.18	4.47	3.96	3.92
9	4.87	4.87	4.87	5.15	5.95	4.69	5.33	5.36	4.54	4.49
10	5.63	5.63	5.63	5.75	6.39	5.63	5.68	6.06	5.55	4.94
11	6.44	6.44	6.44	6.11	6.61	7.18	7.31	6.28	6.88	5.87
12	7.11	7.11	7.11	5.94	6.88	7.21	8.68	6.89	8.14	6.87
13	7.82	7.82	7.82	6.64	6.75	7.00	8.54	8.20	6.06	8.44
14	8.92	8.92	8.92	7.73	7.13	8.73	8.57	9.14	9.66	7.90
15+	9.50	9.50	9.50	9.47	7.66	9.44	10.37	6.47	13.72	10.04

Table 5.7 SUM OF PRODUCTS CHECK

NORTH-EAST ARCTIC SAITHE
CATEGORY: TOTAL

CATCH IN NUMBERS	UNIT: thousands									
-----	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	121	1711	907	486	127	137	484	24	0	0
2	31662	45758	28334	18226	10467	17225	11638	14624	2216	3281
3	99049	48969	61963	47796	83954	34733	17244	41466	48917	20904
4	34317	27685	23328	36644	21822	65052	23768	33233	11974	11704
5	10140	12476	14122	9211	21528	13060	32700	12064	7189	5516
6	2062	4534	4400	5379	3619	8212	3226	11204	5279	3801
7	4332	1468	2901	3200	2550	1054	3008	1135	3740	2748
8	1456	1843	963	1338	2008	1251	1177	1772	775	1568
9	1606	938	1356	147	369	461	760	560	878	370
10	963	976	438	730	279	263	247	557	134	465
11	463	655	305	411	252	120	204	387	274	143
12	244	681	281	454	89	112	123	150	214	101
13	211	264	168	257	144	76	161	117	55	42
14	53	231	222	239	95	97	94	170	126	79
15+	156	299	216	268	49	43	178	73	32	3
TOTAL	186842	146513	139904	113786	147352	141896	95012	117536	81803	50725

Table 5.8

VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC SAITHE

FISHING MORTALITY COEFFICIENT	UNIT: Year-1					NATURAL MORTALITY COEFFICIENT = .20				
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00
2	.21	.19	.20	.05	.06	.13	.11	.10	.02	.01
3	.77	.59	.43	.50	.38	.27	.19	.68	.56	.29
4	.64	.51	.64	.49	.55	.56	.30	.66	.42	.25
5	.45	.51	.53	.57	.60	.78	.62	.25	.29	.35
6	.24	.37	.34	.49	.46	.49	.44	.45	.16	.24
7	.38	.27	.44	.44	.37	.23	.33	.27	.27	.12
8	.26	.27	.28	.37	.56	.32	.44	.33	.30	.17
9	.27	.27	.33	.06	.16	.24	.32	.38	.28	.23
10	.25	.26	.19	.30	.16	.17	.19	.42	.15	.23
11	.15	.27	.12	.28	.16	.10	.19	.52	.38	.23
12	.09	.33	.17	.27	.09	.10	.14	.21	.62	.23
13	.15	.14	.13	.24	.13	.10	.20	.18	.11	.23
14	.16	.25	.15	.27	.13	.12	.18	.33	.31	.23
15+	.16	.25	.15	.27	.13	.12	.18	.33	.31	.23
(3- 30)	.46	.42	.44	.48	.49	.44	.39	.44	.33	.24

Table 5.9 VIRTUAL POPULATION ANALYSIS

NORTH-EAST ARCTIC SAITHE

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	351375	208665	463653	255216	188470	152805	205914	139036	444292 ¹	0 ¹	0 ¹
2	180591	287573	169295	378788	206877	154191	124982	168151	113811	363755 ¹	0 ¹
3	200618	119356	194242	113099	293676	159930	110715	91833	124482	91180	294854 ¹
4	79122	75906	53918	103456	56050	165074	97707	75117	38145	58137	55859
5	30551	34106	37348	23293	51868	26358	76932	60270	31805	20489	37070
6	10693	15922	16748	17933	10828	25212	9932	33749	38492	19576	11821
7	15141	6899	8965	9760	8967	5620	11646	5239	17586	26759	12608
8	6929	8507	4328	4738	5121	5052	3653	6833	3268	11055	19431
9	7403	4363	5303	2678	2678	2396	3012	1935	4003	1979	7622
10	4822	4617	2729	3124	2060	1860	1547	1783	1082	2487	1288
11	3720	3082	2902	1840	1901	1435	1286	1044	960	765	1618
12	3267	2628	1934	2101	1137	1330	1067	869	508	540	498
13	1634	2455	1540	1330	1312	850	988	762	577	225	351
14	432	1147	1754	1109	858	945	628	664	519	423	146
15+	1176	1485	1707	1244	443	419	1189	285	132	16	285
TOTAL NO	897475	776713	966367	917709	832245	701477	653196	587571	819662	597367	
SPS NO	55216	51106	47911	45858	35305	43119	34947	53164	67127	63806	
TOT. BIOM	668177	597036	634445	667126	692554	652725	663313	585622	550246	570459	
SPS BIOM	238869	222504	202333	183071	149757	157807	159306	189880	217094	212280	

¹Ignored.

Table 5.10

List of input variables for the ICES prediction program.

NORTH-EAST ARCTIC SAITHE

The reference F is the mean F for the age group range from 5 to 8

The number of recruits per year is as follows:

Year	Recruitment
1987	200000.0
1988	200000.0
1989	200000.0

Data are printed in the following units:

Number of fish:	thousands
Weight by age group in the catch:	kilogram
Weight by age group in the stock:	kilogram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	200000.0	.00	.20	.00	.216	.216
2	165746.0	.01	.20	.00	.470	.470
3	131101.0	.29	.20	.00	.772	.772
4	55359.0	.25	.20	.00	1.260	1.260
5	37070.0	.35	.20	.00	2.004	2.004
6	11821.0	.24	.20	1.00	2.642	2.642
7	12608.0	.12	.20	1.00	3.528	3.528
8	19431.0	.17	.20	1.00	4.088	4.088
9	7622.0	.23	.20	1.00	4.882	4.882
10	1288.0	.23	.20	1.00	5.572	5.572
11	1618.0	.23	.20	1.00	6.704	6.704
12	498.0	.23	.20	1.00	7.558	7.558
13	351.0	.23	.20	1.00	7.648	7.648
14	146.0	.23	.20	1.00	8.660	8.660
15+	285.0	.23	.20	1.00	10.008	10.008

Table 5.11

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

NORTH-EAST ARCTIC SAITHE

Year 1987						Year 1988					Year 1989	
factor	ref. F	stock biomass	sp. stock biomass	catch	Man. option	ref. F	stock biomass	sp. stock biomass	catch	stock biomass	sp. stock biomass	
.7	.17	587	221	70	F0.1	.14	653	249	66	747	285	
					F87	.17			83	726	274	
					Fmax.	.24			112	690	255	
					Fmed.	.32			142	652	236	

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F for the age group range from 3 to 8

Table 6.1 REDFISH in Sub-areas I and II.
Nominal catch (t) by countries (Sub-area I, Divisions
IIa and IIb combined). (As officially reported to
ICES.)

Country	1977	1978	1979	1980	1981
Belgium	1	-	-	-	-
Faroe Islands	8	1	-	-	206
France	660	3,608	1,142	1,297	537
German Dem.Rep.	17,614	16,165	16,162	8,448	4,614
Germany, Fed.Rep.	7,231	11,483	11,913	7,992	4,688
Norway	7,381	7,802	9,025	8,472	9,249
Poland	175	2,957	261	87	26
Portugal	1,480	378	1,100	271	-
Spain	-	-	1,375	1,965	930
UK (England & Wales)	6,330	3,390	1,756	1,307	470
UK (Scotland)	-	-	-	-	-
USSR	144,993	78,092	70,451	72,802	81,652
Total	185,873	124,172²	113,620²	102,765²	102,372

Country	1982	1983	1984	1985	1986 ¹
Belgium	-	-	-	-	-
Faroe Islands	-	-	-	-	-
France	841	798	2,970	3,326	2,471
German Dem.Rep.	4,463	3,394	4,168	3,260	1,323
Germany, Fed.Rep.	3,182	3,395	3,289	3,306	3,561
Norway	10,045	11,083	18,650	20,456	23,215
Poland	-	-	-	-	-
Portugal	-	-	1,806	2,056	1,591
Spain	72	222	25	38	-
UK (England & Wales)	336	182	716	167	110
UK (Scotland)	-	-	-	-	14
USSR	112,810	105,459	69,689	59,943	20,694
Total	131,749	124,533	101,313	92,552	52,979

¹Provisional figures.

²The total figure used by the Working Group for assessments
(including catches by non-members).

Table 6.2 REDFISH in Sub-areas I and II.
Nominal catch (t) by countries in Sub-area I.
(As officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Belgium	1	-	-	-	-
France	149	27	7	1	16
Germany, Fed.Rep.	786	+	-	-	7
Norway	1,181	1,333	1,374	736	543
Portugal	55	8	-	170	-
UK (England & Wales)	1,686	959	462	295	61
UK (Scotland)	-	-	-	-	-
USSR	13,154	2,575	639	33	1,220
Total	17,012	4,902	2,482	1,235	1,847

Country	1982	1983	1984	1985	1986 ¹
Belgium	-	-	-	-	-
France	-	-	-	-	-
Germany, Fed.Rep.	10	-	1	143	50
Norway	732	580	1,472	2,378	4,319
Portugal	-	-	-	-	-
UK (England & Wales)	77	48	22	43	32
UK (Scotland)	-	-	-	-	3
USSR	1,750	4,023	532	368	1,066
Total	2,569	4,651	2,027	2,932	5,470

¹Provisional figures.

Table 6.3 REDFISH in Sub-areas I and II.
Nominal catch (t) by countries in Division IIa.
(As officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Faroe Islands	8	1	-	-	206
France	478	3,575	1,134	1,296	521
German Dem.Rep.	12,688	12,933	12,439	7,460	2,205
Germany, Fed.Rep.	4,764	11,482	11,913	7,992	4,681
Norway	6,050	6,369	7,637	7,734	8,704
Poland	47	2,477	261	78	26
Portugal	1,249	352	1,100	89	-
Spain	-	-	1,125	1,500	620
UK (England & Wales)	4,064	2,067	1,195	967	409
UK (Scotland)	-	-	-	-	-
USSR	94,639	31,783	29,519	46,762	56,130
Total	123,987	71,039	66,323	73,878	73,502

Country	1982	1983	1984	1985	1986 ¹
Faroe Islands	-	-	-	-	-
France	841	798	2,970	3,326	2,471
German Dem.Rep.	2,760	2,500	2,570	2,800	1,252
Germany, Fed.Rep.	3,172	3,395	3,288	2,972	3,319
Norway	9,140	10,500	17,111	18,062	18,860
Poland	-	-	-	-	-
Portugal	-	-	1,134	1,327	1,273
Spain	-	-	-	-	-
UK (England & Wales)	259	134	672	120	75
UK (Scotland)	-	-	-	-	11
USSR	63,125	82,836	63,342	59,047	19,099
Total	79,297	100,163	91,087	87,654	46,360

¹ Provisional figures.

Table 6.4 REDFISH in Sub-areas I and II.
Nominal catch (t) by countries in Division IIb.
(As officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Faroe Islands	-	+	-	-	-
France	33	6	1	-	-
German Dem.Rep.	4,926	3,232	3,723	988	2,409
Germany, Fed.Rep.	1,681	1	-	-	-
Norway	150	100	14	2	2
Poland	128	480	-	9	-
Portugal	176	18	-	12	-
Spain	-	-	250	465	310
UK (England & Wales)	580	364	99	45	+
UK (Scotland)	-	-	-	-	-
USSR	37,200	43,734	40,293	26,007	24,302
Non-members	-	296 ²	435 ²	124 ²	-
Total	44,874	48,231	44,815	27,652	27,023

Country	1982	1983	1984	1985	1986 ¹
Faroe Islands	-	-	-	-	-
France	-	-	-	-	-
German Dem.Rep.	1,703	894	1,598	460	71
Germany, Fed.Rep.	-	-	-	191	192
Norway	173	3	67	16	36
Poland	-	-	-	-	-
Portugal	-	-	672	729	318
Spain	72	222	25	38	-
UK (England & Wales)	+	-	22	4	3
UK (Scotland)	-	-	-	-	+
USSR	47,935	18,600	5,815	528	529
Total	49,883	19,719	8,199	1,966	1,149

¹ Provisional figures.

² As reported to Norwegian authorities.

Table 6.5 REDFISH in Sub-areas I and II.
Nominal catch (t) of Sebastes marinus and Sebastes mentella in Sub-area I and Divisions IIa and IIb combined.

Species	1977	1978	1979	1980	1981
<u>S. marinus</u>	39,508	31,695	26,475	23,411	20,826
<u>S. mentella</u>	146,365	92,477	87,145	79,354	81,546
Total	185,873	124,172	113,620	102,765	102,372

Species	1982	1983	1984	1985	1986 ¹
<u>S. marinus</u>	16,366	19,260	28,379	29,484	30,127
<u>S. mentella</u>	115,383	105,273	72,934	63,068	22,852
Total	131,749	124,533	101,313	92,552	52,979

¹ Provisional figures.

Table 6.6 *Sebastes mentella* in Divisions IIa and IIb.
Catch per unit effort and calculated total
international effort.

Year	USSR catch/hour trawling (t)		German Dem.Rep. catch/day (t) freezer trawlers	Total effort (USSR units)	
	RT ¹	PST ²		RT ¹	PST ²
1965	0.38	-	-	41,216	-
1966	0.39	-	-	26,008	-
1967	0.37	-	-	16,862	-
1968	0.45	-	-	12,029	-
1969	0.48	-	-	14,242	-
1970	0.46	-	-	49,817	-
1971	0.38	-	-	118,587	-
1972	0.38	-	-	75,953	-
1973	0.45	-	-	85,289	-
1974	0.69	-	-	100,539	-
1975	0.95	-	-	251,653	-
1976	0.99	-	-	271,653	-
1977	0.77	-	-	190,084	-
1978	0.63	-	-	147,002	-
1979	0.56	-	-	155,616	-
1980	0.70	0.91	-	113,363	87,202
1981	0.63	0.95	8.71	129,438	85,338
1982	0.63	1.05	9.58	183,148	109,889
1983	0.80	1.09	17.12	131,591	96,581
1984	0.70	1.30	13.62	104,191	56,103
1985	0.60	1.00	9.89	105,327	63,196
1986	0.43	0.68	7.90	53,144	33,606

¹ Side trawlers, 300-600 hp, For 1986 also side trawlers
(SRIM), 1000 h.p., are included.

² Stern trawlers.

Table 6.7 REDFISH in Sub-areas I and II. Year-class strength.

Year class	Dragesund (1971)	International O-group survey abundance indices	USSR Young fish surveys ¹
1961	poor	-	poor
1962	very poor	-	poor
1963	poor	-	strong
1964	strong	-	strong
1965	strong	159	strong
1966	strong	236	strong
1967	average	44	average
1968	average	21	average
1969	very strong	295	very strong
1970	strong	247	strong
1971	average	172	strong
1972	average	177	average
1973	strong	385	below average
1974	-	468	poor
1975	-	315	poor
1976	-	447	poor
1977	-	472	poor
1978	-	460	poor
1979	-	980	poor
1980	-	651	poor
1981	-	861	close to poor
1982	-	694	strong
1983	-	851	poor
1984	-	732	-
1985	-	795	-
1986	-	702	-
1987	-	631	-

¹ On the basis of the abundance of age groups 1+ to 6+ in the CPUE data of the surveys (published in "Annales Biologiques"). The + is added to the age to indicate that the survey was carried out from the end of one year into the following year.

