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REPORT OF THE ARCTIC FISHERIES WORKING GROUP

Copenhagen, 19-28 September 1989

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2 INTRODUCTION

2.1 Terms of Reference

At the 76th Statutory Meeting of ICES in 1988, it was decided (C.Res.1988/2:4:21) that the Arctic Fisheries Working Group (Chairman: Mr T. Jakobsen) will meet at ICES Headquarters from 19-28 September 1989 to assess the status of and provide catch options for 1990 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 Assessment

The procedure adopted by the Working Group was to use the RCRTINX2 program (Anon., 1987) to estimate recruitment, the ICES VPA tuning program (Anon., 1988) to estimate current fishing mortality levels, and the separable VPA (terminal population) to estimate the current exploitation pattern. This procedure was followed for all stocks unless the data base was insufficient or the results were inconsistent with other information.

3 NORTH-EAST ARCTIC COD (SUB-AREAS I AND II)

3.1 Use of USSR Murman Cod and Norwegian Coastal Cod in the Assessment

Norwegian coastal cod in Division IIa has been excluded from all previous assessments, whereas the USSR Murman cod in Sub-area I has been included. It was suggested that the Murman cod caught in 1988 might be excluded from the assessment. However, removing the estimated 40,000 t from the catches in 1988 would create a severe inconsistency in the time series and it was agreed that a reliable assessment could not be made on such a basis.

The status of the Murman cod and the Norwegian coastal cod in the assessment needs to be clarified at or before the next Working Group meeting. A recommendation on this subject is given in Section 8.

3.2 Status of the Fisheries

3.2.1 Landings prior to 1989 (Tables 3.1 - 3.3, Figure 3.1A)

Final reports of landings for 1987 totalled 523,071 t (Table 3.1). The landings provisionally reported for 1988 are 391,543 t, excluding both Norwegian coastal cod and USSR Murman cod. The agreed TAC, which included 40,000 t of USSR Murman cod, was 451,000 t. Thus, about 20,000 t of the TAC was not taken. The landings were 24,000 t below the quantity expected by last year's Working Group.

Table 3.2 shows that the reduction in landings occurred in the trawl fisheries, while other gears had a small increase. Landings declined for all countries except France (Table 3.3).

3.2.2 Expected landings in 1989

The agreed TAC is 300,000 t, including 40,000 t of USSR Murman cod. The agreement also assumes that 40,000 t of Norwegian coastal cod is taken, allowing total cod landings of 340,000 t. Based on preliminary information, it is expected that the total landings will be close to this level, but that only 10,000 t will be Norwegian coastal cod. This low quantity is mainly due to the closing of the Norwegian coastal fishery already in April.

3.2.3 Effort and catch-per-unit effort (Tables 3.4 and 3.5)

CPUE is derived by dividing the total catch by the total fishing effort involved in taking that catch. The effort will in part have been directed towards other species, but no selection of directed cod catch or directed fishing effort for cod has been made.

Of the eight current CPUE series shown in Table 3.4, five reached a maximum and all reached a peak in the mid-1980s. There has been a general decline since 1986. All indices available showed a decline from 1987 to 1988. Declines ranged from about 5% to 50% with a mean decline of about 25%. The catch-per-gillnet boat week in Lofoten has been declining steadily since 1983 and the 1987 rate was about 45% of the rate in 1983.

Catch-per-unit-effort indices from the fishery on spawning cod in the Lofoten area showed maximum values in 1982 for the longline and handline fisheries and a peak close to the maximum in 1971 was reached in 1983 in the gillnet fishery (Table 3.5). There were declines in all three indices to 1987 followed by substantial increases in the longline and handline indices in 1988. The handline index declined in 1989 but those for gillnet and longline increased.

3.3 Data from Catches

3.3.1 Catch in numbers at age (Table 3.25)

The catch at age for 1987 was revised based on final landings figures and the updated Norwegian age composition. Age compositions of catches by the Soviet Union, the Federal Republic of Germany, and Spain were the same as used in last year's assessment.

For 1988, the catch at age was again calculated separately for Sub-area I and Divisions IIa and IIb using the landings by country and yearly age compositions provided by the Federal Republic of Germany, Norway, the USSR, and the UK for each of these areas and by Spain for Division IIb. Landings by other countries, mainly the Faroe Islands and Portugal, comprised less than 5% of the total and age compositions for them were derived by the use of age compositions from the UK and Spain.

The 1983 year class as 5-year-old cod in 1988 was dominant in the trawl, longline and handline landings. In the gillnet landings, 6-year olds predominated while cod of ages 5 and 6 were of equal strength in the Danish seine landings. For the fishery as a whole, the 1983 year class comprised 57% by number of the landings and cod of ages 4-7 accounted for about 97%.

For 1989, the Federal Republic of Germany, Norway, and USSR provided age and length data for their landings in the first half of the year. The age compositions of landings from other countries were calculated using age compositions from Norwegian trawlers. The total age composition was calculated by raising these age compositions to the respective expected landings.

3.3.2 Weight at age in the landings (Tables 3.6 and 3.26)

In the years 1984-1987, average weights at age from Norwegian landings were higher for the younger ages and lower for the older ages than corresponding values derived from the USSR landings. The difference for the younger age groups was in part due to an unsatisfactory Norwegian length-weight relationship. Differences in the older ages may be in part due to inadequate sampling as these age groups are much less abundant in the landings and in part to differences in fishing pattern by the fleets. The average weights at age in 1988 were similar except for age 2. From both the Norwegian and USSR estimates, average weights at age have declined markedly from 1984 to 1988.

3.4 Survey Results (Tables 3.9-3.14)

Bottom trawl and acoustic surveys conducted by Norway and the USSR confirm that the 1984 and 1985 year classes are much weaker than the 1982 year class and the strong 1983 year class. Estimates of stock abundance as a whole declined from the mid-1980s to 1988 and 1989, reflecting both the decline of the 1982 and 1983 year classes and the recruitment to the stock of much weaker year classes.

3.4.1 Recruitment indices (Tables 3.7-3.8)

The sizes of year classes not considered to be well estimated by the VPA were based on the analysis of recruitment indices using the ICES program RCRTINX2. The 1986-1989 year classes were all estimated to number about 200 million at age 3. Thus, all year classes produced in the 1980s, except for the strong 1983 and average 1981 and 1982 year classes, appear to have been in the range 140-200 million at age 3.

The estimates of recruitment of year classes 1983 and younger in the present assessment are considerably less than those of last year. The reasons for this change are not obvious but may be in part due to perceived changes in the selectivity of survey and commercial gear to cod of lower mean length at age. Discard rates were considered at last year's meeting and increased discarding of small slow-growing cod may also be a factor in the above phenomenon.

3.4.2 Weight at age in the stock (Tables 3.15-3.18, 3.27)

Stock weights used for 1985-1989 are averages of values derived from Norwegian surveys in January-February 1985-1989 and USSR surveys (with ages adjusted by 1 year) in November-December 1984-1988. Cod of ages 3-7 weighed much less in 1989 than in 1984. The decline in growth rate seems to have stopped in 1988. The expected improvement in growth rate would appear to be related to improved temperature conditions in the Barents Sea and an increased feeding on capelin.

3.4.3 Maturity at age in the stock (Table 3.19)

As in 1988, a maturity ogive was only available from the USSR. The ogive for 1989 was similar to that of 1987 and showed a somewhat more gradual attainment of maturity than the USSR ogive of 1988.

3.5 Stock Assessment

3.5.1 Tuning the VPA to survey results

The available data from surveys and CPUE from trawl fisheries were updated by information from the latest year. The USSR surveys taken in the late autumn were allocated to the following year. In this way tuning data for 1989 were obtained and the tuning-VPA was run including 1989. The preliminary catch data for 1989 were given by age. Trial runs revealed that the CPUE data from Norway and the USSR from each area and division gave contradicting results for older ages and a combined CPUE was constructed. First, the data from each area were combined to a total from each country. However, these data also showed contradicting results and a combined total for both countries was calculated. The combined effort was calculated as the sum of the effort from each country divided by the average of each country multiplied by the fraction of total catch taken by each country. These data are given in Table 3.20.

The input F on the oldest age was the average of 4 younger ages and the final year input F to the ages not tuned were the average of the 4 latest years. The results of the tuning are given in Tables 3.21 - 3.23.

3.5.2 Separable VPA

The shift in the fishing pattern from 1985-1986 caused by the recruiting 1982 and 1983 year classes seems to have resulted in a new and stable fishing pattern. A separable VPA was run adjusted to the $F_{5-10} = 0.787$ in 1989 from the tuning. The residuals and resulting fishing pattern are given in Tables 3.24-3.25. The residuals do not show any clear indications of changes in the fishing pattern during the years of heavy weighting, i.e., 1985 to 1989.

3.5.3 Final VPA and present state of the stock (Tables 3.29-3.30, Figures 4.1A-4.1B)

The final VPA was run using F on the oldest ages estimated from the tuning VPA for the years 1967 to 1984 and those estimated by the separable VPA for the later years. The input Fs for 1989 were the ones from the separable VPA based on final populations, except for age 3, where the F value was adjusted to fit the estimated abundance from the recruitment program.

The F values from the final VPA are presented in Table 3.29. Population numbers by age, total biomass, the spawning stock numbers and biomass from the final VPA are presented in Table 3.30, including figures for 1989, thus showing the present state of stock.

3.6 Predictions of Catch and Biomass

3.6.1 Input variables to the prediction

The values used in the prediction are given in Table 3.31. The stock size in 1990 is estimated from the final VPA except for age 3. The recruitment at age 3 is estimated using the program RCRTINX2. The fishing pattern is the one estimated by the separable VPA. The maturation ogive from 1989 is used for all years in the prediction.