Table 6.8 *Sebastes mentella*. Average catch (no. of specimens) of different year classes per hour trawling in the USSR survey in the Barents and Norwegian Sea.

Year classes	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+
1965	-	-	-	-	-	-	-	-	-	-	-	0.4
1966	-	-	-	-	-	-	-	-	-	-	3.0	-
1967	-	-	-	-	-	-	-	-	-	11.7	-	0.3
1968	-	-	-	-	-	-	-	-	16.2	-	1.5	0.3
1969	-	-	-	-	-	-	43.4	-	-	8.7	12.2	3.1
1970	-	-	-	-	-	85.8	-	19.8	34.9	11.9	-	-
1971	-	-	-	-	22.7	-	19.5	51.9	18.0	5.7	-	-
1972	-	-	-	-	9.4	-	6.7	57.6	12.3	6.7	-	-
1973	-	-	-	0.6	-	4.3	37.3	8.6	5.6	-	-	-
1974	-	-	4.8	-	4.9	22.8	4.8	4.8	-	-	-	-
1975	-	7.4	-	1.7	6.4	2.4	3.5	5.0	-	-	-	-
1976	7.0	-	8.1	1.2	2.5	6.8	4.9	5.0	-	-	-	-
1977	-	0.2	0.2	0.2	0.9	5.1	3.7	-	-	-	-	-
1978	0.8	0.02	0.9	1.0	5.0	3.8	-	-	-	-	-	-
1979	-	1.9	1.4	3.6	2.3	-	-	-	-	-	-	-
1980	0.3	0.4	2.0	2.5	-	-	-	-	-	-	-	-
1981	-	2.2	3.9	-	-	-	-	-	-	-	-	-
1982	19.8	13.2	-	-	-	-	-	-	-	-	-	-
1983	12.5	-	-	-	-	-	-	-	-	-	-	-

Table 6.9 *Sebastes mentella*.
Results from the analysis using RCRTINX2
for estimation of recruitment.

Year class	No. of points			Adopted	Log S.E.
	5	4	3		
1974	n.a. ¹	n.a.	(424)	n.a.	n.a.
1975	n.a.	288	284	288	0.50
1976	209	202	175	209	0.50
1977	126	51	59	126	0.74
1978	131	132	125	131	0.51
1979	65	68	65	65	0.54
1980	n.a.	(181)	147	181	1.12
1981	n.a.	n.a.	144	144	1.06

Recent weighted mean = 164

¹Not adopted.

Table 6.10

Title : SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB
 At 16.30.29 22 SEPTEMBER 1987
 from 7/ to 86 on ages 6 to 18
 with Terminal F of .400 on age 13 and Terminal S of .600

Initial sum of squared residuals was 319.582 and
 final sum of squared residuals is 169.814 after 95 iterations

Matrix of Residuals

Years	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86		WTS
Ages											
6/ 7	-9.214	.125	1.367	1.078	2.481	-.513	1.490	-4.435	1.007	-2.867	.083
7/ 8	-2.153	1.061	1.181	1.314	1.278	.833	-.441	-2.134	1.514	.040	.210
8/ 9	-.991	.765	.429	.463	.378	.725	.315	-1.299	.195	.040	.421
9/10	.306	.969	.774	.572	.357	.562	-.014	-1.005	.199	.040	.542
10/11	.723	.336	.431	.182	.243	.724	-.273	-.842	.244	.040	.632
11/12	.693	-.046	.294	-.141	.145	.305	-.275	-.241	.157	.040	1.000
12/13	1.201	-.103	.500	-.117	.049	-.026	-.214	.265	-.158	.040	.689
13/14	.260	-.340	.224	-.699	-.078	-.375	-.299	1.033	-.253	.040	.612
14/15	-.003	-.039	-.629	-.572	-.185	-.715	-.034	1.301	-.369	.040	.514
15/16	-.381	-.513	-1.549	-.097	-.533	-.693	.273	1.107	-.265	.040	.434
16/17	-.562	-.526	-.977	.236	-.893	-.786	.481	1.139	-.521	.040	.430
17/18	-.633	-1.219	-1.454	-.248	-.924	-.614	.849	.554	-.372	.040	.408
	.001	.001	.001	.000	.000	.000	.000	.000	.000	-7.330	
WTS	.100	.100	.100	.100	.100	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

F-values	77	78	79	80	81	82	83	84	85	86
	.9470	.6552	.6032	.5554	.5220	.6673	.7914	.6875	1.0732	.4000

Selection-at-age (S)

S-values	6	7	8	9	10	11	12	13	14	15	16	17	18
	.0010	.0096	.0490	.0954	.2344	.3720	.5983	1.0000	1.0716	1.2309	1.2134	1.0637	.6000

Table 6.11

VIRTUAL POPULATION ANALYSIS

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB

FISHING MORTALITY COEFFICIENT		UNIT: Year-1					NATURAL MORTALITY COEFFICIENT = .10				
-----		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986 1981-85
6	.000	.007	.015	.007	.010	.000	.001	.000	.002	.0004	.003
7	.005	.063	.060	.034	.022	.010	.002	.001	.042	.003	.015
8	.049	.165	.109	.091	.045	.039	.027	.016	.084	.018	.042
9	.158	.191	.154	.139	.115	.077	.043	.032	.188	.051	.091
10	.371	.210	.178	.172	.198	.268	.125	.089	.345	.151	.205
11	.487	.211	.227	.170	.225	.337	.254	.217	.523	.170	.311
12	.836	.276	.314	.240	.290	.400	.504	.470	.694	.294	.472
13	.700	.237	.405	.248	.382	.543	.826	1.091	.906	.546	.750
14	.719	.288	.274	.244	.400	.472	.998	1.368	.673	.421	.782
15	.700	.404	.197	.390	.339	.571	1.313	1.409	.780	.287	.882
16	.649	.459	.430	.605	.292	.557	1.361	1.426	.829	.242	.893
17	.747	.466	.485	.885	.348	.630	1.351	.862	.762	.329	.791
18	.568	.495	.919	1.778	.952	.610	.891	.378	.427	.167	.651
19+	.568	.495	.919	1.778	.952	.610	.891	.378	.427	.167	.651
(10-15)0	.635	.279	.266	.244	.306	.432	.670	.774	.653	.311	

Table 6.12

VIRTUAL POPULATION ANALYSIS

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
6	573823	413750	263497	163483	99133	41774	32077	16297	46796	76354	0
7	500701	519217	371615	234968	146913	88813	37794	29006	14746	42250	69060
8	373801	450754	441147	316771	205562	139080	79550	34116	26213	12800	38119
9	240206	321906	345986	357792	261642	177807	113162	70091	30370	21810	11380
10	176145	185580	240587	263433	281831	211365	148957	98044	61419	22782	18749
11	134662	109995	136058	182118	204491	209171	146331	113925	81143	39365	17723
12	99362	74861	80630	98153	139067	147823	135093	102698	86639	43538	30061
13	69112	38972	51381	53310	69881	94157	89661	73853	58106	39150	29359
14	38945	31067	26470	31006	37636	43158	49482	35509	22441	21252	20516
15	26155	17190	21081	18203	21982	22822	24365	16505	8179	10359	12624
16	12688	11749	10383	15668	11157	14166	11667	5929	3651	3392	7034
17	9670	5999	6715	6112	7743	7537	7347	2707	1289	1443	2409
18	13268	4144	3407	3742	2283	4947	3634	1721	1034	545	939
19+	33553	7324	11413	3175	3244	9582	1190	1572	157	456	766
TOTAL NO	2302093	2193008	2010370	1752934	1492564	1203203	880312	606975	442183	335495	
SPS NO	260173	185129	207672	221363	360468	379063	325043	238411	169001	119742	
TOT. BIOM	670394	603435	524211	502119	464390	429105	311888	202097	152890	103989	
SPS BIOM	162011	102268	115328	118192	176253	179170	157652	101972	77928	55945	

Table 6.13

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB
CATEGORY: TOTAL

CATCH IN NUMBERS		UNIT: thousands									
-----		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
6	U	2905	3635	1065	932	5	20	0	98	29	
7	2418	50158	20497	7412	5000	854	86	34	571	116	
8	17175	65162	43553	26296	8620	4775	1987	525	2009	213	
9	35454	53591	46996	44131	26716	12554	4576	2106	4949	1037	
10	52102	35569	37469	40441	48290	47348	16695	7969	17096	3044	
11	49617	19909	26298	27089	39206	57134	31310	22092	31564	5854	
12	53938	17242	20717	19950	33394	46529	51099	36763	41511	10581	
13	55287	9270	16341	11172	21178	57751	48307	47096	33190	15750	
14	19095	7410	6059	6400	11853	15506	29973	25468	10519	6971	
15	12605	5456	3589	5607	6038	9492	17132	12002	4243	2466	
16	5796	4134	3465	6801	2697	5780	3347	4336	1971	696	
17	4874	2134	2465	3441	2172	3368	5238	1499	658	386	
18	5499	1545	1964	3001	1344	2160	2055	517	343	80	
19	3155	666	1719	1406	632	1624	505	127	52	22	
20	3941	1061	1906	796	802	1191	89	94	0	20	
21	2955	423	1762	145	359	691	79	251	0	11	
22	2531	308	560	145	117	344	0	0	0	7	
23	1002	501	324	27	0	258	0	0	0	4	
24+	522	158	108	27	0	76	0	0	0	3	
TOTAL		503766	255202	239625	205352	207350	247420	217498	160879	148774	47290

Table 6.14

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH

UNIT: kilogram

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
6	.168	.168	.107	.107	.102	.102	.102	.102	.102	.102
7	.183	.183	.155	.155	.138	.138	.138	.105	.135	.120
8	.225	.225	.200	.200	.188	.188	.188	.165	.167	.137
9	.311	.311	.252	.252	.252	.252	.252	.212	.215	.218
10	.367	.367	.310	.310	.310	.310	.310	.283	.303	.301
11	.432	.432	.374	.374	.364	.364	.320	.338	.352	.353
12	.508	.508	.472	.472	.440	.440	.400	.383	.420	.448
13	.611	.611	.568	.568	.560	.560	.466	.438	.481	.510
14	.679	.679	.715	.715	.680	.680	.563	.502	.564	.581
15	.753	.753	.898	.898	.828	.828	.730	.566	.673	.648
16	.821	.821	.934	.934	.906	.906	.992	.711	.809	.845
17	.872	.872	1.024	1.024	.970	.970	1.126	.861	1.014	.948
18	.910	.910	1.050	1.050	1.050	1.050	1.149	.966	1.069	1.056
19	.923	.923	1.076	1.076	1.076	1.076	1.209	1.209	1.160	1.160
20	.985	.985	1.129	1.129	1.129	1.129	1.217	1.217	1.217	1.217
21	1.050	1.056	1.150	1.150	1.150	1.150	1.360	1.360	1.360	1.360
22	1.124	1.124	1.175	1.175	1.175	1.175	1.390	1.390	1.390	1.390
23	1.193	1.193	1.200	1.200	1.200	1.200	1.400	1.400	1.400	1.400
24+	1.215	1.215	1.220	1.220	1.220	1.220	1.450	1.450	1.450	1.450

Table 6.15

VIRTUAL POPULATION ANALYSIS

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB

	FISHING MORTALITY COEFFICIENT					UNIT: Year-1		NATURAL MORTALITY COEFFICIENT = .10				
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1981-85	
6	.000	.007	.015	.007	.010	.000	.001	.000	.002	.000165	.002	
7	.005	.063	.060	.034	.022	.010	.002	.001	.005	.00216	.008	
8	.049	.165	.109	.091	.045	.034	.027	.016	.084	.0021	.042	
9	.158	.191	.154	.139	.113	.077	.043	.032	.187	.051	.091	
10	.371	.210	.178	.172	.198	.268	.125	.089	.345	.151	.205	
11	.437	.211	.227	.170	.225	.337	.254	.217	.523	.170	.311	
12	.836	.276	.314	.240	.290	.400	.504	.470	.694	.294	.472	
13	.700	.287	.405	.248	.382	.543	.826	1.091	.906	.546	.750	
14	.718	.288	.274	.244	.400	.472	.998	1.368	.673	.421	.782	
15	.700	.404	.197	.390	.339	.571	1.313	1.409	.780	.287	.882	
16	.649	.459	.430	.605	.292	.557	1.361	1.426	.829	.242	.893	
17	.747	.466	.485	.885	.348	.630	1.351	.862	.762	.329	.791	
18	.568	.495	.919	1.778	.952	.610	.891	.378	.427	.167	.651	
19*	.563	.495	.919	1.778	.952	.610	.891	.378	.427	.167	.651	
(10-15)u	.655	.279	.266	.244	.306	.432	.670	.774	.654	.312		

Table 6.16

VIRTUAL POPULATION ANALYSIS

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
6	573823	413750	263497	163483	99014	41794	32209	130980	62538	184707	0
7	500701	519217	371615	234968	146913	88705	37812	27125	118516	56494	167102
8	373801	450754	441147	316771	205562	130080	79452	34132	26321	106695	51007
9	240206	321906	345986	357792	261642	177807	113162	70002	30384	21907	96339
10	176145	185580	240587	268433	281831	211365	148957	98044	61339	22795	18837
11	134662	109995	136058	182118	204491	209171	146331	118925	81143	39293	17735
12	99362	74861	80630	98153	139067	147823	135093	102698	86639	43538	29995
13	69112	33972	51381	53310	69881	94157	89661	73853	58106	39150	29359
14	33945	31067	26470	31006	37636	43158	49482	35509	22441	21252	20516
15	26155	17190	21081	18203	21982	22822	24365	16505	8179	10359	12624
16	12688	11749	10383	15668	11157	14166	11667	5929	3651	3392	7034
17	9670	5929	6715	6112	7743	7537	7347	2707	1289	1443	2409
18	13268	4144	3407	3742	2283	4947	3634	1721	1034	545	939
19+	33555	7824	11413	3175	3244	9582	1190	1572	157	456	766
TOTAL NO	2302093	2193078	2010370	1752934	1492445	1203114	880363	721702	561737	552024	
SPS NO	260173	185129	207672	221363	360468	379062	325040	238404	170028	112693	
TOT. BIOM	670394	603435	524211	502119	464378	429092	311885	213791	168502	129614	
SPS BIOM	162011	102268	115328	118192	176253	199170	157651	101971	78064	56343	

Table 6.17

List of input variables for the ICES prediction program.

SEBASTES MENTELLA IN FISHING AREAS IIA and IIB

The reference F is the mean F for the age group range from 10 to 15

The number of recruits per year is as follows:

Year	Recruitment
1937	144000.0
1988	164000.0
1989	164000.0

Data are printed in the following units:

Number of fish:	thousands
Weight by age group in the catch:	kilogram
Weight by age group in the stock:	kilogram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
5	144000.0	.000165	.10	.00	.102	.102
7	187102.0	.00216	.10	.01	.127	.127
8	51007.0	.0021	.10	.03	.152	.152
9	96359.0	.05	.10	.10	.216	.216
10	13857.0	.15	.10	.19	.302	.302
11	17755.0	.17	.10	.28	.352	.352
12	29795.0	.29	.10	.58	.434	.434
13	29359.0	.55	.10	.79	.495	.495
14	20516.0	.42	.10	.91	.572	.572
15	12624.0	.29	.10	.97	.661	.661
16	7054.0	.24	.10	1.00	.827	.827
17	2409.0	.33	.10	1.00	.981	.981
18	459.0	.17	.10	1.00	1.062	1.062
19+	766.0	.17	.10	1.00	1.160	1.160

Table 6.18 Sebastes mentella. Catch projections for 1988 and 1989.

1987					1988					1989	
Stock biom. (6+)	SSB	F ₍₁₀₋₁₅₎	Catch	Management option	Stock biom. (6+)	SSB	F ₍₁₀₋₁₅₎	Catch		Stock biom. (6+)	SSB
134	53	0.13	9	F _{0.1}	156	60	0.14	10		179	67
				F _{max}			0.27	19		170	59
				F ₈₆			0.31	21		167	57

Table 6.19 SUM OF PRODUCTS CHECK

SEJASTES MAXINUS IN FISHING AREAS I AND IIA
CATEGORY: TOTAL

CATCH IN NUMBERS		UNIT: thousands											
-----		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	530
6	0	0	0	0	0	0	0	0	0	0	0	0	2884
7	0	0	0	0	0	0	0	0	0	0	0	0	5719
8	0	0	0	0	0	0	0	0	0	0	0	0	12162
9	0	0	0	0	0	0	0	0	0	0	0	0	10250
10	0	0	0	0	0	0	0	0	0	0	0	0	4515
11	0	0	0	0	0	0	0	0	0	0	0	0	5963
12	250	41	44	43	51	62	66	261	590	387	623	5008	
13	322	118	94	32	35	122	41	332	570	455	438	1686	
14	805	370	199	74	97	229	107	635	913	1049	1638	2670	
15	1551	865	406	165	209	444	239	1137	1527	2079	2984	2991	
16	3505	2952	1363	550	666	1232	896	2563	3266	5479	7397	6775	
17	1527	1737	919	364	556	723	594	1261	1441	2757	3533	2707	
18	2321	2753	1536	611	954	1138	935	2014	2157	4164	5117	3938	
19	2251	2718	1695	634	1223	997	990	2046	1892	3528	4402	3417	
20	445	503	310	131	223	185	185	385	342	634	775	614	
21	2225	2471	1459	753	1456	1003	858	1732	1420	2359	2829	2475	
22	1024	1687	951	555	1084	750	595	1112	849	1373	1721	1529	
23	1753	2138	1167	898	1518	921	779	1251	1123	1527	1813	1814	
24	1741	1924	1241	1206	2259	956	1123	1121	1248	1103	1432	1672	
25	953	960	396	923	1845	716	776	746	884	702	951	1106	
26	657	515	723	857	1667	623	636	585	729	530	417	918	
27	403	406	504	644	1362	526	426	429	568	369	701	822	
28+	323	435	432	614	1038	347	431	377	508	332	589	624	
TOTAL		22674	22631	13959	9264	16243	10934	9647	17985	20027	28831	38259	87789

Table 6.19 (cont'd)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
3	30	0	0	0	0	0	0	0	0	0
4	423	0	0	0	0	0	0	0	0	0
5	1839	20	0	10	10	0	0	0	0	0
6	1331	13	0	11	7	0	0	0	0	0
7	1621	30	12	13	125	0	0	0	0	0
8	4179	523	73	87	225	0	0	0	0	88
9	4620	641	101	180	434	3	0	0	0	157
10	4501	930	149	352	779	36	0	0	0	197
11	2359	615	145	517	885	179	8	0	65	145
12	3306	2003	723	768	1224	816	86	199	830	251
13	2557	2788	914	571	952	814	249	101	1009	836
14	4242	5453	3422	2368	1704	1961	581	601	2697	3142
15	5334	6404	5276	3677	2502	2364	1358	1623	5720	3687
16	6072	5380	3554	3502	2435	2636	2186	1425	5300	5251
17	2372	2569	1726	1073	868	1335	831	701	2275	2821
18	3462	3669	2212	2341	2399	1939	2241	4572	4421	7292
19	5115	2719	2237	1364	1274	1174	1314	1624	2632	3180
20	964	1533	1314	1330	1457	1309	1100	2124	1818	1862
21	2406	1716	2237	1829	1392	2121	1803	4551	2242	3227
22	1170	352	959	1040	734	927	864	1475	1168	405
23	1404	491	945	1507	1007	715	643	2599	975	446
24	1313	411	959	968	550	353	929	1651	1006	281
25	923	241	673	519	407	129	656	825	162	0
26	772	175	637	383	273	48	924	702	161	0
27	666	155	541	341	41	18	330	225	0	0
28+	677	141	239	39	36	0	0	0	0	0
TOTAL	62236	59312	27542	24790	21770	13925	16112	24998	32532	33359

Table 6.20A

Title : SEBASTES MARINUS IN FISHING AREAS I AND IIA
 At 09.58.05 23 SEPTEMBER 1987
 from 77 to 86 on ages 11 to 23
 with Terminal F of .150 on age 18 and Terminal S of 1.000

Initial sum of squared residuals was 148.971 and
 final sum of squared residuals is 57.217 after 145 iterations

Matrix of Residuals

Years	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86		WTS
Ages											
11/12	1.952	1.318	.059	.872	1.928	2.202	-.935	-4.113	.565	.000	.125
12/13	-.064	.264	-.036	-.479	.258	.660	.123	-.730	-.051	.000	.602
13/14	.081	.354	-.142	-.273	.213	.898	.489	-1.312	-.159	.000	.401
14/15	-.140	.516	.196	.229	.074	.399	-.186	-.822	.116	.000	.628
15/16	-.277	.154	-.228	.252	-.071	-.308	.378	-.176	.080	.000	1.000
16/17	-.201	-.099	.149	.365	-.285	-.125	.675	-.336	-.259	.000	.724
17/18	.280	.624	.442	-.036	.061	.008	-.371	.058	-.269	.000	.779
18/19	-.558	-.539	-.250	-.095	.140	-.523	.204	1.004	-.258	.000	.496
19/20	.332	-.206	.200	-.359	-.194	-.472	-.195	.741	.173	.000	.640
20/21	-.493	-.493	.179	.180	-.019	-.314	-.596	1.292	-.256	.000	.426
21/22	.534	-.938	-.421	-.231	-.601	-.467	-.335	1.384	.461	.000	.343
22/23	.514	-1.440	-.738	-.223	-.102	-.122	-.774	1.301	.820	.000	.286
	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.986	
WTS	.100	.500	.500	.500	.500	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	77	78	79	80	81	82	83	84	85	86
F-values	.2736	.2256	.1390	.1093	.0856	.0768	.0466	.0636	.1605	.1500

Selection-at-age (S)

	11	12	13							
S-values	.0089	.0704	.0761							
	14	15	16	17	18	19	20	21	22	23
S-values	.2447	.4691	.5991	.3129	1.0000	.7544	.8495	1.6714	.8459	1.0000

Table C.20B

Title : SEBASTES MARINUS IN FISHING AREAS I AND IIA
 At 17.17.50 23 SEPTEMBER 1987
 from 77 to 86 on ages 11 to 23
 with Terminal F of .500 on age 18 and Terminal S of 1.000

Initial sum of squared residuals was 191.075 and
 final sum of squared residuals is 53.920 after 121 iterations

Matrix of Residuals

Years Ages	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	WTS
11/12	1.466	.867	-.391	.426	1.484	1.757	-1.374	-4.501	.264	.000 .128
12/13	-.096	.244	-.054	-.491	.247	.647	.118	-.684	.070	.000 .626
13/14	.032	.319	-.175	-.301	.186	.871	.466	-1.308	-.090	.000 .412
14/15	-.204	.465	.148	.185	.031	.356	-.226	-.860	.105	.000 .635
15/16	-.266	.176	-.203	.279	-.045	-.231	.407	-.159	.092	.000 1.000
16/17	-.204	-.095	.155	.374	-.276	-.119	.690	-.301	-.223	.000 .737
17/18	.197	.543	.358	-.119	-.025	-.074	-.459	-.051	-.366	.000 .777
18/19	-.439	-.425	-.144	.009	.239	-.427	.303	1.090	-.207	.000 .506
19/20	.347	-.195	.203	-.357	-.196	-.477	-.198	.728	.144	.000 .651
20/21	-.383	-.394	.265	.260	.053	-.242	-.534	1.287	-.312	.000 .444
21/22	.654	-.834	-.331	-.149	-.526	-.399	-.262	1.433	.414	.000 .355
22/23	.631	-1.378	-.635	-.124	-.007	-.029	-.682	1.367	.857	.000 .294
	-.001	.000	.000	.000	.000	.000	.000	.000	.000	.000
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

Fishing Mortalities (F)

	77	78	79	80	81	82	83	84	85	86
F-values	.2675	.2428	.1665	.1457	.1289	.1280	.0867	.1331	.4039	.5000

Selection-at-age (S)

	11	12	13	14	15	16	17	18	19	20	21	22	23
S-values	.0290	.1326	.1278										
S-values	.3642	.6177	.7565	.3687	1.0000	.7762	.8082	1.6086	.8251	1.0000			

Table 6.20C

Title : SEBASTES MARINUS IN FISHING AREAS I AND IIA
 At 17.25.57 25 SEPTEMBER 1987
 from 77 to 86 on ages 11 to 23
 with Terminal F of .300 on age 18 and Terminal S of 1.000

Initial sum of squared residuals was 163.775 and
 final sum of squared residuals is 54.524 after 71 iterations

Matrix of Residuals

Years Ages	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86		WTS
11/12	1.484	.883	-.375	.440	1.497	1.771	-1.363	-4.519	.199	.017	.127
12/13	-.080	.259	-.039	-.478	.259	.661	.127	-.704	.010	.015	.614
13/14	.045	.330	-.164	-.292	.194	.880	.472	-1.319	-.134	.013	.406
14/15	-.195	.471	.154	.188	.033	.359	-.225	-.864	.089	.011	.630
15/16	-.260	.179	-.202	.278	-.046	-.282	.405	-.159	.098	.010	1.000
16/17	-.195	-.087	.161	.578	-.273	-.114	.690	-.514	-.237	.010	.730
17/18	.199	.544	.358	-.121	-.027	-.079	-.460	-.044	-.361	.009	.775
18/19	-.439	-.424	-.145	.076	.236	-.428	.298	1.089	-.185	.009	.506
19/20	.548	-.194	.204	-.358	-.197	-.478	-.200	.728	.157	.009	.647
20/21	-.392	-.404	.254	.248	.042	-.255	-.543	1.511	-.252	.008	.439
21/22	.649	-.837	-.338	-.158	-.534	-.405	-.273	1.433	.472	.008	.350
22/23	.630	-1.380	-.639	-.128	-.012	-.033	-.688	1.373	.885	.009	.291
	.028	.026	.017	.010	.003	-.002	-.006	-.007	-.002	.127	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

F-values	77	78	79	80	81	82	83	84	85	86
	.2420	.2133	.1419	.1207	.1036	.0996	.0655	.0972	.2744	.3000

Selection-at-age (S)

	11	12	13										
S-values	.0244	.1163	.1166										
	14	15	16	17	18	19	20	21	22	23			
S-values	.3429	.5927	.7534	.3643	1.0000	.7805	.8210	1.6178	.8237	1.0000			

Table 6.21

VIRTUAL POPULATION ANALYSIS

SEBASTES MARINUS IN FISHING AREAS I AND IIA

FISHING MORTALITY COEFFICIENT

UNIT: Year⁻¹

NATURAL MORTALITY COEFFICIENT = .10

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
11	.03	.01	.00	.01	.02	.01	.00	.00	.01	.01
12	.05	.03	.01	.01	.02	.02	.00	.01	.05	.03
13	.05	.05	.02	.01	.02	.02	.01	.00	.04	.06
14	.08	.12	.07	.05	.04	.05	.01	.02	.15	.17
15	.12	.16	.09	.09	.06	.07	.04	.04	.18	.27
16	.15	.18	.11	.12	.07	.07	.07	.05	.18	.22
17	.09	.08	.06	.04	.04	.04	.03	.03	.09	.12
18	.16	.16	.08	.10	.11	.10	.09	.18	.22	.39
19	.17	.16	.13	.06	.07	.06	.08	.07	.13	.22
20	.08	.11	.14	.09	.08	.08	.07	.15	.10	.12
21	.32	.13	.20	.18	.12	.14	.14	.40	.21	.23
22	.31	.07	.13	.12	.09	.10	.07	.15	.15	.06
23	.24	.18	.22	.27	.15	.11	.08	.27	.13	.07
24+	.24	.18	.22	.27	.15	.11	.08	.27	.13	.07

Table 6.22

VIRTUAL POPULATION ANALYSIS

SEBASTES MARINUS IN FISHING AREAS I AND IIA

STOCK SIZE IN NUMBERS

UNIT: thousands

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
11	79411	60907	61532	62843	57426	28635	29795	20087	8829	20910	0
12	75013	69611	54526	55538	56371	51120	25740	26952	18176	7926	18782
13	57316	64733	61083	48650	49523	49843	45480	23208	24198	15610	6934
14	54908	49432	55923	54401	43477	43905	44326	40915	20904	20936	13330
15	47920	45652	39548	47349	46973	37720	37863	39556	36450	16353	15961
16	45138	38294	35227	32672	39349	40125	31884	32969	34249	27551	11299
17	30547	35076	29067	28498	26236	33243	33802	26773	28477	25958	19945
18	24484	25387	29297	24660	24766	22914	28813	27795	23559	23606	20808
19	20825	18866	19437	24408	20090	20131	18844	23941	22619	17121	14448
20	13204	15885	14489	15508	20789	16967	17099	15802	20120	17967	12473
21	9107	11086	12912	11388	12768	17426	14109	14418	12281	16478	14488
22	4643	5957	8402	9560	8568	10231	13753	11054	8733	8985	11846
23	7143	3091	5027	6691	7663	7055	8377	11623	8601	6793	7659
24+	21255	7070	16164	9990	9945	5407	36986	15219	11724	4280	9328
TOTAL NO	490973	451045	442683	432156	423945	334723	386871	332314	278921	230473	
SPS NO	224325	206364	209620	210724	217147	211220	241530	221151	206814	165091	

Table 6.23

SHOT Forecast : Sebastes Marinus

recruit weights		.30	.40	.30	G-M =		.00	
YEAR	CATCH	RECRUIT INDEX	W'TD INDEX	Y/B RATIO	HANG- OVER	EST'D PROD'N	EST'D SOC. BIOMASS	EXPL
1978	32	1		.30	.70			107
1979	26	1	1	.30	.70	12		87
1980	23	1	1	.30	.70	16		77
1981	21	1	1	.20	.70	16		70
1982	16	1	1	.30	.70	4	13	53
1983	19	1	1	.30	.70	26	15	63
1984	28	1	1	.30	.70	49	19	93
1985	29	1	1	.30	.70	31	26	97
1986	30	1	1	.30	.70	32	25	100
1987		1	1	.30	.70		28	94
1988		1	1	.30	.70		27	90
1989		1						

Table 7.1 GREENLAND HALIBUT in Sub-areas I and II.
 Nominal catch (t) by countries (Sub-area I, Divisions
 IIa and IIb combined). (As officially reported to
 ICES.)