The data on weight in catch and stock are calculated by assuming a length increment equal to the average over the last 10 years for the years in the prediction, starting with the observed length in 1989. The data are the average length at age from the Norwegian and USSR surveys. For the ages 9 and older the average of age 7 and 8 is used. To calculate the weight in the stock, the corresponding average condition factors are used, i.e., the relationship between the cubic length and the weight.

The weights in the catches are taken to be the stock weights the year after for ages 3 and 4, and the average of the stock weights at the beginning of the year and the year after for older age groups.

3.6.2 Biological reference points (Figure 3.1C)

The yield-per-recruit analysis using the 1989 catch and stock parameters resulted in estimates of $F_{0.1} = 0.15$ and $F_{max} = 0.24$. Jakobsen (1989) gives the values of $F_{low} = 0.32$, $F_{med} = 0.46$ and $F_{high} = 0.78$ for North-East Arctic cod. The latter estimates are substantially lower than the values estimated last year. The present exploitation level is $F_{89} = 0.78$ corresponding to F_{high} .

3.6.3 Projections of catch and biomass (Table 3.32, Figure 3.1D)

Table 3.32 shows the expected development of the stock and the expected catches under various assumptions of F_{5-10} . For 1990, all the biological reference points are included, but from 1991 only $F_{0.1}$, F_{max} , F_{med} , and F_{89} are given. The recruitment up to 1992 is based on observed year classes, but after that a recent, average recruitment is assumed.

3.6.4 Comments to the stock situation

High fishing mortalities in recent years, at or above the F_{high} -level, have reduced the stock severely. A reduction in stock biomass of more than 50% has occurred from 1986 to 1989 and the current spawning stock biomass is at a historic low level. Recruitment in the most recent years for a series of year classes has been only about 1/3 of the long-term average and this makes the stock situation even more serious. The catches must be kept at a low level for some years to avoid a further reduction of the stock.

4 NORTH-EAST ARCTIC HADDOCK (SUB-AREAS I AND II)

4.1 Status of the Fisheries

4.1.1 Landings prior to 1989 (Tables 4.1-4.3, Figure 4.1A)

The final landings figure for 1987 was 150,659 t which is very close to the value used in last year's assessment. The preliminary landing value for 1988 of 91,771 t, a decrease of about 40% from the 1987 level, is well below the landing expected at last year's meeting. In Sub-area I, landings fell from 109,000 t to 44,000 t, while the landings in Division IIa reached 47,000 t, the maximum since 1960. Landings in Division IIb declined but these are variable and comprise only a small portion of the total.

4.1.2 Expected landings in 1989

Based on reports for the first half of the year, the expected landings in 1989 of 57,000 t will be somewhat lower than the agreed TAC of 83,000 t.

4.1.3 Effort and catch per unit effort (Table 4.4)

In Sub-area I, CPUE in Norwegian trawl fishery increased steadily from 1984 to a peak in 1987 close to the maximum in the series since 1972. The USSR CPUE in 1985-1987 was relatively stable. There were, however, substantial drops in CPUE in 1988, both in the Norwegian (37%) and USSR (22%) fisheries. The increase since the mid-1980s in the Norwegian CPUE in Division IIa continued in 1988. It should be noted that a substantial portion of the haddock landings is taken as a by-catch and no great confidence may be placed in the trends in CPUE outlined above.

4.2 Data from Catches

4.2.1 Catch in number at age (Table 4.24)

The catch at age for 1987 was revised based on final landings figures and the updated Norwegian age composition. Age compositions of catches by the Soviet Union, the Federal Republic of Germany, and the UK were unchanged.

For 1988, age compositions were available for all areas from Norway, the UK, and the Federal Republic of Germany and from Sub-area I and Division IIa from the USSR. The age compositions of the small catches by other countries were considered to be the same as those of Norwegian trawlers. The 1983 year class as 5-year olds in 1988 was predominant in all areas and accounted for 63% of the catch in numbers. Haddock of ages 4-6 made up 98% of the total number.

4.2.2 Weight at age in the landings (Table 4.5)

For 1989, the Federal Republic of Germany, Norway, and USSR provided age and length data for their landings in the first half of the year. The age compositions of landings from other countries were calculated using age compositions from Norwegian trawlers. The total age composition was calculated by raising these age compositions to the respective expected landings.

Differences between Norway and USSR estimates in recent years of mean weights at age of younger haddock were partly due to the use of an unsatisfactory Norwegian length-weight relationship. There has been a clear reduction since 1984 in average weights at age of haddock up to age 9. In the 1984-1988 period, the average weights were at a minimum in 1988 for almost all ages. The average weights of 4-, 5-, and 6-year-old haddock in 1988 were less than half those in 1984.

4.3 Survey Results (Tables 4.6, 4.8-4.12)

Bottom trawl and acoustic surveys by Norway and the USSR confirm that the stock is dominated by the 1982-1984 year classes which are much more abundant than subsequent year classes. The 1987 year class, as 1-year olds, seemed strong in the autumn acoustic survey by Norway but was poorly represented in other surveys in 1988 and 1989.

4.3.1 Recruitment indices (Tables 4.6-4.7, 4.28)

The abundances of the 1985-1989 year classes as estimated from an analysis of recruitment indices with the ICES RCRTINX2 program, were quite low and comparable to the estimates of last year.

4.3.2 Weight at age in the stock (Tables 4.13-4.14, 4.23)

Stock weights used for 1987-1989 are averages of values derived from Norwegian surveys in January-February 1987-1989, and USSR surveys (with ages adjusted by 1 year) in November-December 1986-1988. Haddock of ages 3-6 showed a decline in growth from 1986-1987 but the growth rate appears to have increased in 1988. (See also remarks in Section 3.4.2).

4.3.3 Maturity at age (Table 4.15)

No new maturity ogive was available at this meeting. The USSR ogive for 1988 was, therefore, used in the VPA for 1988 and 1989 and in the projections.

4.4 Stock Assessment

4.4.1 Tuning the VPA to survey results

The available data from surveys were updated by information from the latest year. The USSR surveys taken in the late autumn were allocated to the following year. In this way tuning data for 1989 were obtained and the tuning VPA was run including 1989. The preliminary catch data for 1989 were given by age. Tuning data are given in Table 4.16.

The input F on the oldest age was the average of 4 younger ages and the final year input F to the ages not tuned was the average of the 4 latest years. The results of the tuning are given in Tables 4.17-4.19.

4.4.2 Separable VPA

The shift in the fishing pattern from 1985-1986 caused by the recruiting 1982 and 1983 year classes seems to have resulted in a new and stable fishing pattern. A separable VPA was run adjusted to the $F_{4-7} = 0.403$ in 1989 from the tuning. The residuals and resulting fishing pattern are given in Tables 4.20-4.21 and the

residuals do not show any clear indications of changes in the fishing pattern during the years of heavy weighting, i.e., 1985 to 1989.

4.4.3 Final VPA and present state of the stock (Tables 4.25-4.26, Figures 4.1A-4.1B)

The final VPA was run using the F on the oldest ages estimated from the tuning VPA for the years 1967 to 1984 and those estimated by the separable VPA for the later years. The input Fs for 1989 were the ones from the separable VPA based on final populations, except for age 3, where the F values were adjusted to fit the estimated abundance from the recruitment program.

The F values from the final VPA are presented in Table 4.25. Population numbers by age, the total biomass, the spawning stock numbers, and biomass from the final VPA are presented in Table 4.26, including figures for 1989, thus showing the present state of stock.

4.5 Predictions of Catch and Biomass

4.5.1 Input variables to the prediction

The values used in the prediction are given in Table 4.27. The stock size in 1990 is estimated from the final VPA except for age 3. The recruitment at age 3 is estimated using the program RCRTINX2. The fishing pattern is the one estimated by the separable VPA. Due to lack of new data on maturation, the ogive from 1988 is used for all years in the prediction.

The data on weight in catch and stock are calculated by assuming a length increment equal to the average over the last 5 years for the years in the prediction, starting with the observed lengths in 1989. The data are the average length at age from the Norwegian and USSR surveys. For the ages 8 and older, the average of age 7 is used. To calculate the weight in stock, the corresponding average condition factors are used, i.e., the relationship between the cubic length and the weight.

The weights in the catches are taken to be the stock weights the year after for ages 3 and 4, and the average of the stock weights at the beginning of the year and the year after for older age groups.

4.5.2 Biological reference points

The yield-per-recruit analysis using the 1989 catch and stock parameters resulted in $F_{0.1} = 0.13$ and $F_{max} = 0.24$ (Figure 4.1C). Jakobsen (1989) gives the values of $F_{low} = 0.02$, $F_{med} = 0.35$ and $F_{high} = 1.11$ for North-East Arctic haddock. The present exploitation level is $F_{89} = 0.40$.

4.5.3 Projections of catch and biomass (Table 4.28, Figure 4.1D)

Table 4.28 shows the expected development of the stock and the expected catches under various assumptions of F_{4-7} . Only the biological reference points $F_{0.1}$, F_{med} , and F_{89} are used in the calculations. The recruitment up to 1992 is based on observed year classes, but after that a recent, average recruitment is assumed.

4.5.4 Comments to the stock situation

A series of very poor year classes have recruited to the stock in the most recent years and the stock biomass will be at a very low level from 1994 onwards.