Country	1977	1978	1979	1980	1981
Faroe Islands	21	-	3	-	8
France	-	-	-	-	-
German Dem.Rep.	8,176	4,611	3,488	2,080	1,358
Germany, Fed.Rep.	148	321	481	303	128
Norway	4,217	4,082	2,843	3,157	4,201
Poland	224	544	106	-	-
UK (Engl.& Wales)	1,059	407	59	26	9
UK (Scotland)	-	-	-	-	-
USSR	15,045	14,651	10,311	7,670	9,276
Others	-	1	21	48	38
Total	28,890	24,617	17,312	13,284	15,018

Country	1982	1983	1984	1985	1986 ¹
Faroe Islands	-	-	-	-	-
France	8	67	138	239	13
German Dem.Rep.	1,153	1,913	2,089	3,807	2,659
Germany, Fed.Rep.	18	130	76	193	59
Norway	3,206	4,883	4,376	5,464	7,812
Poland	-	-	-	-	-
UK (Engl.& Wales)	10	2	23	5	10
UK (Scotland)	-	-	-	-	2
USSR	12,394	15,152	15,181	10,237	12,200
Others	-	-	-	-	-
Total	16,789	22,147	21,883	19,945	22,755

¹Provisional figures.

Table 7.2 GREENLAND HALIBUT in Sub-areas I and II.
Nominal catch (t) by countries in Sub-area I. (As
officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Germany, Fed.Rep.	1	-	-	-	19
Norway	1,371	1,148	727	490	641
UK (Engl.& Wales)	541	232	36	12	5
UK (Scotland)	-	-	-	-	-
USSR	360	211	182	100	564
Others	-	-	-	-	1
Total	2,273	1,591	945	602	1,230

Country	1982	1983	1984	1985	1986 ¹
Germany, Fed.Rep.	-	-	-	-	1
Norway	505	490	593	602	936
UK (Engl.& Wales)	8	1	17	1	5
UK (Scotland)	-	-	-	-	1
USSR	200	196	81	122	615
Others	-	-	-	-	-
Total	713	687	691	725	1,558

¹ Provisional figures.

Table 7.3 GREENLAND HALIBUT in Sub-areas I and II.
Nominal catch (t) by countries in Division IIa. (As
officially reported to ICES.)

Country	1977	1978	1979	1980	1981
Faroe Islands	21	-	3	-	8
France	-	-	-	-	-
German Dem.Rep.	1,641	1,398	787	570	18
Germany, Fed.Rep.	22	321	481	303	109
Norway	1,446	2,084	2,051	2,529	3,077
Poland	95	197	4	-	-
UK (Engl.& Wales)	211	82	11	9	4
UK (Scotland)	-	-	-	-	-
USSR	6,960	8,809	6,929	2,014	2,031
Others	-	1	21	48	37
Total	10,396	12,892	10,287	5,473	5,284

Country	1982	1983	1984	1985	1986 ¹
Faroe Islands	-	-	-	-	-
France	8	67	138	239	13
German Dem.Rep.	73	14	189	82	55
Germany, Fed.Rep.	18	130	76	172	42
Norway	2,487	4,257	3,703	4,791	6,733
Poland	-	-	-	-	-
UK (Engl.& Wales)	2	1	1	2	5
UK (Scotland)	-	-	-	-	1
USSR	2,459	5,031	5,459	6,894	5,553
Others	-	-	-	-	-
Total	5,047	9,500	9,566	12,180	12,402

¹ Provisional figures.

Table 7.4 GREENLAND HALIBUT in Sub-areas I and II.
Nominal catch (t) by countries in Division IIb. (As
officially reported to ICES.)

Country	1977	1978	1979	1980	1981
German Dem.Rep.	6,535	3,213	2,701	1,510	1,340
Germany, Fed.Rep.	125	-	-	-	-
Norway	1,400	850	65	138	483
Poland	129	347	102	-	-
UK (Engl.& Wales)	307	93	12	5	-
USSR	7,725	5,631	3,200	5,556	6,681
Total	16,221	10,134	6,080	7,209	8,504

Country	1982	1983	1984	1985	1986 ¹
German Dem.Rep.	1,080	1,899	1,900	3,725	2,604
Germany, Fed.Rep.	-	-	-	21	16
Norway	214	136	80	71	143
Poland	-	-	-	-	-
UK (Engl.& Wales)	+	+	5	2	+
USSR	9,735	9,925	9,641	3,221	6,032
Total	11,029	11,960	11,626	7,040	8,795

¹ Provisional figures.

Table 7.5 GREENLAND HALIBUT in Sub-areas I and II.
Catch per unit effort and total effort.

Year	USSR catch/hour trawling (t)		Norway catch/hour trawling (t)	Average CPUE ⁴	Total effort (in '000 hrs trawling)	CPUE 7+
	RT ²	PST ³				
1965	0.80	-	-	0.80	-	-
1966	0.77	-	-	0.77	-	-
1967	0.70	-	-	0.70	-	-
1968	0.65	-	-	0.65	-	-
1969	0.53	-	-	0.53	-	-
1970	0.53	-	-	0.53	169	0.50
1971	0.46	-	-	0.46	172	0.43
1972	0.37	-	-	0.37	116	0.33
1973	0.37	-	0.41	0.39	77	0.38
1974	0.40	-	0.34	0.36	105	0.33
1975	0.39	-	0.40	0.40	95	0.38
1976	0.40	-	0.34	0.37	97	0.34
1977	0.27	-	0.34	0.31	93	0.26
1978	0.21	-	0.22	0.22	112	0.18
1979	0.23	-	0.27	0.25	69	0.18
1980	0.24	0.33	0.33	0.29	46	0.25
1981	0.30	0.36	0.35	0.33	45	0.24
1982	0.26	0.45	0.40	0.33	51	0.29
1983	0.26	0.40	0.35	0.31	72	0.26
1984	0.27	0.41	0.31	0.29	75	0.24
1985	0.28	0.52	0.36	0.32	62	0.27
1986 ¹	0.23	0.42	0.35	0.29	78	0.25

¹ Provisional.

² Side trawlers, 300-600 hp. From 1983 onwards, side trawlers (SRTM), 1,000 hp.

³ Stern trawlers, up to 2,000 hp.

⁴ Arithmetic average of CPUE from USSR RT and SRTM trawlers and Norwegian fresh fish trawlers.

Table 7.6 GREENLAND HALIBUT in Sub-areas I and II.
Norwegian survey indices (numbers $\times 10^{-6}$)
in the Svalbard area (Division IIB).

Year	Total index	Index fish <20 cm
1981	20.1	2.1
1982	26.0	0.7
1983	26.7	5.9
1984	36.6	3.2
1985	39.5	1.6
1986	19.5	0.1

Table 7.7

VIRTUAL POPULATION ANALYSIS

GREENLAND HALIBUT IN FISHING AREAS I AND II

CATCH IN NUMBERS

UNIT: thousands

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
3	1	1	1	1	1	22	1	62	78	88	64	664
4	34	1	461	19	276	334	98	755	532	887	275	1146
5	526	80	1109	212	917	840	830	2037	1897	2218	731	1896
6	2792	4486	5521	1117	2519	2357	2982	3255	3589	3155	1138	1917
7	10464	12712	9605	3923	6204	6520	5824	4200	4118	2727	1665	1919
8	18562	12283	6438	5515	3838	4118	5002	2524	2365	1234	1341	933
9	10034	6130	2775	2551	1834	2265	3000	1610	1509	495	944	484
10	6671	4339	1734	1919	1942	1654	1350	1104	946	319	473	448
11	2517	2703	1368	1536	1622	1857	915	1062	934	296	511	482
12	1250	1660	1234	1127	1338	1536	1212	858	438	243	275	380
13	616	1044	675	716	734	1122	698	595	349	103	242	384
14	1104	300	200	251	531	600	526	384	147	45	145	150
15	266	123	40	70	137	270	254	93	83	37	62	47
16+	15	20	40	56	79	98	104	87	29	21	16	15
TOTAL	54852	45882	29201	17013	21972	23573	22796	18626	17014	11861	7882	10865
	1982	1983	1984	1985	1986							
3	48	314	0	88	140							
4	551	1212	36	461	981							
5	1304	1543	915	1219	1665							
6	1494	1864	3698	2874	3320							
7	1276	1851	3350	2561	2700							
8	1203	2287	1938	1548	1524							
9	1493	1491	1064	972	1123							
10	1258	1228	1191	1037	993							
11	858	713	602	614	528							
12	502	488	340	363	432							
13	324	247	171	161	313							
14	108	201	132	120	304							
15	43	51	41	55	231							
16+	3	13	30	8	7							
TOTAL	10450	13503	13508	12081	14261							

Table 7.8

GREENLAND HALIBUT IN FISHING AREAS I AND II
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH

UNIT: kilogram

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
3	.200	.200	.200	.200	.200	.200	.200	.200	.200	.300	.200	.200
4	.441	.441	.441	.441	.441	.441	.441	.441	.441	.600	.482	.500
5	.567	.567	.567	.567	.567	.567	.567	.567	.567	.900	.702	.660
6	.737	.737	.737	.737	.737	.737	.737	.737	.737	1.200	.872	.840
7	1.079	1.079	1.079	1.079	1.079	1.079	1.079	1.079	1.079	1.500	1.141	1.150
8	1.421	1.421	1.421	1.421	1.421	1.421	1.421	1.421	1.421	1.800	1.468	1.560
9	1.843	1.843	1.843	1.843	1.843	1.843	1.843	1.843	1.843	2.200	1.778	2.040
10	2.281	2.281	2.281	2.281	2.281	2.281	2.281	2.281	2.281	2.600	2.302	2.570
11	2.887	2.887	2.887	2.887	2.887	2.887	2.887	2.887	2.887	3.000	2.664	2.980
12	3.247	3.247	3.247	3.247	3.247	3.247	3.247	3.247	3.247	3.500	3.046	3.430
13	4.303	4.303	4.303	4.303	4.303	4.303	4.303	4.303	4.303	4.100	3.368	4.130
14	4.931	4.931	4.931	4.931	4.931	4.931	4.931	4.931	4.931	4.800	4.285	4.680
15	5.765	5.765	5.765	5.765	5.765	5.765	5.765	5.765	5.765	5.600	5.025	5.810
16+	6.308	6.308	6.308	6.308	6.308	6.308	6.308	6.308	6.308	7.000	6.589	6.590

	1982	1983	1984	1985	1986
3	.270	.310	.300	.300	.340
4	.620	.450	.480	.380	.470
5	.690	.750	.630	.600	.620
6	.840	1.040	.960	.890	.920
7	1.030	1.340	1.180	1.200	1.280
8	1.310	1.570	1.530	1.850	1.900
9	1.740	1.970	2.310	2.590	2.480
10	2.240	2.730	2.870	3.180	3.110
11	2.770	3.290	3.460	3.620	3.350
12	3.370	4.220	3.770	3.950	3.720
13	4.320	4.710	3.990	4.480	4.000
14	5.350	6.780	4.350	4.250	4.180
15	5.780	6.000	4.470	4.800	4.500
16+	6.600	6.600	4.600	5.000	5.400

Table 7.9

Title : GREENLAND HALIBUT IN FISHING AREAS I AND II
 At 09.21.12 24 SEPTEMBER 1987
 from 77 to 86 on ages 3 to 15
 with Terminal F of .250 on age 8 and Terminal S of 1.500

Initial sum of squared residuals was 159.450 and
 final sum of squared residuals is 67.555 after 144 iterations

Matrix of Residuals

Years	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86		WTS
Ages											
3/ 4	-.294	-1.276	.899	-.867	2.290	-1.180	3.807	-3.120	-.254	.000	.077
4/ 5	.115	-1.066	1.444	-.703	1.180	.220	1.129	-2.396	.079	.000	.128
5/ 6	-.162	-.736	1.350	-.308	.967	.302	-.606	-.590	-.218	.000	.216
6/ 7	-.409	-.493	.823	-.372	.622	-.081	-.840	.416	.334	.000	.277
7/ 8	-.074	-.051	.464	.296	.242	-.892	-.747	.386	.557	.000	.317
8/ 9	-.161	.297	-.009	.706	-.721	-.548	.034	.274	.129	.000	.362
9/10	.080	.532	.006	.669	-.973	.083	-.268	-.153	.019	.000	.335
10/11	-.380	.077	-.543	-.137	-.693	.403	.169	.442	.668	.000	.335
11/12	.093	.033	-.194	-.017	-.377	.163	-.013	.090	.147	.000	1.000
12/13	.070	.115	-.269	-.655	-.119	.320	.282	.324	-.067	.000	.493
13/14	.453	.610	-.699	.071	.931	-.003	-.233	-.157	-.939	.000	.265
14/15	.373	-.094	-.910	.483	.657	.045	.493	.131	-1.183	.000	.246
	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.001	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	77	78	79	80	81	82	83	84	85	86
f-values	.4264	.3928	.1788	.1968	.2124	.2502	.2793	.2067	.2013	.2500

Selection-at-age (S)

	3	4	5	6	7	8	9	10	11	12	13	14	15
S-values	.0095	.0774	.2954										
S-values	.6766	1.0044	1.0000	.9616	1.1941	1.5018	1.6247	1.7965	1.8685	1.5000			

Table 7.10

Title : GREENLAND HALIBUT IN FISHING AREAS I AND II
 At 09.21.12 24 SEPTEMBER 1987
 SEPERABLE FISHING MORTALITIES

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
3	.004	.004	.002	.002	.002	.002	.003	.002	.002	.002
4	.033	.030	.014	.015	.016	.019	.022	.016	.016	.019
5	.126	.116	.053	.058	.063	.074	.083	.061	.059	.074
6	.289	.266	.121	.133	.144	.169	.189	.140	.136	.169
7	.428	.395	.180	.198	.213	.251	.281	.208	.202	.251
8	.426	.393	.179	.197	.212	.250	.279	.207	.201	.250
9	.410	.378	.172	.189	.204	.241	.269	.199	.194	.240
10	.509	.469	.214	.235	.254	.299	.333	.247	.240	.299
11	.640	.590	.269	.296	.319	.376	.419	.310	.302	.375
12	.693	.638	.290	.320	.345	.407	.454	.336	.327	.406
13	.766	.706	.321	.354	.382	.449	.502	.371	.362	.449
14	.797	.734	.334	.368	.397	.468	.522	.386	.376	.467
15	.640	.589	.268	.295	.319	.375	.419	.310	.302	.375

Table 7.11

Title : GREENLAND HALIBUT IN FISHING AREAS I AND II
 At 09.21.12 24 SEPTEMBER 1987
 SEPERABLE POPULATION NUMBERS units: thousands

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
3	27287	25209	23850	32699	38305	33585	25619	20370	58349	63747
4	24489	23393	21617	24790	28092	32904	28838	21992	17498	50126
5	21022	20394	19532	18351	21014	23785	27777	24291	18628	14828
6	23427	15952	15630	15946	14902	16987	19013	22015	19668	15108
7	12595	15110	10526	11920	12014	11110	12344	13547	16475	14773
8	8161	7064	8765	7570	8419	8354	7437	8026	9474	11585
9	4746	4586	4105	6309	5352	5860	5599	4841	5618	6667
10	3694	2711	2705	2975	4494	3755	3965	3684	3416	3984
11	2416	1911	1460	1881	2024	3002	2397	2445	2477	2312
12	1874	1097	912	960	1205	1266	1774	1357	1543	1576
13	862	807	499	587	600	734	726	970	835	957
14	553	348	343	311	355	353	403	378	576	500
15	210	214	144	211	186	205	190	206	221	340