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

5.1 Status of the Fishery

5.1.1 Landings prior to 1989 (Table 5.1, Figure 5.3A)

Revised landings as reported to ICES for 1987 were 91,679 t, an increase of 21,221 t from the low level in 1986 (Table 5.1). Provisional reports of landings in 1988 give a total of 114,050 t compared to 105,000 t expected by last year's Working Group.

5.1.2 Expected landings in 1989

Norwegian authorities have introduced quota regulations in order to limit the total landings to the recommended TAC of 120,000 t. Landings to date in 1989 indicate that the TAC will be taken.

5.1.3 Effort and catch per unit effort

Figure 5.1 shows the landings for the main gear categories since 1977. For the two dominant gears, trawl and purse seine, landings increased in 1988.

Table 5.2 shows the number of vessels of different size categories that have taken part in the purse seine fishery since 1977, with corresponding catch and catch per vessel. On the basis of these data, indices of total purse seine effort have been calculated and are given in Table 5.4. The size category 20-24.9 m has been used as a basis because it has the highest catches and the lowest fluctuations in catch rates over the period. An increase in effort of 19% from 1987 to 1988 is indicated.

Table 5.3 gives catch, effort, and catch per unit effort for Norwegian trawlers since 1976, including only hauls where the effort clearly has been directed towards saithe. Indices of total Norwegian trawl effort are given in Table 5.4 and show an increase of 63% from 1987 to 1988. Thus, the effort indices for the two main gears indicate that the total effort has increased by about 40% in 1988.

5.2 Catch in numbers at Age (Table 5.8)

Age compositions of landings in 1987 were revised, reducing the catches of the oldest age groups which caused problems in last year's assessment. New data were available for 1988 from the Federal Republic of Germany and Norway, accounting for 99% of the landings. Landings of other countries were assumed to have the same age composition as that of the Federal Republic of Germany. Poor sampling of older age groups is, however, still a problem in the Norwegian data.

5.3 Weight at Age (Table 5.9)

A constant set of weight at age data are used for all years in the period 1960-1979. For subsequent years, annual estimates are used. Data for 1987 were revised and new data were available for 1988. The poor sampling of older groups gives obvious inconsistencies between the years. Weight at age in the stock is assumed to be equal to the weight at age in the catch.

5.4 Age at Maturity

No maturity ogive is available for this stock of saithe. As in the previous assessments, knife-edge maturity at age 6 has been assumed.

5.5 Survey Results

An acoustic survey for saithe in October-November was started in 1985. Indices of abundance of immature saithe are obtained, but the time series of 4 years is still too short to be used in the assessment.

5.6 Recruitment

Recruitment indices are available from 0-group (post larvae) surveys since 1985. So far, only the 1985 and 1986 year classes have recruited to the fishery, but the estimates from the VPA are still unreliable. It is, therefore, too early to make an evaluation of the usefulness of the 0-group indices.

5.7 Fishing Mortalities and VPA

Fishing effort and catch-at-age data (ages 3-9) from the Norwegian purse-seine and trawl fishery were used as input to the ICES VPA tuning program (Table 5.5). Input F s on age groups not included in the tuning were set equal to the 1980-1987 mean. The results are given in Table 5.6. F_{3-8} in 1988 was estimated to be 0.37.

The fishing mortality levels from the tuning were carried forward to the separable VPA and the results of the separable analysis are given in Table 5.7. The resulting fishing mortalities were used as input to the conventional VPA and the results are given

in Tables 5.10 and 5.11 and Figures 5.3A and 5.3B. The VPA shows an increase of 41% in fishing mortality from 1987 to 1988 which corresponds closely to the effort indices. A concentration in effort on the relatively abundant year classes of 1983 and 1984 is indicated. The year classes 1985 and 1986 appear to be poor.

The spawning stock biomass has been at a low level (Figure 5.3B), but an increase is indicated in 1988.

5.8 Predictions of Catch and Biomass

5.8.1 Input variables to the predictions

Input values for the prediction are given in Table 5.12. It is unlikely that the concentration of effort on the year classes 1983 and 1984 will continue in 1989, mainly because they will to a large extent have left the purse seine grounds. The separable pattern (Table 5.7), adjusted to the 1988 level, has, therefore, been used in the prediction. The weights are mean values for 1980-1988, except for the year classes 1983-1986 which have had a slower growth.

The low estimates for the year classes 1985 and 1986 from the VPA were accepted. For more recent year classes, the average for the year classes 1979-1985 of 200 million at age 1 was assumed.

5.8.2 Biological reference points

Yield and SSB per recruit were based on the exploitation pattern in Table 5.12 and mean weights 1980-1988. The calculations give $F_{0.1} = 0.17$ and $F_{max} = 0.28$ (Figure 5.3C). A plot of SSB versus recruitment is shown in Figure 5.2 and from it the following reference points were calculated: $F_{low} = 0.25$, $F_{med} = 0.36$, and $F_{high} = 0.41$. The low level of F_{high} is caused by the fact that low levels of SSB usually have produced small year classes.

5.8.3 Results of the prediction (Table 5.13, Figure 5.3D)

Fishing mortalities will increase to 0.46 in 1989 if the TAC of 120,000 t is taken. Continued fishing mortality at the expected 1989 level will correspond to a catch of 115,000 t in 1990. The increase in spawning stock biomass in 1989 and 1990 from the recent low level is caused mainly by the 1983 and 1984 year classes, but the spawning stock will decline in 1991 when the poor 1985 year class matures.

5.9 Comments to the Assessment

The assessment confirms the belief that last year's assessment was invalid due to inconsistencies in the catch-at-age matrix. Comparisons should, therefore, be made only with the assessments prior to 1988.

6 REDFISH IN SUB-AREAS I AND II

6.1 Status of the Fisheries

6.1.1 Landings prior to 1989 - (Tables 6.1.-6.6, Figure 6.5A)

Total redfish landings in 1982 were 131,749 t, but since then landings declined continuously to 34,596 t in 1987 (Table 6.1). This decline is associated with reduced landings in the USSR fishery, particularly in Division IIa. Provisional figures for 1988 show an increase to 38,039 t. This is caused by an increase in the Norwegian Sebastes marinus fishery and a minor increase in the USSR Sebastes mentella fishery in Division IIa.

The peak level of landings of 5,396 t in 1986 in Sub-area I was exceeded in 1988 when 5,774 t were reported (Table 6.2). Landings in Division IIa declined from 100,163 t in 1983 to 27,730 t in 1987, but show a small increase to 30,485 t in 1988 (Table 6.3). This is accounted for by a similar trend in the USSR landings. Landings in Division IIb have remained at a low level (Table 6.4).

The national landings statistics of redfish reported to ICES by the USSR, the German Democratic Republic, the Federal Republic of Germany, Norway, and Spain distinguish between the species. For the other countries The Working Group has split the landings into Sebastes mentella and Sebastes marinus based on the reporting schemes from the different fleets to the Norwegian fisheries authorities. The total landings of S. mentella have declined progressively from 115,383 t in 1982 to only 10,518 t in 1987, but show a small increase to 14,287 t in 1988 (Table 6.5). Landings of S. marinus increased from 16,366 t in 1982 to 30,199 t in 1986 but fell to about 24,000 t in 1987 and 1988.

The redfish in Sub-area IV is believed to belong to the north-east Arctic stock of S. marinus. The landings from Sub-area IV have been declining from about 2,000 t in 1985 to 1,366 t in 1988 (Table 6.6). These catches are not included in the assessment.

6.1.2 Expected landings in 1989

On the basis of reports of landings in the early part of the year, landings expected for the whole of 1989 are estimated to be 18,000 t and 24,000 t for S. mentella and S. marinus, respectively.

6.1.3 Effort and catch per unit effort

Catch-per-hour-trawling data for the S. mentella fishery were available for two classes of USSR vessels, RT and PST vessels (Table 6.7). In the late 1970s, the fleet of RT vessels was being replaced by the PST vessels (see also Greenland halibut). By 1981, these newer vessels comprised 70% of the USSR fishing effort and by 1985 the PST vessels had almost completely replaced the RT fleet in this fishery. A more limited series of data was available for the German Democratic Republic where factory trawlers now are replacing the earlier freezer trawlers. Esti-

mates of total effort are calculated in USSR units. The catch per unit effort (PST) shows considerable stability.

Data for S. marinus were available for Norwegian stern trawlers from 1981 (Table 6.21) and for a mixed-species fishery of the Federal Republic of Germany from 1986. However, for the German fishery it was impossible to estimate reliably the effort that was directed towards S. marinus. Total international effort was, therefore, estimated only in Norwegian units.

6.2 Catch in Numbers at Age (Table 6.15)

Data for 1987 were revised. New data for 1988 for S. mentella were available for the USSR and the Federal Republic of Germany, corresponding to 55% and 7% of the total landings, respectively. The length distributions of the USSR and the German landings were similar (Figure 6.1A), but the corresponding catch-at-age from these countries were different (Figure 6.1B). There is nearly a systematic difference of about 3 years in the age/length keys which is difficult to explain in other ways than by different procedures for age reading. The Working Group had no independent information that could be used to tell whether the USSR or the Federal Republic of Germany's age readings were correct. However, since the catch in numbers at age in previous S. mentella assessments has been based on the USSR age readings, the Working Group decided to be consistent to use the USSR age distribution from Division IIa on both the Federal Republic of Germany landings and on the landings from other countries.

For S. marinus, age-composition data for 1988 were provided by the Federal Republic of Germany and the USSR, accounting for 2% and 5% of the total landings, respectively. For Norway, accounting for 90% of the total landings, only length composition data were provided. Age reading differences between the USSR and the Federal Republic of Germany also occurred for S. marinus (Figure 6.2). The length composition of the Norwegian landings was similar to the Federal Republic of Germany, but no age/length key was available. Therefore, and also to be consistent with previous assessments, the age composition of the Federal Republic of Germany was adopted for Norway and other countries with no age data. Age readings, using both otoliths and scales, have been conducted in Norway, but the results may be controversial and must be published and discussed before they can be used in the assessments.

6.3 Weight at Age (Table 6.16)

Catch weight-at-age data were available from the USSR for S. mentella for the ages 9-20 in 1988 and 8-19 in 1989. As in previous assessments weight at age in the stock was taken to be the same as the weight at age in the catch.

Weight-at-length data for S. marinus, based on the relationship $W=0.0058L^{3.26}$, were available from the Norwegian landings in 1988. Catch weight-at-age data for ages 9-16 were available from the USSR landings in Subarea I. The Norwegian weight-at-length data were converted to weight-at-age by using the most recent age-length key available, namely the 1987 Federal Republic of

Germany age-length key. However, this produced a large (18%) discrepancy in the SOP check, and the final catch weight-at-age was, therefore, raised according to the ratio SOP/Nominal catch.

6.4 Age at Maturity (Table 6.11)

Maturity-at-age ogives from research vessels, sexes combined, have been made by the USSR for several time periods. An average maturity ogive from USSR research vessels for the years 1966-1972 has in previous assessments been used on all years up to and including 1980. New data from the USSR were made available at this year's Working Group, and based on this new information, the maturity ogives for previous years have also been revised. An average ogive for 1966-1972 has been used for the period 1965-1975. The presented average ogive for 1975-1983 has been used for the years 1976-1983. Then, from 1984 onwards, a smoothed running average of three years has been used.

A maturity ogive was not available for S. marinus, and as in the previous assessments, knife-edge maturity at age 15 was assumed.

6.5 Survey Results

Apart from the USSR survey on the spawning grounds of S. mentella in 1986-1988, there is no directed survey towards the redfish species in the North-East Arctic.

Since 1981, a stratified random bottom trawl survey has been carried out by Norway in February in the Barents Sea. This has been combined with a synoptic acoustic survey. However, reliable comparable results from year to year from these investigations only exist back to 1987, so the time series are too short to tell whether the observed numbers are at a historical low or high level. However, the estimates for S. mentella show an overall stabilizing trend, and an increase in numbers of specimens less than 15 cm is promising. Compared to the results for 1988 the estimates for S. marinus in 1989 increased for nearly all length groups although the level is lower than in 1987.

Since 1981, a stratified random bottom trawl survey has also been carried out by Norway in September in the Svalbard area. In September 1986, Norway and USSR started a joint multispecies trawl/acoustic survey to cover both the Svalbard area and the Barents Sea. The abundance indices of S. mentella in 1988 point to a more stable stock situation after the rapid decrease from the 1984-1985 level. Both surveys confirm this. The present stock situation of S. marinus in this northern part of the species' geographical distribution, had shown a decreasing trend since 1985-1986, but the acoustic survey gives a higher index in 1988 compared to 1987.

In the years 1986-1988 the USSR carried out a trawl/acoustic survey in March-June on the S. mentella spawning grounds near Bear Island. The results indicated a reduction in biomass from 90,000 t in 1986 to 60,000 t in 1987 and 30,000 t in 1988. In 1989 the USSR carried out a similar survey in March which estimated the biomass to be about 111,000 t. However, the surveyed area was in-

creased compared to the previous years, and a greater proportion of immature fish is included in this estimate. However, the results nevertheless indicate an increased abundance of immature fish.

6.6 Recruitment (Tables 6.8-6.10)

From the data of the international 0-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 are generally low in 1965-1972, average in 1973-1978, and high in 1979-1989. However, the survey does not distinguish between the species of redfish.

There are large discrepancies between the international 0-group fish survey data (Table 6.8) and the data from the USSR survey on the 1+ - 6+ group of S. mentella (Table 6.9). 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 age 2+ - 5+ is caused by large by-catches in the shrimp and capelin fisheries, and predation on juvenile redfish (mainly S. mentella) by the cod stock also contributes to the mortality (Mehl, 1987; Yaraguina, USSR, pers. comm.).

Since S. mentella do not fully recruit to the fishery until about age 12-13, the VPA will not give complete values for the younger part of the stock in the most recent years. Therefore, independent information about the recruitment is needed. The data on S. mentella from the USSR survey (Table 6.9) were used as input to the recruitment program RCRTINX2. The results are given in Table 6.10. There are some inconsistencies in the USSR survey data, e.g., the strength of the same year class may differ rather considerably from survey to survey. There is no clear correlation between survey results and VPA, and for some surveys, data are missing. The Working Group agreed that the RCRTINX2 program gave too high values for the recruitment. The USSR presented data on the recruitment (at age 6) of the year classes 1980-1986 (Table 6.10) which were calculated from population fecundity (Serebrjakov, 1984). Although the strong 1982 year class comes out less than it probably should, the overall recruitment level showed a better fit to the survey data, and were, therefore, adopted as the values to be used for the recruitment at age 6 in 1986-1988. The recruitment at age 6 of the 1978 and 1979 year classes was set at the same low level as the 1976 and 1977 year classes.

6.7 Assessment of *Sebastes mentella*

6.7.1 Fishing mortalities - VPA) Tables 6.12-6.13, Figures 6.5A-6.5B)

USSR effort and catch data (Table 6.12) were used as input to the tuning method. The results from the tuning method are shown in Table 6.13. A separable VPA was then run with Fs adjusted to the tuning level. A plot was made of average fishing mortality (ages 10-15) against total international effort in USSR PST units (Fig-

ure 6.3). The points for the years 1984-1988 appear to lie near a regression line different from that indicated for years prior to 1983, with the point for 1983 in an intermediate position. This shift is considered to be related to a mesh decrease introduced in 1983, with 1983 as a transitional year between the two regimes. The bulk of the catches in recent years is made up of 10-15-year-old fish, and the trend in the biomass of ages 10-15 corresponded reasonably well with the CPUE values in Table 6.7. A conventional VPA was made using the terminal populations from the separable VPA to initiate the calculation. Table 6.17 gives the final estimates of fishing mortality, and the corresponding estimates of stock numbers and biomass are given in Table 6.18.

6.7.2 Projection of stock biomass and catch

Input data used in the catch predictions are shown in Table 6.19. Population numbers in 1989 are those calculated by VPA for age groups 7 and older. For the 1978 and later year classes the strength at age 6 has been set equal to the USSR values in Table 6.10. Since the F_s for ages 6-10 were adjusted to get this recruitment, the input F_s for these ages in the prediction were taken from the separable exploitation pattern. For the older ages, the F_s for 1988 were taken as input. The maturity ogive is the 1988-1989 average calculated from Table 6.11. Weight at age in the catch has been set equal to the weight at age in the USSR catches in the first half of 1989. Weight at age in the stock has been set equal to the average weight at age from the 1988 and 1989 catches.

Yield- and spawning stock biomass-per-recruit curves were calculated using the above data (Figure 6.5C), $F_{0.1}$ and F_{max} were estimated to be 0.08 and 0.18, respectively, and $F_{89} = F_{max}$ provided that the expected catch for 1989 is correct. The stock-recruitment plot (Figure 6.4) was used to estimate $F_{high} = 0.55$, $F_{med} = 0.16$, and $F_{low} = 0.04$.

Results of the catch predictions are given in Table 6.20 and Figure 6.5D. To take the expected catch of 18,000 t in 1989 will result in an increase of fishing mortality of 10% compared with 1988. Catch predictions for 1990 have been made for the biological reference points and for fishing mortality being maintained at both the 1988 and 1989 level. At the 1989 level, 18,000 t is also expected to be landed in 1990.

6.8 Assessment of *Sebastes marinus*

Inspection of the catch-at-age matrix for this stock (Table 6.22) suggests that there are some problems with the age determination for this species (see Section 6.2).

Trawl effort and corresponding catch-at-age data exist for Norwegian trawlers for 1986-1988. This time series was considered too short by the Working Group and the tuning method gave unrealistic stock estimates.

At last year's Working Group meeting, trial separable VPAs were made, and based on information from these runs, a separable VPA

was made this year with an input terminal F of 0.14 on age 18 and a terminal S of 1.0. Only the three most recent years were given full weight, and automatic weighting was used on the ages (Table 6.23). The terminal population was used to initiate a conventional VPA (Tables 6.24 and 6.25). A plot of average F (ages 15-21) vs estimates of total fishing effort (Figure 6.6) gave a reasonable relationship for the years 1982-1985 and 1987, whereas the points for 1986 and 1988 (preliminary) did not fit so well. The time series with consistent data was considered too short to be reliable, and the Working Group concluded that no meaningful assessment could be made. However, the consistency seems to be improving and an assessment might be attempted next year when an additional year for the tuning also will be available.

A SHOT forecast for this stock is given in Table 6.26. The results indicate that catches in the short term are likely to remain at the 1988 level, i.e., 23,000 t, if the present level of exploitation is maintained. This result is dependent on recruitment being maintained at an average level.

7 GREENLAND HALIBUT IN SUB-AREAS I AND II

7.1 Status of Fisheries

7.1.1 Landings prior to 1989 (Tables 7.1-7.4, Figure 7.2A)

Nominal catches by country for Sub-areas I and II combined are presented in Table 7.1. The nominal catches by country for Sub-area I and Divisions IIa and IIb separately are shown in Tables 7.2 - 7.4. The total catch in 1988 was 19,312 t, which is about the same as predicted during the 1988 Working Group meeting and is also similar to that reported for 1987. Catches in Division IIa were about the same as those reported in recent years and continued to account for at least half the total catch. The catch in Sub-area I in 1988, however, was considerably higher than in previous years whereas the catch in Division IIb in 1988 was lower.