Table 7.12

VIRTUAL POPULATION ANALYSIS

GREENLAND HALIBUT IN FISHING AREAS I AND II

FISHING MORTALITY COEFFICIENT

UNIT: Year-1

NATURAL MORTALITY COEFFICIENT = .15

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
3	.002	.003	.003	.002	.018	.001	.013	.000	.002	.002
4	.032	.024	.042	.013	.044	.018	.045	.002	.028	.021
5	.104	.099	.125	.042	.106	.062	.061	.041	.072	.129
6	.212	.255	.225	.082	.141	.109	.112	.191	.165	.269
7	.432	.424	.296	.169	.184	.124	.180	.284	.186	.218
8	.383	.436	.204	.219	.127	.160	.322	.274	.194	.152
9	.398	.392	.143	.224	.108	.290	.285	.230	.203	.200
10	.370	.406	.126	.187	.149	.423	.388	.366	.346	.311
11	.637	.577	.201	.286	.279	.429	.425	.315	.307	.281
12	.744	.557	.270	.275	.357	.492	.449	.348	.300	.348
13	.987	.738	.229	.444	.717	.505	.452	.263	.260	.431
14	.971	.663	.180	.542	.515	.421	.641	.438	.282	1.039
15	.640	.534	.254	.378	.317	.255	.339	.240	.310	1.272
16+	.640	.534	.254	.378	.317	.255	.339	.240	.310	1.272
(-11)0	.444	.447	.194	.217	.170	.285	.320	.294	.248	.233

Table 7.13

VIRTUAL POPULATION ANALYSIS

GREENLAND HALIBUT IN FISHING AREAS I AND II

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
3	28226	26843	27692	33009	39414	34659	25847	20593	58333	63747	0
4	25851	24257	23032	23753	28352	33309	29787	21956	17724	50126	54738
5	22100	21550	20368	19002	20190	23341	28158	24515	18864	14828	42235
6	18328	17136	16792	15478	15678	15622	18882	22807	20253	15108	11222
7	12826	12766	11453	11537	12269	11721	12063	14527	16211	14773	9956
8	8500	7168	7191	7323	8390	8785	8907	8671	9409	11585	10220
9	5255	4988	3989	5049	5063	6358	6444	5555	5673	6667	8561
10	3829	5038	2901	2975	3473	3910	4094	4169	3798	3984	4700
11	2410	2277	1742	2202	2124	2575	2205	2391	2490	2312	2513
12	1745	1097	1100	1226	1423	1383	1443	1241	1502	1576	1502
13	1009	714	541	723	801	874	727	793	754	957	958
14	653	324	294	371	399	337	454	398	524	500	536
15	210	214	144	211	186	205	190	206	221	340	152
16+	197	75	101	55	59	14	49	151	32	10	85
TOTAL NO	131144	122428	117321	122914	137820	143093	139252	127973	155789	136515	
SPS NO	15312	12727	10812	12811	45596	49002	51578	52315	50605	54540	
TOT. BIOM	110109	97527	121258	99670	112859	121289	137188	128722	133985	159289	
SPS BIOM	41107	32662	30535	30869	66319	66777	80691	79347	84171	88743	

Table 7.14

List of input variables for the ICES prediction program.

GREENLAND HALIBUT IN I AND II

The reference F is the mean F for the age group range from 7 to 11

The number of recruits per year is as follows:

Year	Recruitment
1987	50000.0
1988	50000.0
1989	50000.0

Data are printed in the following units:

Number of fish:	thousands
Weight by age group in the catch:	kilogram
Weight by age group in the stock:	kilogram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
3	50000.0	.00	.15	.00	.513	.513
4	26000.0	.02	.15	.18	.443	.443
5	22000.0	.07	.15	.25	.617	.617
6	11222.0	.17	.15	.54	.923	.923
7	9936.0	.25	.15	.70	1.220	1.220
8	10220.0	.25	.15	.75	1.760	1.760
9	3561.0	.24	.15	.83	2.460	2.460
10	4700.0	.30	.15	.85	3.053	3.053
11	2515.0	.38	.15	.97	3.477	3.477
12	1502.0	.41	.15	.99	3.813	3.813
13	753.0	.45	.15	.95	4.157	4.157
14	536.0	.47	.15	1.00	4.260	4.260
15	152.0	.38	.15	1.00	4.590	4.590
16+	85.0	.38	.15	1.00	5.000	5.000

Table 7.15

Effects of different levels of fishing mortality on
catch, stock biomass and spawning stock biomass.

GREENLAND HALIBUT IN I AND II

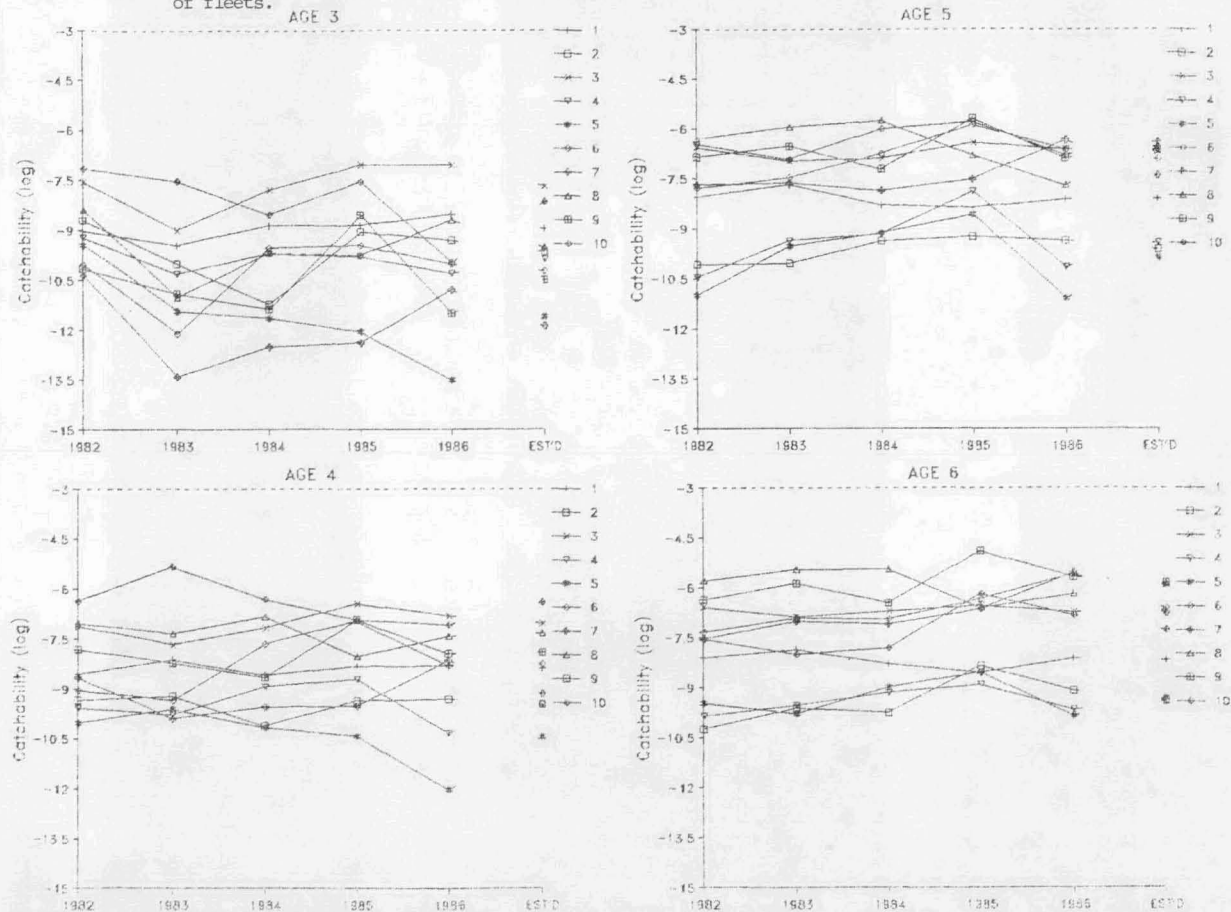
Year 1937					Year 1988					Year 1989	
ref. torl	ref. F	stock biomass	sp.stock biomass	catch	Man. option	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.1	.32	132	34	26	F _{0.1}	.11	128	80	10	140	91
					F _{max.}	.25			18	131	82
					F ₁₉₈₆	.25			19	130	82
					F _{med.}	.65			43	102	58

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F for the age group range from 7 to 11

Figure 3.1 Log catchability plots for ten different fleets for North-East Arctic Cod. See Table 3.18 for identification of fleets.



NORTH-EAST ARCTIC COD

Figure 3.1 (cont'd)

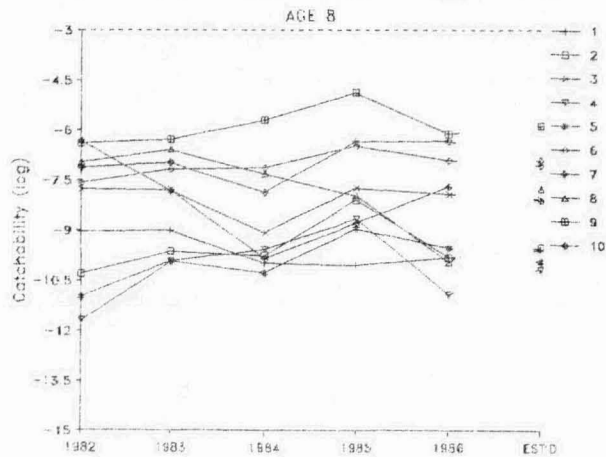
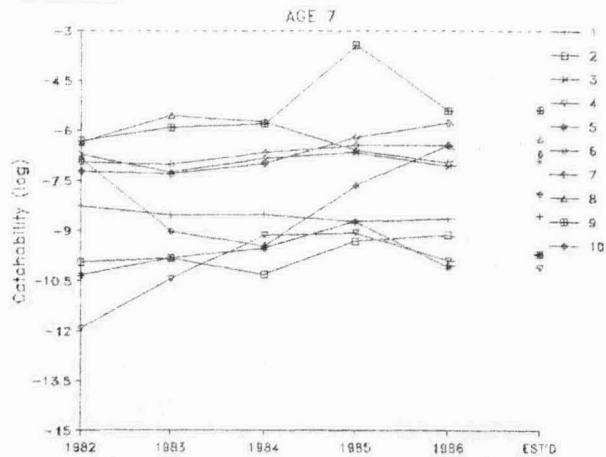


Figure 3.2 North-East Arctic Cod.
Spawning stock biomass vs. recruitment, 1964-1982.
Estimates of F_{med} and F_{high} .

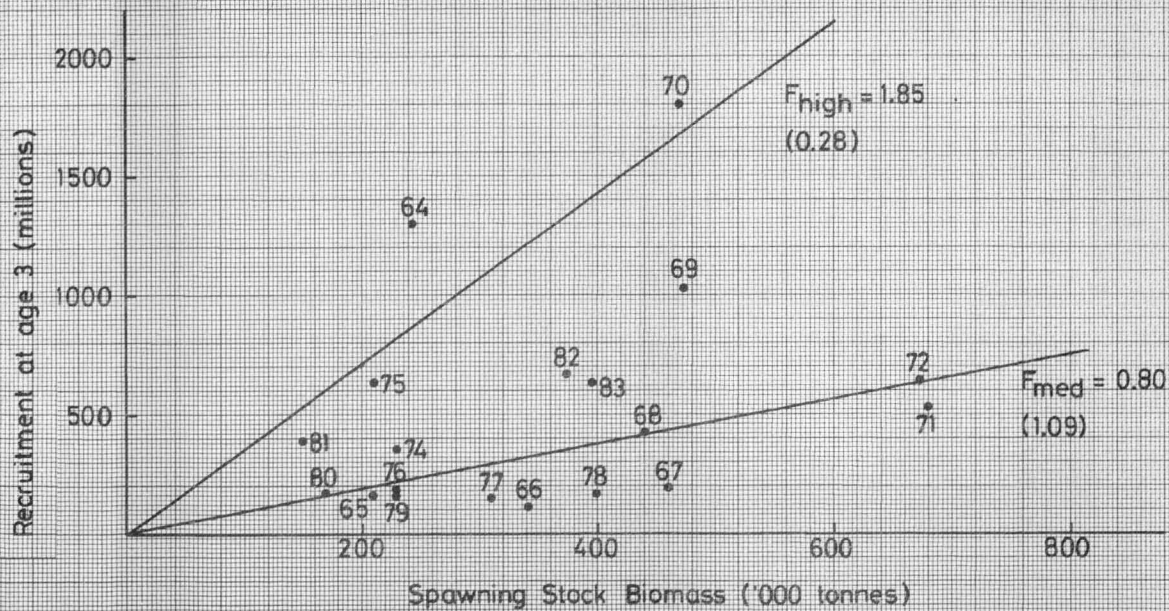


Figure 3.3

FISH STOCK SUMMARY

STOCK: North-East Arctic Cod

14-10-1987

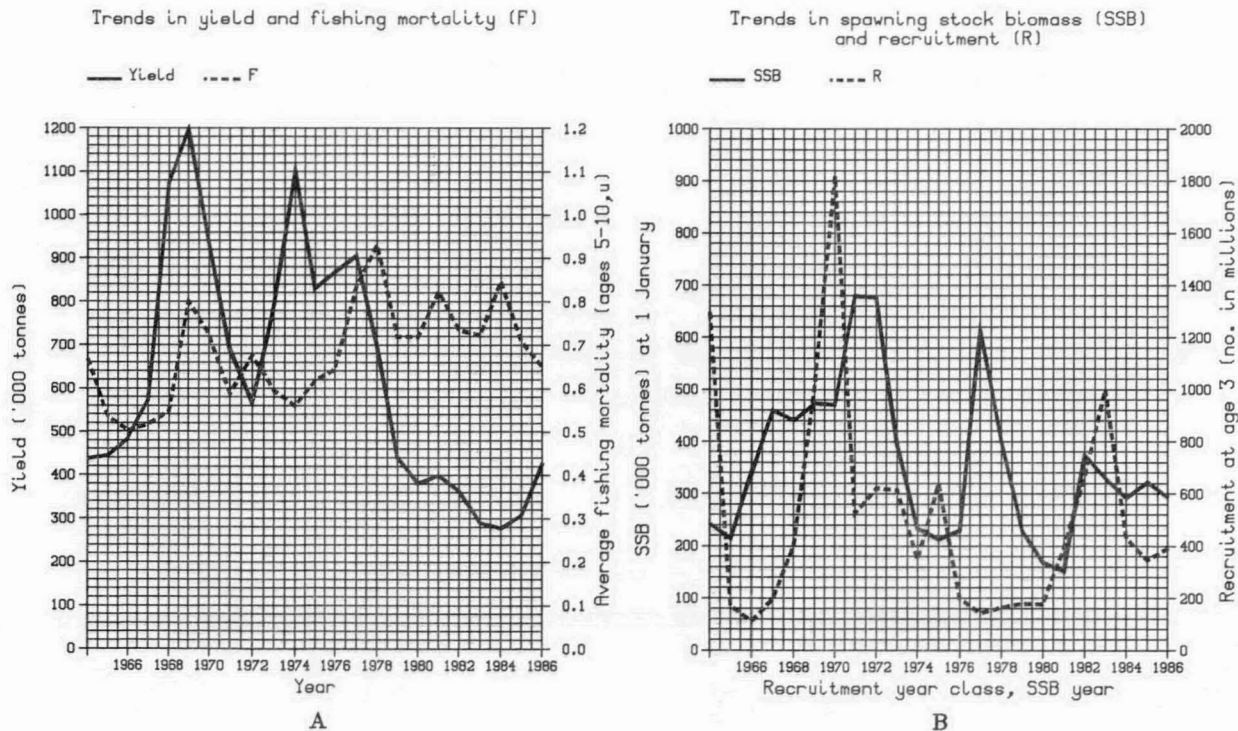
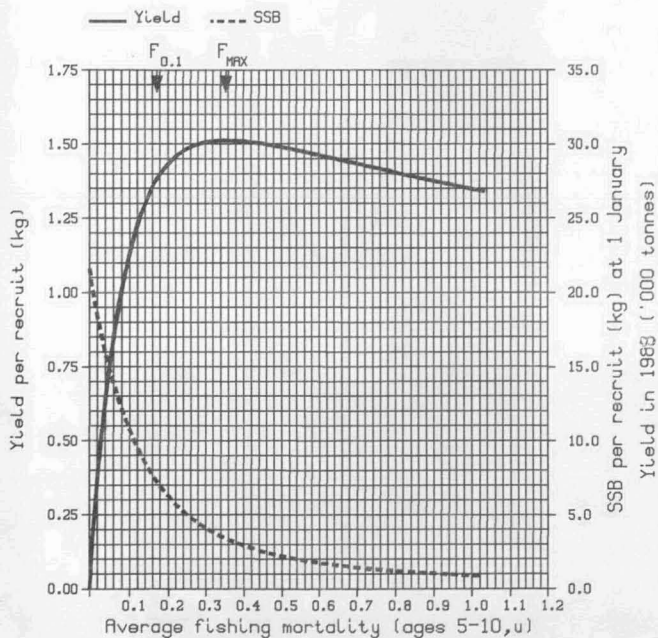