7.1.2 Expected landings in 1989

Based upon reported catches for the first half of the year, it is estimated that the 1989 total catch should be in the vicinity of 14,000 t. The reduction is expected to be mainly in the Norwegian fishery.

7.1.3 Effort and catch per unit effort

Catch-per-unit-effort data were available for two classes (RT and PST) of USSR vessels and for Norwegian fresh-fish trawlers (Table 7.5). Until 1977, the USSR fishery was conducted almost entirely by RT vessels which are side trawlers with 800-1000 horsepower (HP). In the late 1970s, this fleet of vessels was being replaced by the PST vessels which are stern trawlers with up to 2000 HP. By 1981, these newer vessels comprised 70% of the USSR fishing effort and by 1986 the PST vessels had almost completely replaced the RT fleet in this fishery.

In recognizing that this newer vessel class was the major component of the USSR fishery in more recent years and will continue to be, it was agreed that the CPUE series from this vessel class only was most representative of catch rates within the USSR fishery.

In order to obtain an index of total annual trawling effort the average of the annual Norwegian (250-500 GRT stern trawlers) and USSR (PST vessels) catch rates was calculated and applied to the total annual landings. The catch rates indicate that the stock size has been relatively stable, particularly in the 1980s although the 1988 catch rate suggests a possible downturn in the resource.

7.2 Catch in Numbers at Age (Table 7.11)

The catch-at-age data for 1987 were updated by adjusting the age composition used in the previous assessment to the final catch statistics for that year. Catch-at-age data for 1988 were available for the USSR, German Democratic Republic, and Norwegian fisheries and were combined along with catch by other countries adjusted by the combined age composition. Little or no sampling information was available, however, for most age compositions to allow a full evaluation of the representativeness of the age samples to overall national fisheries. Age-length keys from the Norwegian fishery in 1988 indicated that age compositions from certain components were often based on low levels of sampling.

7.3 Weight at Age (Table 7.12)

The mean weight at age from the 1988 fishery was calculated using an average of the USSR, German Democratic Republic, and Norwegian sample weights at age weighted by the numbers caught at age by each individual country. As in previous years, the weights at age in the stock were assumed to be similar to those in the catch.

7.4 Age at Maturity (Table 7.10)

USSR maturity ogives for 1983-1987 were relatively stable and there were no maturity data for 1988. Therefore the spawning stock biomasses for 1983-1988 were calculated by application of an average maturity ogive derived from USSR data for the period 1983-1987. The same ogive was applied to the period 1970-1980 for which knife-edge maturity at age 9 had previously been applied, and also to 1981-1982 where the available ogives were quite variable. For the period 1970-1980, this gave a considerable rise of the spawning stock biomass levels.

7.5 Survey Results

Stratified random bottom trawl surveys have been conducted annually in both the Svalbard and Barents Sea area since 1981. While the surveys cover the main nursery area of Greenland halibut they do not cover the whole distribution of the stock. Also,

the Svalbard surveys do not fish beyond depths of 600 m which likely include a significant proportion of adult fish biomass. Nevertheless, abundance indices of both the total stock size and of fish less than 20 cm in length are presented in Table 7.6. The total stock index from the survey would suggest that the abundance in 1986-1987 is about half the level estimated in 1984-1985 whereas the 1988 estimate is about the 1984-1985 level. Fluctuations of this magnitude clearly are not indicators of stock size and may well be an artifact of incomplete survey coverage and migration.

7.6 Recruitment

Fish of lengths less than 20 cm in the survey include 1 and 2-year-old fish. Although the proportion of 2-year-old fish less than 20 cm may vary from year to year, the survey indices of these fish given in Table 7.6 may be of value in providing an index of pre-recruit year classes. However, until the reliability of these survey data can be established, average recruitment (1978-1987) has been assumed for the catch predictions.

7.7 Assessment

7.7.1 Estimation of fishing mortality

Trawl effort data and the corresponding catch-at-age data were available for Norwegian and USSR trawlers for the years 1979-1987. The data (Table 7.7) for the Norwegian fleet for age groups 6-10 and for the USSR fleet for age groups 5-10 were used in the VPA tuning module, and the results are given in Table 7.8. A separable VPA was then run with the input terminal F value for age 8 adjusted so that the average F (ages 5-10) for 1988 from the analysis was equal to the average F for that year as indicated by the tuning. The matrix of residuals from the separable VPA is given in Table 7.9. Finally a conventional VPA was run using the 1988 population numbers from the separable VPA to initiate the calculation (Tables 7.13 and 7.14).

7.7.2 State of the stock

The results of VPA show that fishing mortality (ages 7-11) was relatively high in 1978 when it was 0.43 (Table 7.13, Figure 7.2A). It subsequently fell to about 0.20 for three years before increasing to about 0.37 in 1983-1987. The value estimated for 1988 is 0.39. From 1981 to 1986, the spawning stock has been stable at about 60,000 t (Table 7.14, Figure 7.2B). However, from 1983, we observe a decreasing trend in both total and spawning stock, which is opposite to the slightly increasing trend observed during the 1988 Working Group meeting. This reduction is consistent with the rather severe decline (25%) in the combined USSR and Norwegian CPUE in 1988 (Table 7.5). One should, however, bear in mind that some of the 1988 data are preliminary.

7.8 Catch Predictions

Input data used in the catch predictions are shown in Table 7.15. Population numbers in 1989 are those calculated by VPA for age groups 6 and older. For the 1984 and later year classes the strength at age 3 has been set equal to the average for the years 1978-1987. The exploitation pattern used is that for 1988 from the VPA (Table 7.13). However, for the age groups 3-5 in 1988 average recruitment was assumed, and the Fs in the prediction were taken from the separable exploitation pattern (Table 7.9). Based on information from the fishery for the first half of 1989, the expected reduction in total catch for 1989 is expected to take place in both the trawl and gill-net/long-line fishery, and large changes in the exploitation pattern are, therefore, not expected. The maturity ogive is the 1983-1987 average which have been used for all years in the VPA. Weight at age in both the catch and the stock has been set equal to the weight at age in the catch averaged for the years 1987 and 1988.

Yield- and spawning stock biomass-per-recruit have been calculated using the above data, and the results have been plotted in Figure 7.2C. The values of $F_{0.1}$ and F_{max} are 0.13 and 0.25, respectively. Using the stock-recruitment plot in Figure 7.1 the values of F_{med} and F_{high} have been evaluated as 0.27 (equals F_{89} provided that the expected catch for 1989 is correct) and 0.38 (close to F_{88}), respectively.

Results of the catch predictions are given in Table 7.16 and Figure 7.2D. To take the expected catch of 14,000 t in 1989 will result in a reduction of fishing mortality of 30% compared with 1988. Catch predictions for 1990 have been made for the biological reference points and for fishing mortality being maintained at both the 1988 and 1989 level. At the 1989 level, 15,000 t is expected to be landed in 1990.

8 RECOMMENDATIONS

- 1) It has been accepted by ICES that the catches of Norwegian coastal cod not be included in the assessment of North-East Arctic cod. The USSR Murman cod has so far been included in the assessment, but it has now become urgent to clarify the status of both these cod categories in relation to the assessment of North-East Arctic cod. This cannot be done in an ordinary Working Group meeting. The Arctic Fisheries Working Group, therefore, recommends that ICES takes the initiative to ensure that this problem is solved in good time before the next Working Group meeting.

- 2) Differences in the age-reading results between the countries fishing for redfish create severe inconsistencies in the catch-at-age matrix. To improve the reliability of the assessment, it is necessary to harmonize the age readings. The Arctic Fisheries Working Group, therefore, recommends that ICES arranges a Work-shop on Age Reading of Redfish. The Working Group realizes that this will be only the first step in a long process, but nevertheless wants to stress the urgency for all the involved countries to participate in such a Workshop.

9 REFERENCES

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Table 3.1 North-East Arctic COD.
Total nominal catch (t) by fishing areas.

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	157,631	202,688	69,794	430,113
1987	146,106	245,387	131,578	523,071
1988 ¹	123,303 ²	199,346	68,894	391,543

¹ Provisional figures.

² 40,000 t USSR Murman cod not included.

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		Others
	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	109.5	48.1	116.3	86.4	69.8	-	-
1987	126.3	19.8	167.9	77.5	129.9	1.7	-
1988 ¹	107.4 ²	17.5	119.8	88.9	57.7	-	-

¹ Provisional.

² 40,000 t USSR Murman cod not included.

Table 3.3 North-East Arctic COD.
Nominal catch (t) by countries (Sub-area I and Divisions IIA and IIB combined).

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	18,667	591	1,543	10,092	232,096	5,497	7,581	150,541	3,505	430,113
1987	15,036	1	986	7,035	268,004	16,223	10,957	202,314	2,515	523,071
1988 ¹	14,478	360	584	2,803	222,844	10,905	8,107	129,600 ²	1,862	391,543

¹ Provisional figures.

² 40,000 t USSR Murman cod not included.

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	0.86	1.94	0.106	0.77	1.19	0.028	3.4
1975	1.82	0.077	0.94	1.67	0.100	0.43	1.36	0.033	3.4
1976	1.69	0.060	0.84	1.20	0.081	0.30	1.69	0.035	3.8
1977	1.54	0.052	0.63	0.91	0.056	0.25	1.16	0.044	5.0
1978	1.37	0.062	0.52	0.56	0.044	0.08	1.12	0.037	7.1
1979	0.85	0.046	0.43	0.62	-	0.06	1.06	0.042	6.4
1980	1.47	-	0.49	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	1.86	-	1.04	1.51	1.37	0.50	0.90	0.39	5.1
1986	1.97	-	1.00	2.39	1.73	0.84	1.36	1.14	4.1
1987	1.77	-	0.97	2.00	1.61	1.05	1.73	0.67	3.3
1988 ¹	1.69	-	0.66	1.56	1.36	0.54	0.99	0.55	-

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 hr fishing.⁵ Norwegian data - t per gillnet boat week in Lofoten.⁶ Spanish data - t per hr fishing.

Period	Sub-area I	Divisions IIA and IIB
1960-1973	RT	RT
1974-1980	PST	RT
1981-	PST	PST

Vessel type:

RT = side trawlers, 800-1000 HP.

PST = stern trawlers, up to 2000 Hp.

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
1988	136.4	202.0	237.7
1989	161.1	285.8	153.1

Table 3.6 North-East Arctic COD.
Weights (kg) in Norwegian and USSR landings.

Age	1984		1985		1986		1987		1988	
	Norway	USSR	Norway	USSR	Norway	USSR	Norway	USSR	Norway	USSR
2	1.16	0.22	0.76	0.29	(1.20)	0.22	0.56	0.24	0.53	0.11
3	1.47	0.76	1.47	0.77	1.24	0.63	0.92	0.41	0.57	0.48
4	1.97	1.30	1.90	1.23	1.94	1.15	1.45	0.92	0.84	0.82
5	2.53	2.04	2.49	1.75	2.53	1.75	2.24	1.51	1.37	1.33
6	3.13	2.90	3.32	2.64	3.36	2.44	3.04	2.14	2.38	2.07
7	3.82	4.12	4.21	3.93	4.54	4.09	4.17	2.95	3.76	3.04
8	4.81	5.56	5.01	5.35	5.60	6.19	5.33	5.62	5.84	4.93
9	5.95	8.76	5.94	6.72	5.94	8.15	6.62	7.13	7.62	7.08
10	7.19	13.55	7.10	9.87	6.73	10.31	6.99	11.17	8.64	9.68
11	7.85	14.95	8.20	9.00	8.20	11.73	8.33	10.90	11.24	-
12	8.46	14.85	8.92	13.72	8.76	17.29	8.58	12.29	11.66	17.50
13	7.99	19.52	9.73	15.10	9.94	-	9.58	-	14.23	22.10
14	9.78	19.31	9.85	15.30	7.80	27.30	8.27	-	-	-
15+	10.64	22.37	9.26	19.25	8.23	-	10.67	-	-	-

Table 3.8 Recruitment analysis for North-East Arctic Cod.

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 33 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 = 1984

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	.6931	.900	4.604	.5019	14	5.2279	.73731	.78068	.01756
R-2B-1	.6931	1.088	4.403	.5412	14	5.1569	.68146	.72535	.02034
R-1-2	1.0986	.686	4.624	.7451	14	5.3769	.43290	.45716	.05121
R-2B-2	2.1972	1.114	4.424	.4796	14	6.8713	.77091	.84172	.01510
R-1-3	2.0794	.552	4.591	.7879	27	5.7398	.38745	.40340	.06576
R-2B-3	2.7726	1.086	3.724	.3849	27	6.7344	.94394	1.00731	.01055
INTOGP	.9361	3.038	4.557	.4986	18	7.4005	.74860	.85422	.01467
N-BST1	2.1163	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	4.5433	.423	4.487	.6322	5	6.4093	.57498	.67009	.02383
N-BST3	4.5726	.466	3.932	.9732	6	6.0607	.12042	.13451	.59147
N-SVT1	3.3322	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT2	3.9338	.705	3.612	.4487	5	6.3859	.83554	.95443	.01175
N-SVT3	4.2195	.676	3.536	.5109	6	6.3876	.70996	.81041	.01629
N-BSA1	4.2485	.444	4.045	.3319	6	5.9291	1.04217	1.14293	.00819
N-BSA2	6.3613	.447	3.656	.5166	8	6.5009	.69010	.77236	.01794
N-BSA3	4.8442	.474	3.298	.8364	9	5.5944	.28871	.30607	.11424
MEAN						5.8310	.71218	.71218	.02110

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	1.3863	.919	4.593	.4833	14	5.8676	.75701	.79189	.01674
R-2B-1	2.3979	1.129	4.355	.5238	14	7.0618	.69813	.78864	.01687
R-1-2	1.0986	.692	4.620	.7342	14	5.3805	.44048	.46614	.04830
R-2B-2	1.3863	1.144	4.386	.4626	14	5.9712	.78908	.82644	.01537
R-1-3	1.6094	.540	4.618	.8011	27	5.4868	.36778	.38693	.07010
R-2B-3	1.9459	1.103	3.662	.3732	27	5.8082	.95665	.99892	.01052
INTOGP	1.2413	3.013	4.548	.5042	18	8.2882	.73207	.95978	.01139
N-BST1	4.4248	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	4.5031	.422	4.491	.6335	5	6.3910	.57493	.66829	.02350
N-BST3	4.2556	.465	3.932	.9734	6	5.9130	.12041	.13203	.60203
N-SVT1	1.5041	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT2	3.3032	.701	3.625	.4518	5	5.9413	.83272	.91658	.01249
N-SVT3	2.8094	.673	3.545	.5123	6	5.4361	.71115	.77372	.01753
N-BSA1	6.4394	.438	4.071	.3374	6	6.8906	1.04440	1.27752	.00643
N-BSA2	3.8712	.446	3.668	.5157	8	5.3951	.69415	.74503	.01891
N-BSA3	4.3820	.472	3.308	.8385	9	5.3754	.28882	.31108	.10845
MEAN						5.8059	.70060	.70060	.02138

Table 3.8 (cont'd)

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	.6931	.949	4.575	.4604	14	5.2329	.78427	.83468	.01582
R-2B-1	1.0986	1.174	4.302	.5059	14	5.5911	.71582	.75243	.01947
R-1-2	.6931	.702	4.614	.7210	14	5.1007	.45062	.48908	.04608
R-2B-2	.6931	1.174	4.345	.4454	14	5.1589	.80836	.86335	.01479
R-1-3	1.0986	.528	4.645	.8148	27	5.2246	.34788	.37423	.07871
R-2B-3	1.7918	1.113	3.611	.3646	27	5.6059	.96330	1.01114	.01078
INT06P	.8629	2.977	4.546	.5102	18	7.1148	.71505	.81891	.01644
N-BST1	1.7047	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	2.9285	.420	4.496	.6354	5	5.7272	.57552	.63242	.02756
N-BST3	2.9392	.465	3.933	.9737	6	5.3003	.12050	.13420	.61208
N-SVT1	1.4586	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT2	1.2809	.696	3.643	.4562	5	4.5342	.82961	1.05067	.00960
N-SVT3									
N-BSA1	.6931	.430	4.104	.3450	6	4.4027	1.04721	1.24469	.00711
N-BSA2	3.1781	.445	3.682	.5152	8	5.0960	.69914	.76933	.01862
N-BSA3	3.4657	.469	3.320	.8412	9	4.9460	.28913	.33251	.09946
MEAN						5.7774	.68833	.68833	.02327

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	.6931	.993	4.547	.4329	14	5.2356	.82192	.87824	.07954
R-2B-1	.6931	1.218	4.248	.4897	14	5.0918	.73299	.79227	.07774
R-1-2	.6931	.716	4.605	.7054	14	5.1009	.46400	.50641	.23923
R-2B-2	.6931	1.201	4.306	.4299	14	5.1384	.82700	.83853	.07771
R-1-3									
R-2B-3									
INT06P	.1570	2.931	4.552	.5147	18	5.0117	.70108	.76346	.10525
N-BST1	.5306	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2	1.6292	.419	4.502	.6380	5	5.1840	.57729	.67199	.13566
N-BST3									
N-SVT1	.1823	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-SVT2									
N-SVT3									
N-BSA1	.6931	.421	4.146	.3550	6	4.4374	1.05175	1.25726	.03881
N-BSA2	2.3026	.443	3.701	.5155	8	4.7205	.70536	.81854	.09156
N-BSA3									
MEAN						5.7481	.67588	.67583	.13430

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-1-1	.6931	1.059	4.505	.4017	14	5.2385	.87320	.94804	.16916
R-2B-1	.6931	1.251	4.202	.4787	14	5.0699	.74655	.81411	.22458
R-1-2									
R-2B-2									
R-1-3									
R-2B-3									
INT06P	.2852	2.883	4.562	.5157	18	5.3844	.69523	.74313	.26953
N-BST1	.7419	.000	.000	.0000	0	.0000	.00000	.00000	.00000
N-BST2									
N-BST3									
N-SVT1									
N-SVT2									
N-SVT3									
N-BSA1									
N-BSA2									
N-BSA3									
MEAN						5.7227	.66486	.66486	.33672

Table 3.8 (cont'd)

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare No.	Predicted Value	Sigma	Standard Error	Weight
R-1-1								
R-2B-1								
R-1-2								
R-2B-2								
R-1-3								
R-2B-3								
INTOGP	.3221	2.836	4.576	.5133 18	5.4898	.70132	.75198	.43414
N-BST1								
N-BST2								
N-BST3								
N-SVT1								
N-SVT2								
N-SVT3								
N-BSA1								
N-BSA2								
N-BSA3								
MEAN					5.7055	.65867	.65867	.56586