Figure 3.3 (cont'd)

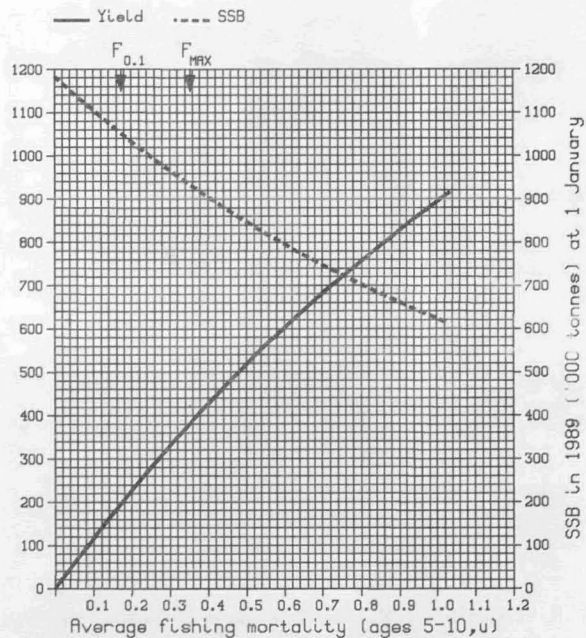
FISH STOCK SUMMARY STOCK: North-East Arctic Cod 14-10-1987

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 4.1 Trends in log-catchability for the ICES VPA tuning program. See Table 4.15 for identification of fleets.

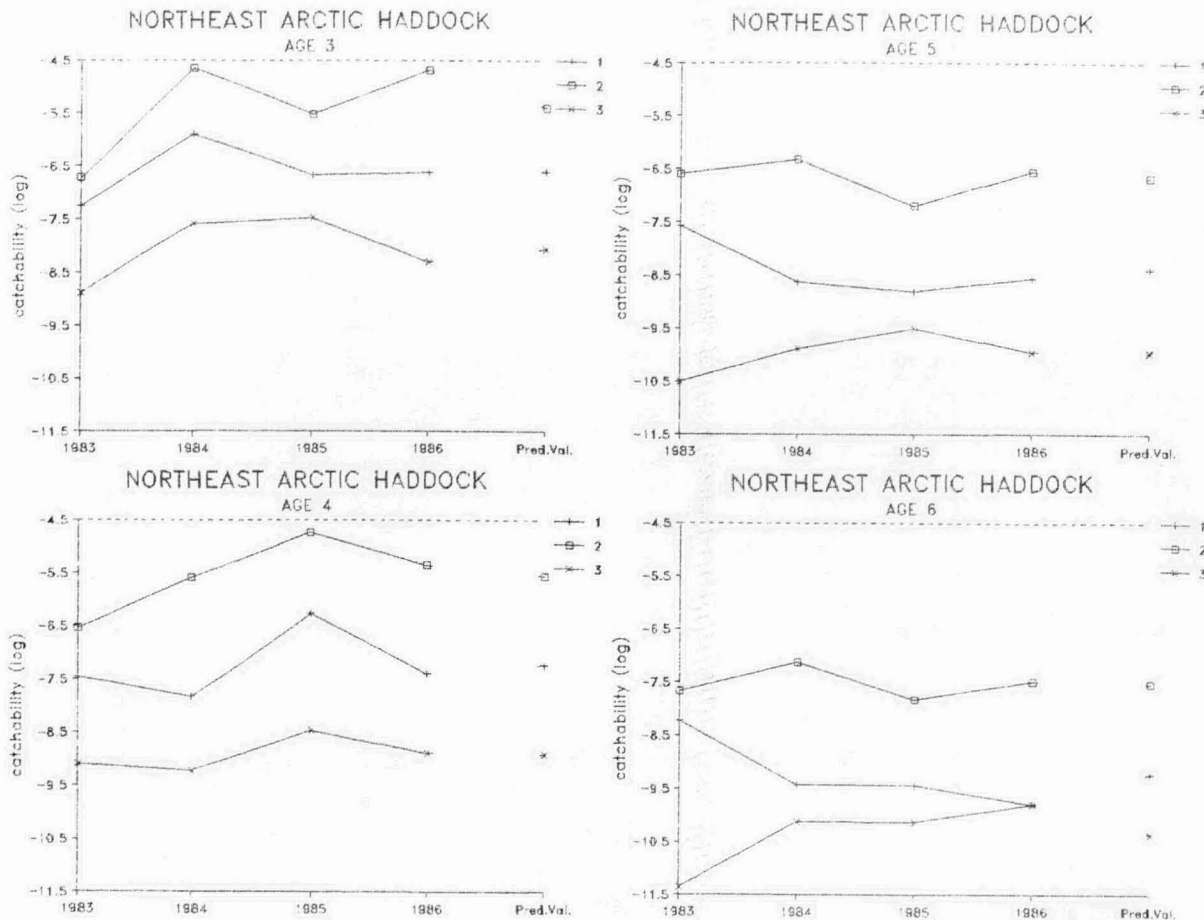


Figure 4.2 North-East Arctic Haddock.
Spawning stock biomass vs recruitment, 1964-1982. Estimates of F_{med} and F_{high} .

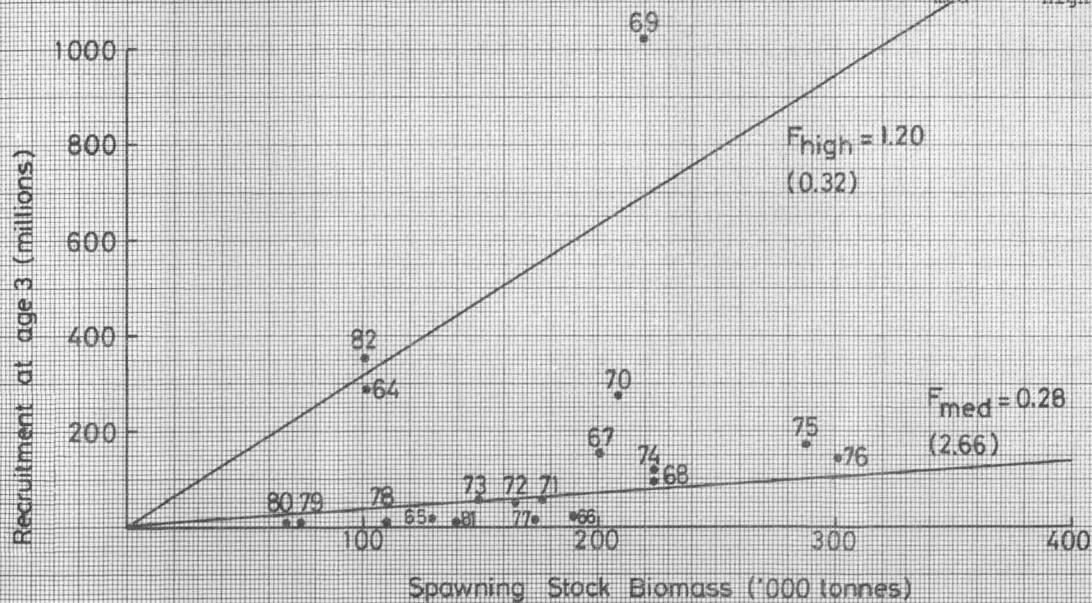


Figure 4.3

FISH STOCK SUMMARY STOCK: North-East Arctic Haddock 15-10-1987

128

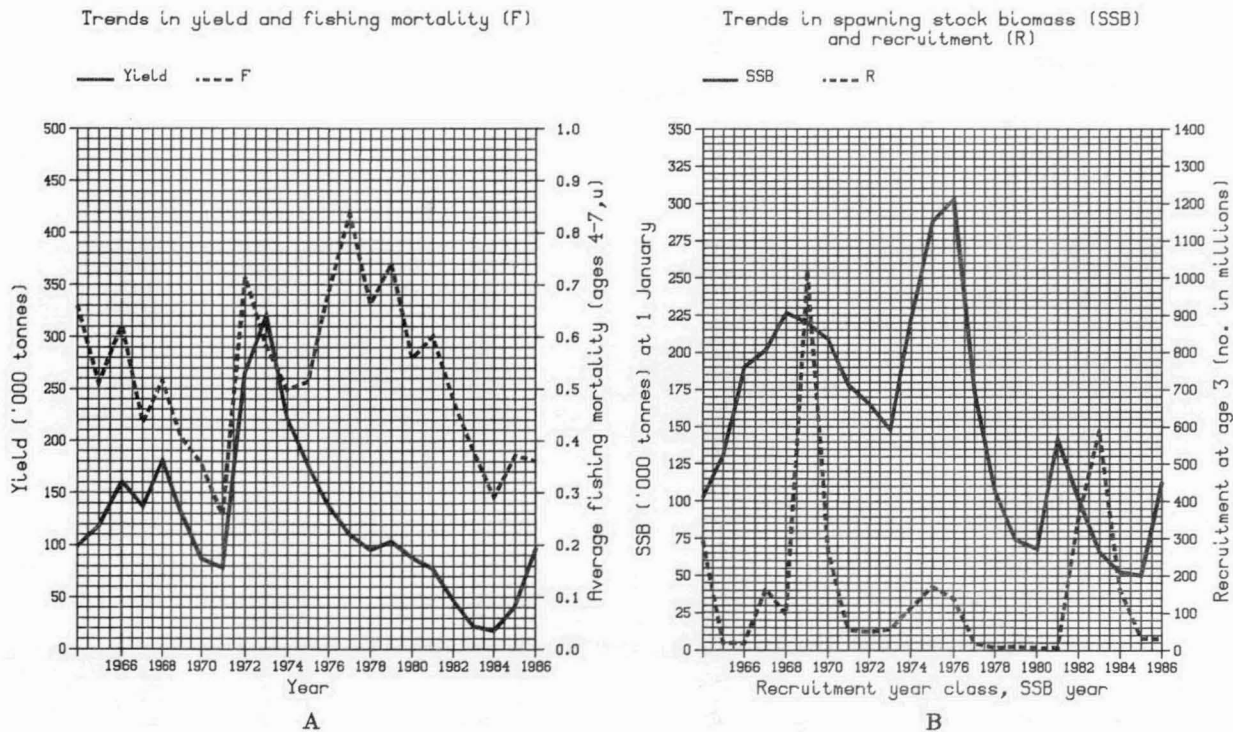


Figure 4.3 (cont'd)

FISH STOCK SUMMARY STOCK: North-East Arctic Haddock 15-10-1987

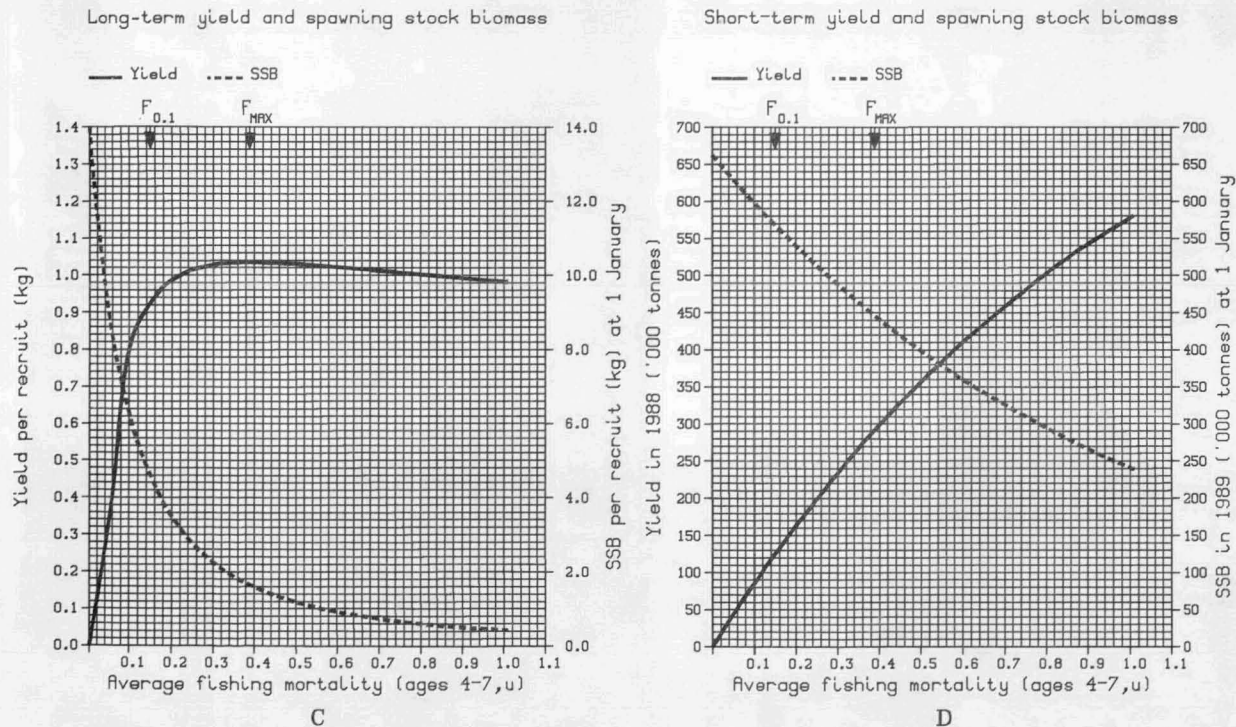


Figure 5.1 North-East Arctic SAITHE.
Landings by gear categories 1977-1986 and estimates for 1987.