Yearclass	Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1965	5.80	330.37	.28	.41	5.14 171.00 1.47
1966	5.61	273.39	.28	.28	4.73 113.00 .98
1967	5.19	178.96	.36	.36	5.29 198.00 .99
1968	5.77	319.99	.32	.37	6.01 406.00 1.13
1969	6.31	551.83	.32	.16	6.92 1017.00 .49
1970	7.74	2307.31	.39	.56	7.51 1820.00 1.42
1971	7.12	1242.15	.33	.23	6.26 525.00 .69
1972	6.92	1016.85	.37	.34	6.43 623.00 .91
1973	6.75	852.22	.38	.48	6.42 615.00 1.26
1974	5.66	286.11	.38	.23	5.86 349.00 .61
1975	6.30	543.55	.18	.28	6.46 641.00 1.58
1976	5.66	286.43	.22	.15	5.30 200.00 .66
1977	5.55	257.22	.22	.13	4.95 141.00 .58
1978	5.35	210.84	.25	.17	5.08 160.00 .69
1979	5.33	206.44	.24	.20	5.07 159.00 .81
1980	4.99	146.93	.21	.18	5.13 169.00 .88
1981	5.30	200.33	.19	.11	5.93 378.00 .62
1982	6.17	479.15	.21	.19	6.06 429.00 .90
1983	6.64	765.33	.15	.18	6.60 734.00 1.20
1984	5.98	394.16	.10	.10	.93
1985	5.84	344.48	.10	.11	1.04
1986	5.29	198.49	.10	.09	.81
1987	5.14	171.04	.25	.11	.42
1988	5.40	222.08	.39	.15	.38
1989	5.61	273.65	.50	.11	.22

Table 3.9 North-East Arctic COD.
Results from the Norwegian Bottom trawl survey in the Barents Sea in January-March. Index of number of fish at each age.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10	
1981	0.7	11.0	8.6	16.9	34.1	37.9	4.8	1.0	0.3		115.3
1982	0.1	0.9	16.1	20.4	21.4	16.0	15.8	1.4	0.2		92.3
1983	44.6	5.9	10.8	28.0	31.9	14.3	4.7	3.0	0.6		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	+		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	+	+	473.7
1988	0.7	17.7	69.5	52.8	143.0	17.9	3.6	0.6	0.1	-	305.9
1989	1.1	4.1	17.9	38.7	24.5	66.7	8.1	0.6	0.1	0.1	161.9

Table 3.10 North-East Arctic COD.
Results from the Norwegian Bottom trawl survey in the Svalbard Area in September-October. Index of number of fish at each age.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10	
1981	0.1	22.2	9.0	5.5	1.6	6.1	3.8	0.7	0.4	0.4	49.8
1982	1.5	4.0	22.3	9.6	2.8	1.9	2.9	0.4	0.1	0.1	45.6
1983	14.6	5.1	6.2	9.5	3.0	2.5	1.3	1.6	0.4	0.2	44.4
1984	52.2	42.7	5.6	4.2	5.3	2.2	0.5	0.5			113.8
1985	27.0	131.1	74.3	27.9	6.5	7.7	1.4	1.4	0.1		279.7
1986	3.5	50.1	164.0	44.0	18.1	3.2	1.3	0.3	0.1	-	285.0
1987	3.3	26.2	67.0	94.7	18.1	6.5	0.6	0.1	0.1	-	215.0
1988	0.2	2.6	15.6	12.8	36.0	11.2	0.8	0.8	0.8	0.2	90.9

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

Year	Age									Older	Total	
	0	1	2	3	4	5	6	7	8			9
<u>Sub-area I</u>												
1982	1.4	0.2	6.9	13.2	7.4						5.1	34.2
1983	4.3	8.0	5.1	4.6	5.4	5.9					4.7	38.0
1984	0.7	12.3	11.6	25.5	13.7	6.5	4.0				2.5	76.8
1985	3.3	2.9	51.3	35.2	53.1	25.2	4.4	1.8			1.0	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
1987	+	0.1	3.6	4.0	35.9	6.3	3.6	0.6	0.1	0.1	+	54.4
1988	0.2	0.1	1.7	5.7	5.2	17.2	2.6	0.6	0.2	0.1	+	33.4
<u>Sub-area IIA</u>												
1982	0.1	+	11.7	10.6	4.7						7.9	35.0
1983	0.7	0.4	0.3	1.5	6.4	5.0					4.9	19.2
1984	0.4	0.7	0.6	3.7	4.0	6.7	4.7				1.7	22.5
1985	0.2	0.2	1.4	3.7	9.5	12.6	6.4	2.5			0.8	37.6
1986	-	+	0.1	2.5	2.9	3.2	1.5	0.5	0.4		0.2	11.3
1987	-	-			3.0	1.7	2.3	0.9	0.1	-	0.1	8.1
1988	0.2	+	0.1	0.2	1.2	10.0	2.4	0.7	0.2	0.1	+	15.1
<u>Sub-area IIB</u>												
1982	9.9	1.7	42.5	17.8	1.1						2.2	75.2
1983	9.7	14.9	5.0	9.4	11.0	2.6					2.4	55.0
1984	1.4	7.7	22.7	7.4	2.7	2.4	1.3				0.8	46.4
1985	9.1	9.4	45.2	32.3	32.8	11.5	5.3	1.8			0.4	147.8
1986	1.6	2.9	14.8	67.2	19.9	16.4	5.4	1.3	0.6		0.1	127.1
1987	-	0.2	5.6	11.0	64.4	4.0	2.2	0.5	0.1	-	-	88.0
1988	0.1	0.4	4.8	13.7	15.1	25.0	2.5	0.6	0.1	0.2	-	62.8
<u>Total (Sub-areas I + IIA + IIB)</u>												
1982	3.7	0.6	18.1	14.1	5.1						4.7	46.3
1983	5.4	8.9	4.3	5.6	7.3	4.7					4.0	40.2
1984	0.9	9.2	14.2	16.2	8.6	5.0	3.1				1.9	59.1
1985	5.0	4.9	43.0	30.3	40.5	18.8	4.9	1.9			0.6	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
1987	-	0.2	4.0	5.9	42.6	5.4	3.1	0.6	0.1	+	-	61.9
1988	0.1	0.2	2.5	7.7	7.8	19.0	2.5	0.6	0.1	0.2	-	40.8

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

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10	
1981	3	73	58	124	243	270	41	8	3	4	827
1982	1	4	71	86	93	73	74	5	1	-	408
1983	-	15	17	45	65	38	17	10	2	1	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	625	578	1,246	424	225	27	9	-	-	-	3,136
1987	1	47	126	500	128	37	4	3	-	-	852
1988	1	23	79	74	179	26	6	+	+	-	389
1989	-	9	31	77	56	145	21	3	+	+	346

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

Year	Age											Total	
	0	1	2	3	4	5	6	7	8	9	Older		
1985 ¹	45	105	895	422	255	83	44	50				39	1,939
1986 ¹	60	53	141	980	444	183	56	62	19			2	2,000
1987	8	15	170	170	738	99	67	42	20	9		5	1,344
1988	+	+	43	161	106	245	34	10	2	+		+	602

¹ November-December.

Table 3.14 North-East Arctic COD.
Results from the Norwegian acoustic survey in the
Barents Sea and the Svalbard Region September-October.
Stock numbers in millions.

Year	Age									Total
	1	2	3	4	5	6	7	8	9	
<u>Sub-area I and Division IIa¹</u>										
1986	42	96	290	99	45	12	1	-	-	587
1987	2	49	42	302	90	26	3	+	-	516
1988	5	4	23	14	43	15	9	+	+	114
<u>Division IIb</u>										
1986	10	68	125	42	19	5	12	-	-	281
1987	13	98	329	413	87	33	2	+	-	971
1988	+	16	22	24	50	18	6	+	+	138
<u>Total</u>										
1986	52	164	415	141	64	17	13	-	-	868
1987	15	147	371	715	177	59	5	+	-	1,487
1988	5	20	45	38	93	33	15	+	+	252

¹Northern part.

Table 3.15 North-East Arctic COD.
Length (cm) at age from the Norwegian surveys in January-February 1979-1989.

Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	-	-	-	-	-	-	-	-	14.5	14.7	12.7
2	-	-	-	-	-	-	-	-	21.0	22.5	25.7
3	33.1	34.2	35.5	37.6	34.8	35.8	40.3	34.4	31.8	29.7	34.7
4	40.0	40.5	44.7	46.3	46.8	49.2	50.8	50.4	41.1	37.0	40.6
5	53.3	52.5	52.0	54.7	56.0	57.9	62.2	60.0	55.7	46.4	47.5
6	64.4	63.5	61.3	63.1	64.5	67.4	71.1	70.2	67.2	58.0	57.1
7	74.7	73.6	69.6	70.8	73.3	79.6	81.8	82.3	81.8	70.1	68.5
8	83.0	83.6	77.9	82.9	80.4	82.2	88.7	95.2	94.5	81.1	84.0

Table 3.16 North-East Arctic COD.
Length at age (cm) from USSR surveys
in November-December 1984-1988.

Age	1984	1985	1986	1987	1988
0+	15.7	15.0	15.2	-	11.3
1+	22.3	21.1	19.7	19.2	21.3
2+	30.7	30.6	28.3	27.9	28.7
3+	44.3	43.2	39.0	33.4	36.2
4+	51.7	53.7	51.8	41.4	43.9
5+	63.6	61.2	62.2	59.1	53.3
6+	73.4	72.8	70.9	69.2	65.3
7+	82.5	83.0	83.0	80.1	79.5

Table 3.17 North-East Arctic COD.
Weight (g) at age from Norwegian surveys
in January-February 1985-1989.