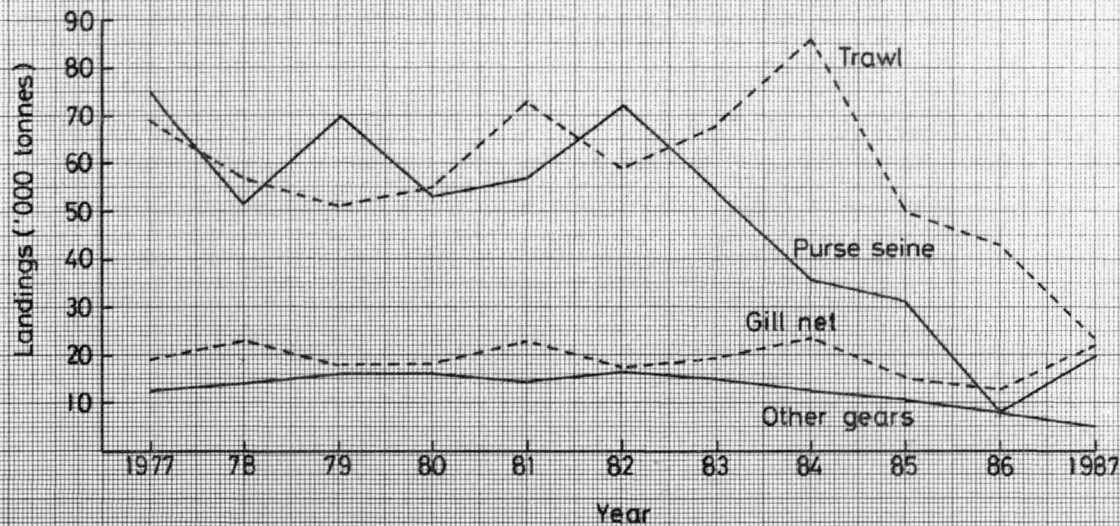


Figure 5.2 Log catchability plots for two fleets for North-East Arctic Saithe. See Table 5.4 for identification of fleets.

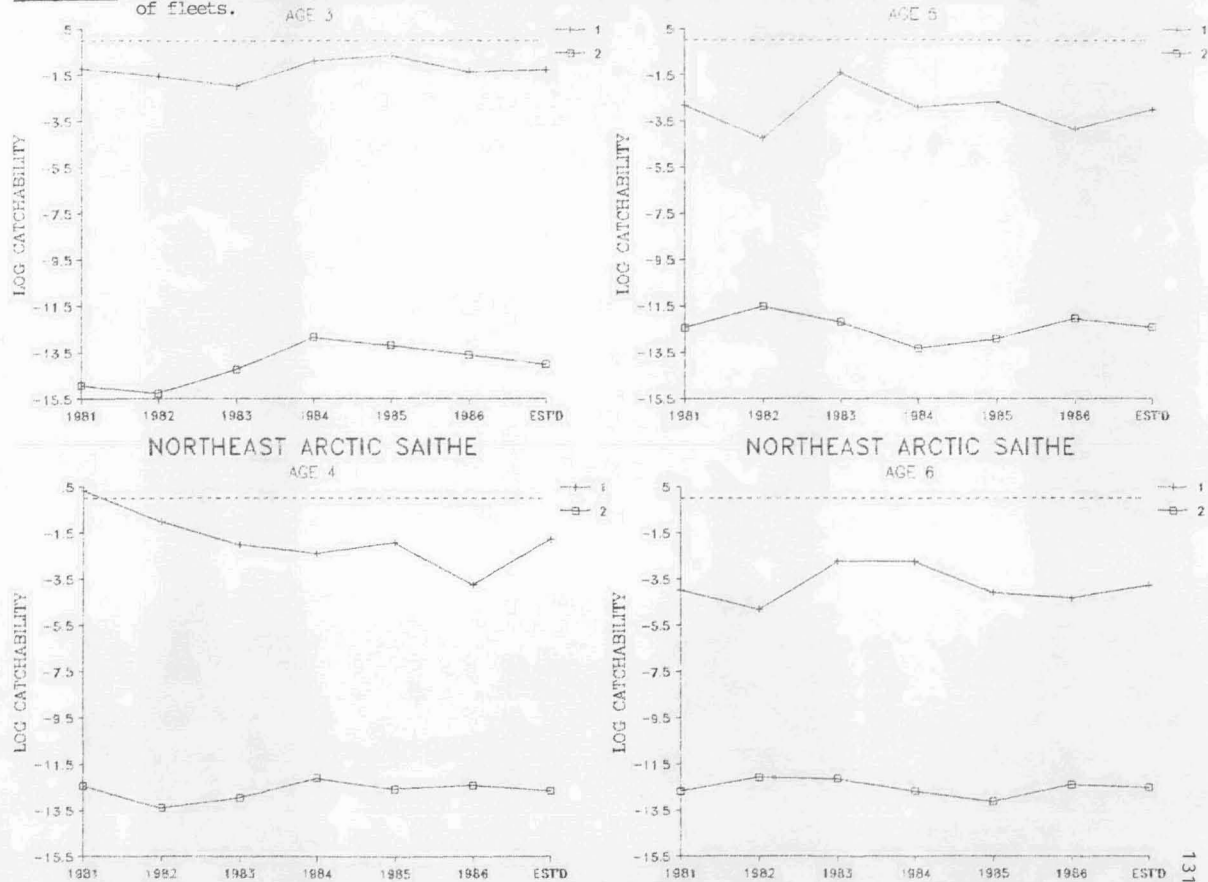


Figure 5.2 (cont'd)

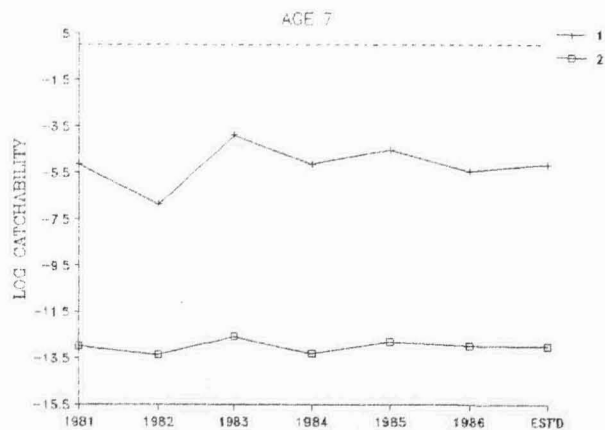


Figure 5.3 North-East Arctic SAITHE.
Spawning stock biomass vs recruitment, 1961-1982.
Estimates of F_{med} and F_{high} .

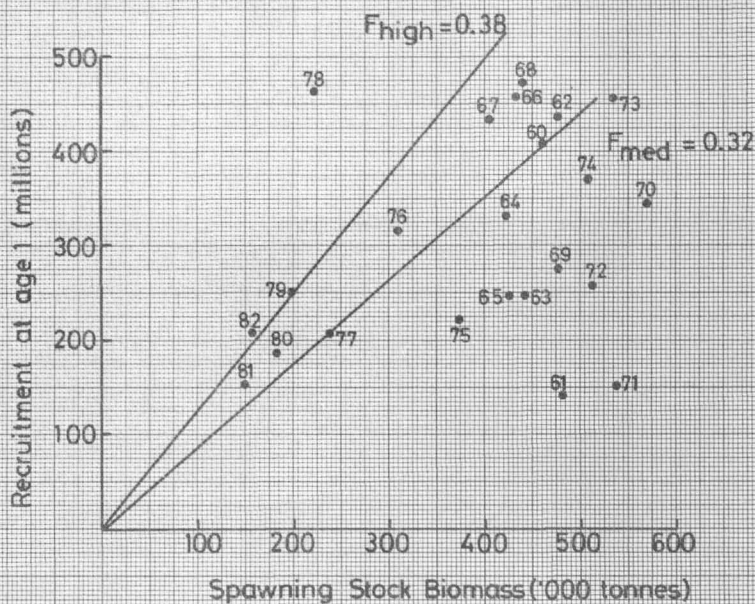


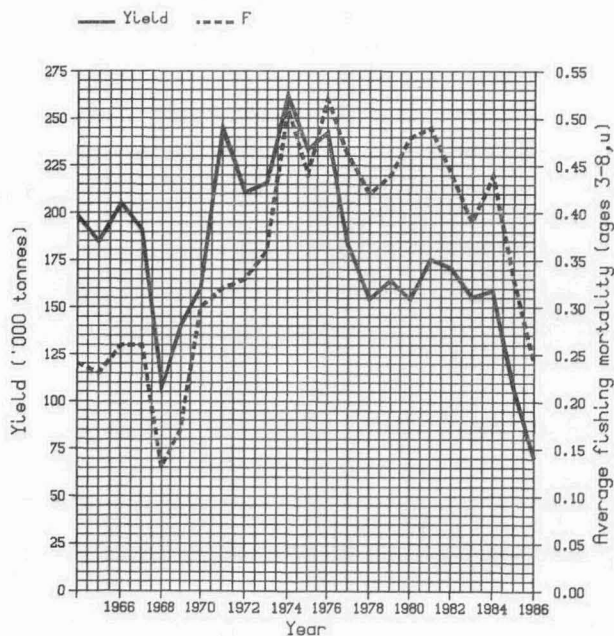
Figure 5.4

FISH STOCK SUMMARY

STOCK: NE Arctic Saithe

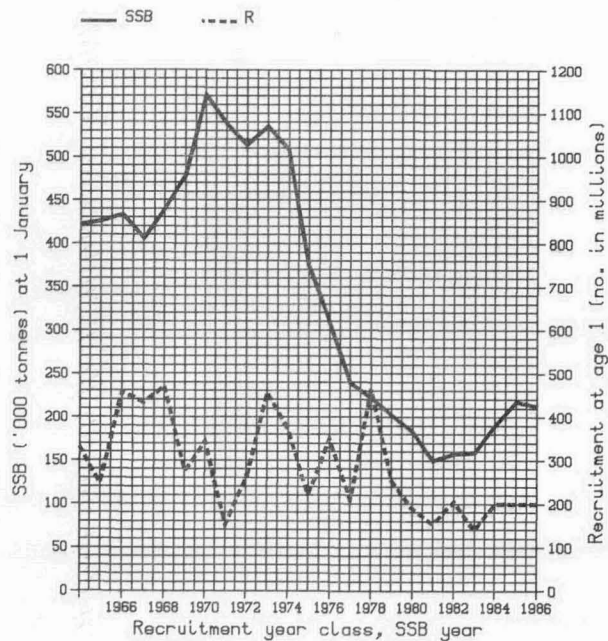
15-10-1987

Trends in yield and fishing mortality (F)



A

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

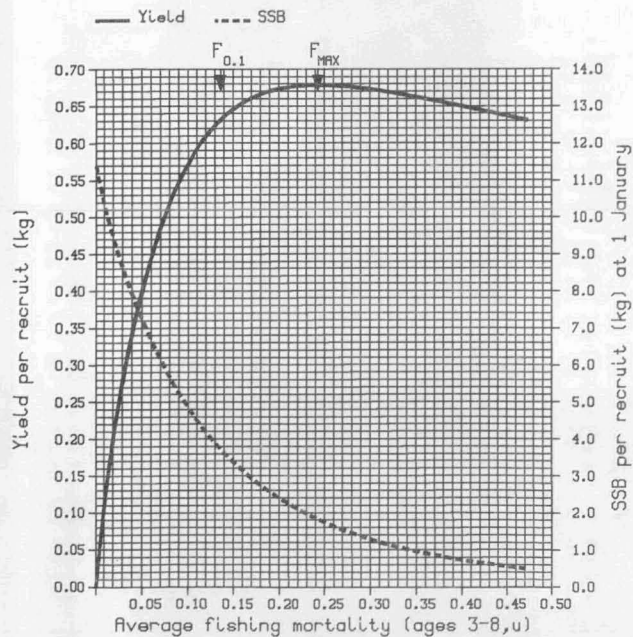


B

Figure 5.4 (cont'd)

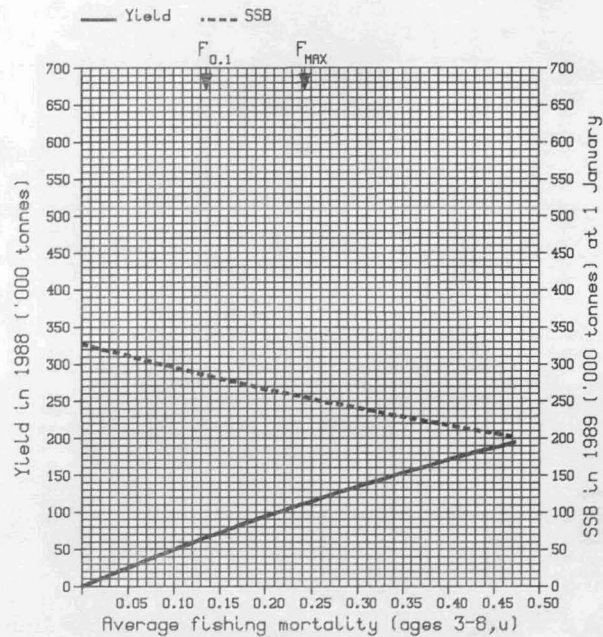
FISH STOCK SUMMARY
STOCK: NE Arctic Saithe
15-10-1987

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 6.1 *Sebastes mentella* in Divisions IIa and IIb.
Relation of mean fishing mortality (ages 10-15)
to total effort.

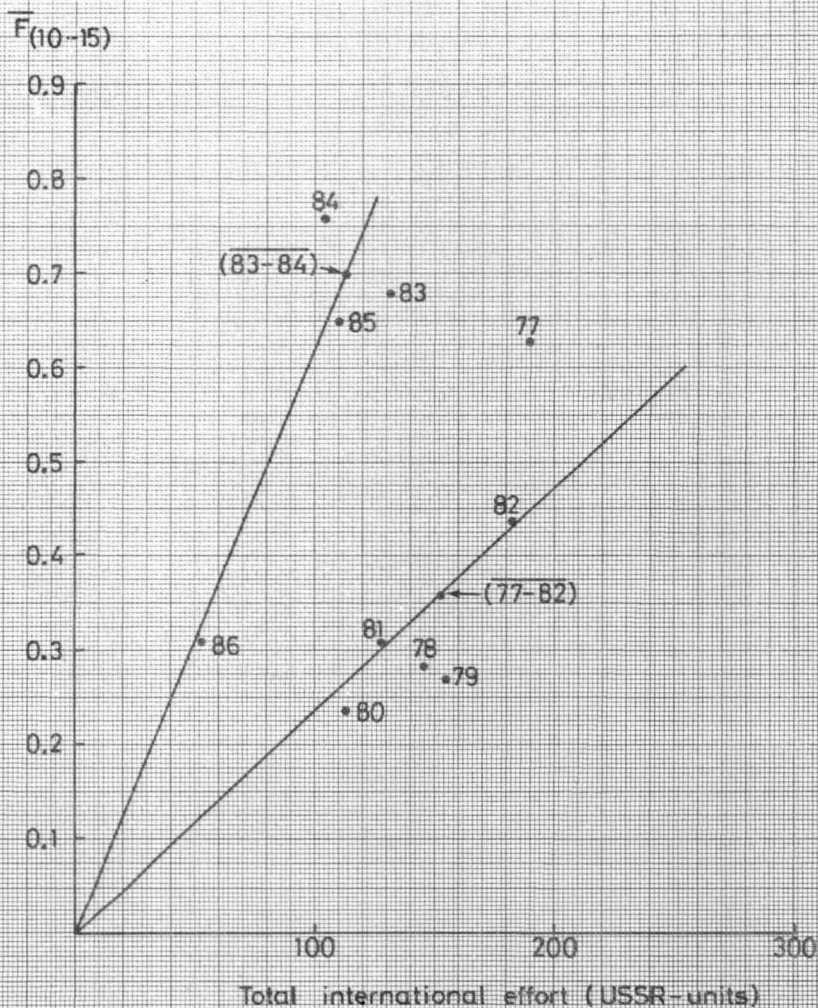


Figure 6.2

FISH STOCK SUMMARY STOCK: *Sebastes Mentella* in area IIA and IIB 19-10-1987

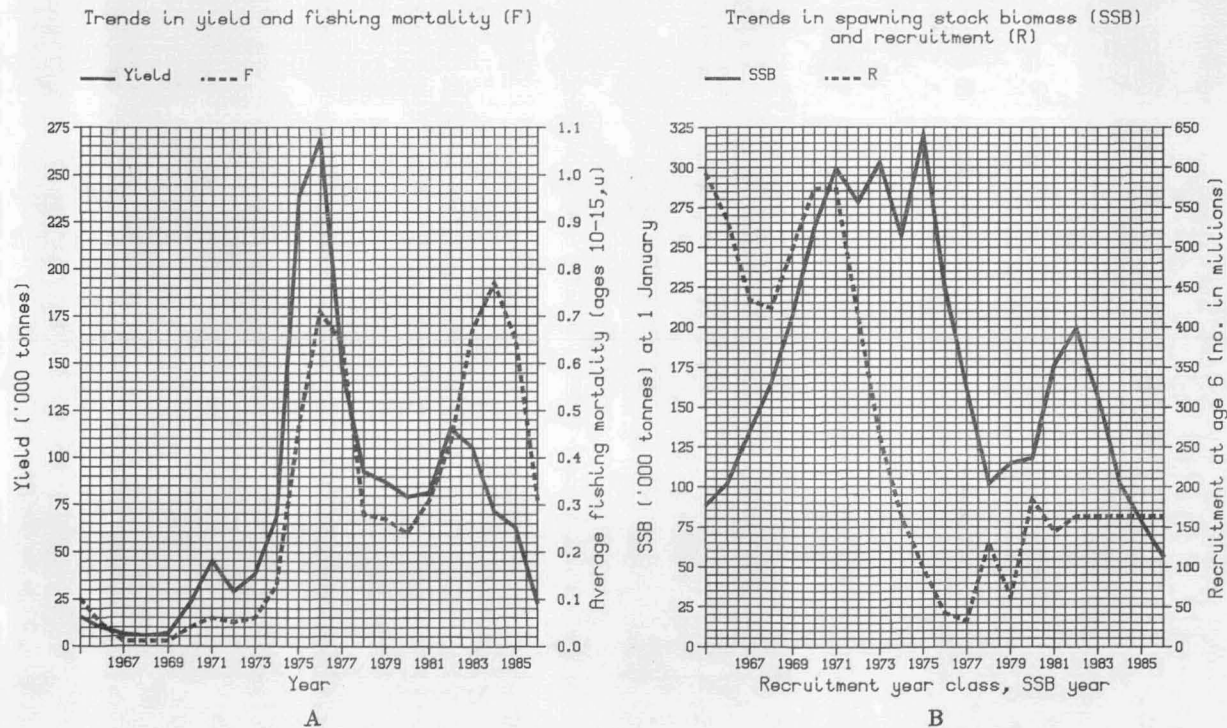
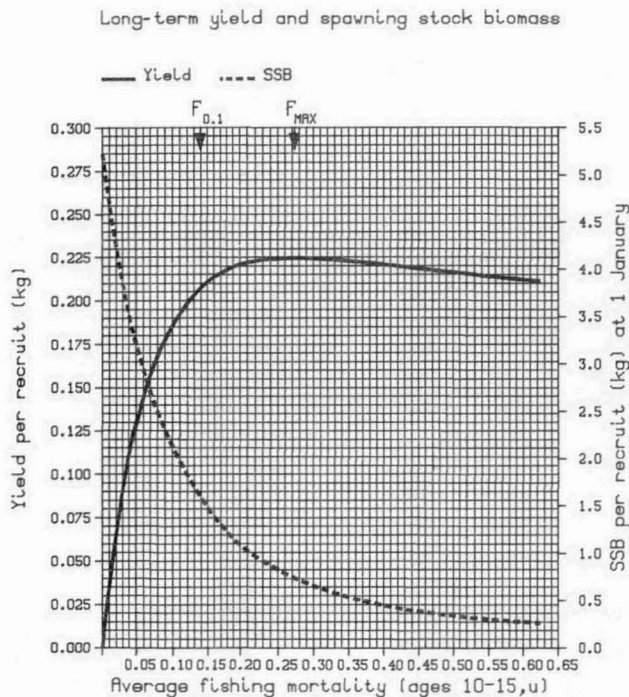


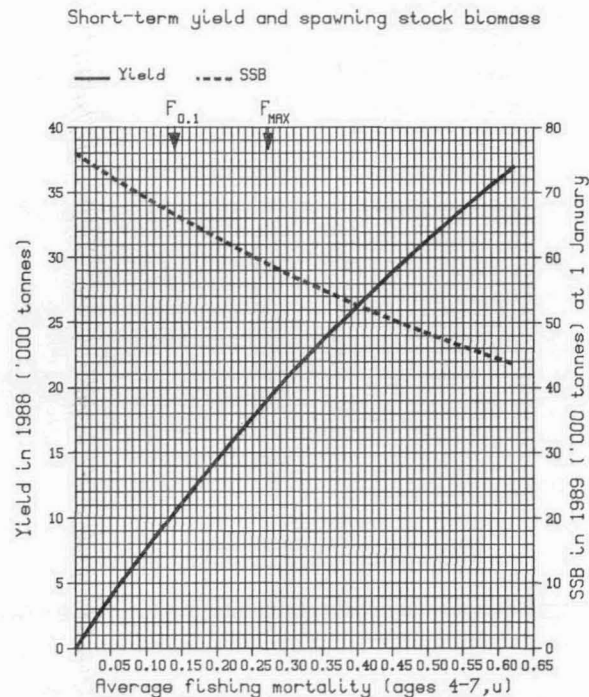
Figure 6.2 (cont'd)

FISH STOCK SUMMARY STOCK: *Sebastes Mentella* in area IIA and IIB 19-10-1987

138



C



D

Figure 7.1 Greenland Halibut in Sub-areas I and II.
Relation of mean fishing mortality (ages 7-11)
to total effort.

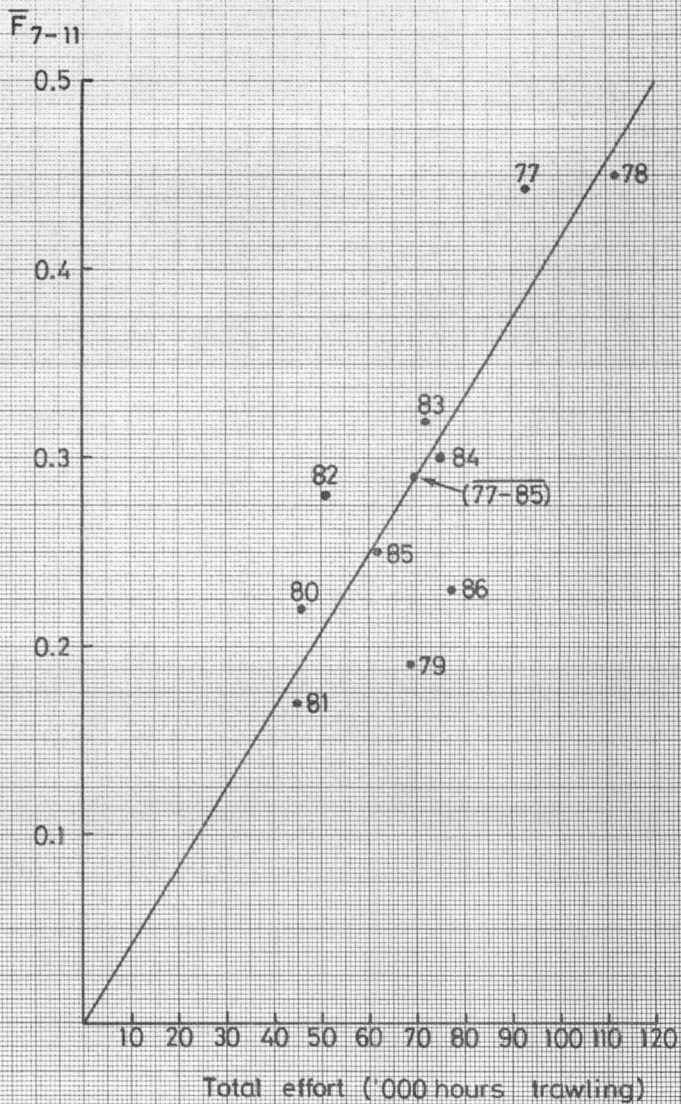


Figure 7.2 North-East Arctic GREENLAND HALIBUT.
Spawning stock biomass vs recruitment, 1977-1983.
Estimates of F_{med} and F_{high} .

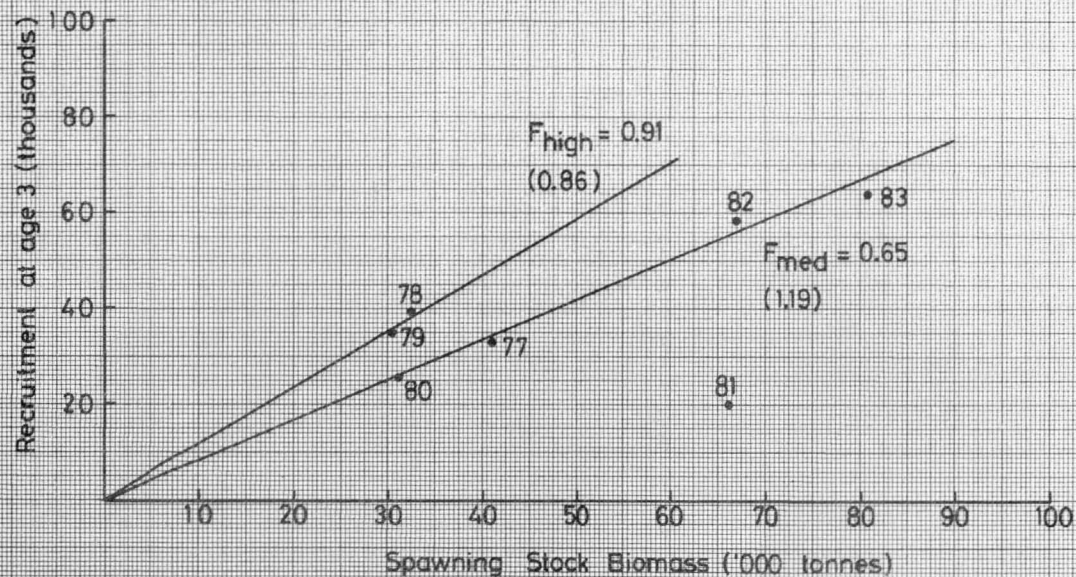


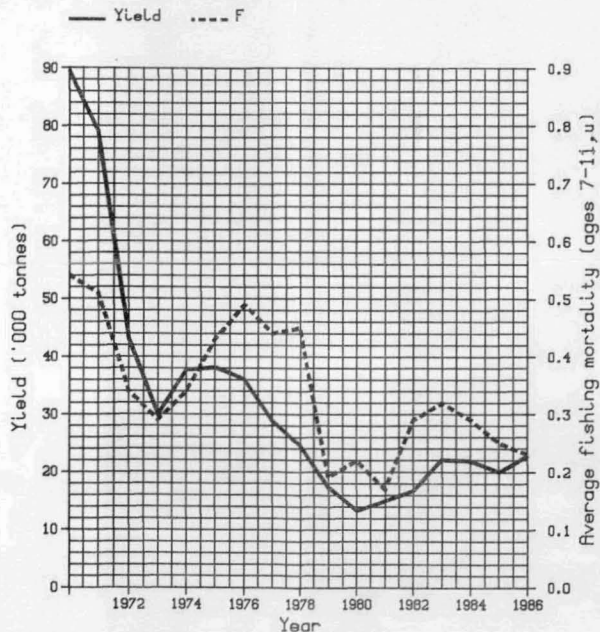
Figure 7.3

FISH STOCK SUMMARY

STOCK: Greenland Halibut in Sub-areas I and II

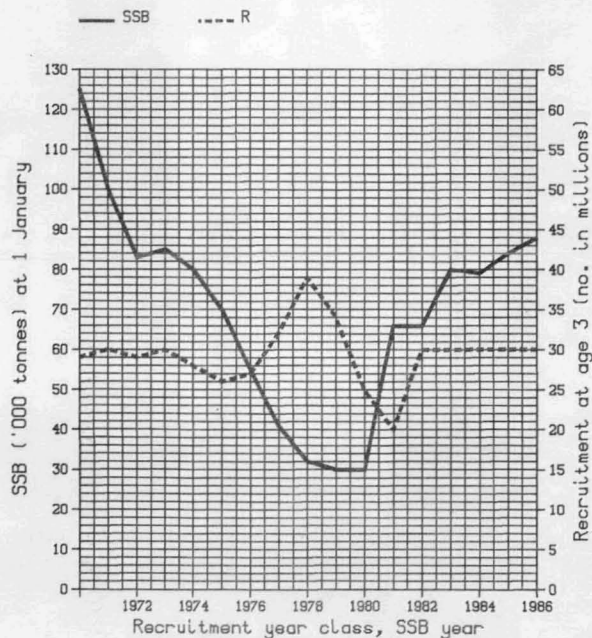
15-10-1987

Trends in yield and fishing mortality (F)



A

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

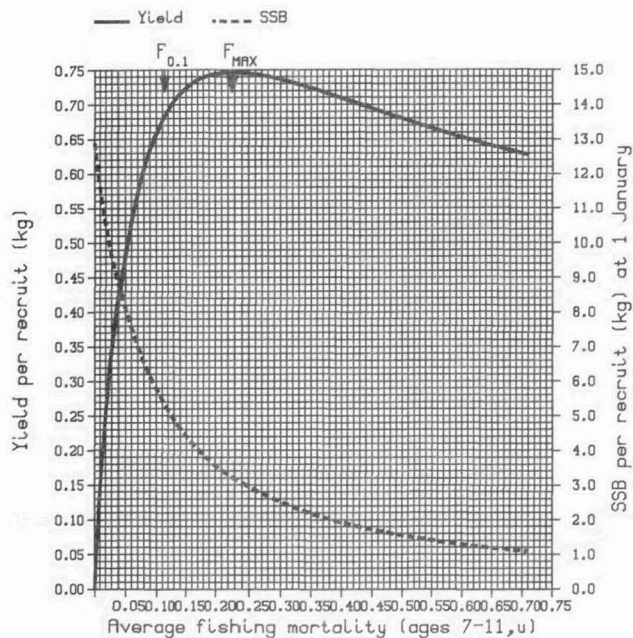


B

Figure 7.3 (cont'd)

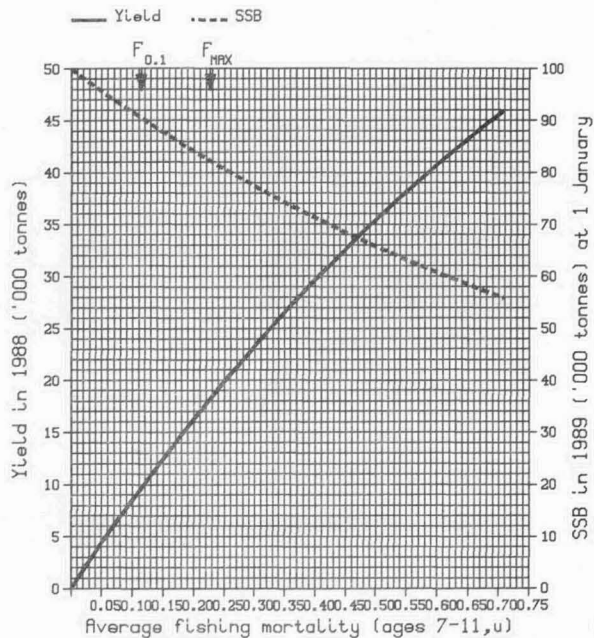
FISH STOCK SUMMARY
STOCK: Greenland Halibut in Sub-areas I and II
15-10-1987

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D