Age	1985	1986	1987	1988	1989
1	-	-	21	20	10
2	-	-	65	80	150
3	670	390	230	203	380
4	1,070	1,090	490	410	590
5	2,230	1,850	1,380	793	930
6	3,650	3,110	2,300	1,473	1,570
7	4,920	4,320	3,970	2,706	2,640
8	5,060	5,500	-	4,613	4,940

Table 3.18 North-East Arctic COD.
Weight (g) at age from USSR surveys in
November-December 1984-1988.

Age	1984	1985	1986	1987	1988
0+	26	26	25	-	15
1+	90	80	63	54	78
2+	250	245	191	182	223
3+	746	762	506	316	435
4+	1,187	1,296	1,117	612	789
5+	2,234	1,924	1,940	1,691	1,373
6+	3,422	3,346	2,949	2,688	2,609
7+	5,027	5,094	4,942	3,959	4,465

Table 3.19 North-East Arctic COD.
Basis for maturity ogives used in the assessment.

Age	Percentage mature									
	1984		1985		1986		1987		1988	1989
	Norway	USSR	Norway	USSR	Norway	USSR	Norway	USSR	USSR	USSR
3	-	-	-	-	1	-	5	-	-	-
4	1	5	+	1	11	2	12	1	1	-
5	18	18	13	10	16	9	21	9	3	2
6	32	31	63	33	18	19	47	23	25	15
7	69	56	96	59	67	56	72	27	53	39
8	100	90	100	85	100	76	91	61	79	59
9	100	99	100	92	100	89	74	81	100	83
10	100	100	100	100	100	100	100	80	100	100

Table 3.20 North-East Arctic Cod. Tuning Data.

NORTHEAST ARCTIC COD : SURVEY DATA

105.0											
Norway Barents Trawlsurvey											
82.0	89.0										
1.0	1.0										
3.0	9.0										
1.0	16.1	20.4	21.4	16.0	15.8	1.4	0.2				
1.0	10.8	28.0	31.9	14.3	4.7	3.0	0.6				
1.0	60.2	19.2	15.6	9.4	3.0	0.4	0.2				
1.0	90.3	78.1	15.7	6.3	2.5	0.2	0.1				
1.0	356.0	119.0	62.6	8.3	2.1	0.3	0.1				
1.0	95.8	229.0	43.0	11.4	1.3	0.4	0.1				
1.0	69.5	52.8	143.0	17.9	3.6	0.6	0.1				
1.0	17.9	38.7	24.5	66.7	8.1	0.6	0.1				
Norway Barents Acousticsurvey											
82.0	89.0										
1.0	1.0										
3.0	9.0										
1.0	71.0	86.0	93.0	73.0	74.0	5.0	1.0				
1.0	17.0	45.0	65.0	38.0	17.0	10.0	2.0				
1.0	174.0	80.0	63.0	46.0	16.0	1.0	0.5				
1.0	550.0	510.0	109.0	48.0	20.0	2.0	1.0				
1.0	1246.0	424.0	225.0	27.0	9.0	0.5	0.5				
1.0	126.0	506.0	128.0	37.0	4.0	3.0	0.5				
1.0	79.0	74.0	179.0	26.0	6.0	0.5	0.5				
1.0	31.0	77.0	56.0	145.0	21.0	3.0	0.5				
USSR Trawl/Acousticsurvey											
83.0	89.0										
1.0	1.0										
3.0	10.0										
1.0	18.1	14.1	5.1	1.3	3.6	0.7	0.2	0.1			
1.0	4.3	5.6	7.3	4.7	2.0	0.8	1.1	0.1			
1.0	14.2	16.2	8.6	5.0	3.1	1.1	0.4	0.3			
1.0	43.0	30.3	40.5	18.8	4.9	1.9	0.6	0.1			
1.0	9.1	56.2	16.1	10.6	3.0	0.8	0.3	0.1			
1.0	4.0	5.9	42.6	5.4	3.1	0.6	0.1	0.1			
1.0	2.5	7.7	7.8	19.0	2.5	0.6	0.1	0.2			
USSR Acoustic survey											
86.0	89.0										
1.0	1.0										
3.0	10.0										
1.0	895.0	422.0	255.0	83.0	44.0	50.0	21.0	2.0			
1.0	141.0	980.0	444.0	183.0	56.0	62.0	19.0	1.0			
1.0	170.0	170.0	738.0	99.0	67.0	42.0	20.0	4.0			
1.0	43.0	161.0	106.0	245.0	34.0	10.0	2.0	0.5			
TOTAL Effort Catch											
82.0	89.0										
1.0	1.0										
3.0	10.0										
0.94	3540.0	8624.0	8296.0	9169.0	11489.0	1945.0	487.0	113.0	74.0	62.0	
0.60	846.1	6465.0	8489.0	7870.0	4660.0	3224.0	540.0	65.0	45.0	7.0	
0.59	1471.0	3953.0	7160.0	6116.0	3255.0	1585.0	962.0	112.0	48.0	37.0	
0.52	5274.0	23731.0	15619.0	8270.0	9529.0	1034.0	445.0	173.0	13.0	12.0	
0.98	9583.0	27958.0	53209.0	19297.0	6416.0	1647.0	275.0	100.1	66.0	1.1	
1.37	1546.1	60360.0	55851.0	45102.0	9656.0	2009.0	426.2	160.0	21.1	57.1	
1.67	2352.0	12354.0	95755.0	33545.0	12266.0	1955.0	462.0	168.0	12.1	13.5	
1.32	410.0	13224.0	22076.0	69355.0	13731.0	2444.0	562.0	125.0	32.1	0.0	
USSR Effort Catch From here the data is not included in the tuning											
82.0	89.0										
1.0	1.0										
3.0	10.0										
131.6	2850.0	5203.0	3180.0	2449.0	4558.0	833.0	220.0	24.0	19.0	52.0	
65.5	716.1	4625.0	2153.0	1598.0	828.0	969.0	193.0	19.0	2.0	2.0	
61.2	1027.0	2159.0	3384.0	2040.0	767.0	226.0	151.0	19.0	13.0	4.0	
69.7	2723.0	16876.0	10776.0	3788.0	1753.0	490.0	178.0	99.0	2.0	1.0	
151.7	8315.0	17543.0	40957.0	13921.0	3565.0	960.0	184.0	0.1	29.0	0.1	
240.5	1356.1	51438.0	38780.0	32996.0	8004.0	1184.0	174.2	43.0	0.1	0.1	
275.3	1474.0	8060.0	64264.0	19626.0	7343.0	1647.0	309.0	93.0	0.1	0.5	
244.0	307.0	11138.0	18157.0	47569.0	9620.0	1540.0	312.0	73.0	0.1	0.1	
Norway Effort Catch											
82.0	89.0										
1.0	1.0										
3.0	10.0										
62.7	690.0	3421.0	5116.0	6720.0	6931.0	1112.0	267.0	89.0	55.0	10.0	
52.9	130.0	1840.0	6326.0	6272.0	3832.0	2255.0	347.0	46.0	44.0	5.0	
53.8	444.0	1794.0	3776.0	4076.0	2488.0	1359.0	811.0	93.0	35.0	33.0	
35.9	2551.0	6855.0	4843.0	4482.0	7776.0	544.0	267.0	79.0	11.0	11.0	
54.7	1268.0	10415.0	12252.0	5376.0	2851.0	687.0	91.0	100.0	37.0	1.0	
56.7	190.0	8922.0	17071.0	12106.0	1652.0	825.0	252.0	117.0	21.0	57.0	
80.8	878.0	4294.0	31491.0	13919.0	4923.0	308.0	153.0	70.0	12.0	13.0	
46.5	103.0	2086.0	3919.0	21786.0	4111.0	904.0	250.0	79.0	32.0	0.0	

Table 3.21 North-East Arctic Cod. Tuning Analysis.

Module run at 10.33.08 27 SEPTEMBER 1989

DISAGGREGATED QS

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 Norway Barents Trawl, has terminal q estimated as the mean

Fleet 2 Norway Barents Acous, has terminal q estimated from trend

Fleet 3 USSR Trawl/Acoustics, has terminal q estimated as the mean

Fleet 4 USSR Acoustic survey, has terminal q estimated from trend

Fleet 5 TOTAL Effort Catch, has terminal q estimated as the mean

FLEETS COMBINED BY ** VARIANCE **

Terminal Fs estimated using Laurec/Shepherd method

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age F = 1.000*average of 4 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age	82	83	84	85	86	87	88	89
3	.064	.020	.020	.049	.023	.039	.027	.019
4	.201	.194	.121	.148	.194	.185	.189	.142
5	.297	.309	.289	.359	.480	.603	.431	.491
6	.548	.484	.576	.580	.766	.958	.941	.555
7	.795	.772	1.072	.997	.983	1.051	1.130	1.145
8	.998	1.008	1.184	1.101	1.213	.928	.933	1.074
9	1.124	1.007	1.213	1.002	.935	1.034	.789	.885
10	.686	.849	1.012	.700	.965	1.396	1.266	.567
11	.568	.496	.813	.615	.754	.638	.880	.730
12	1.262	.296	.737	.536	1.507	1.201	.822	1.000
13	.440	1.116	.333	.589	.554	.901	1.008	.750
14	.734	.689	.738	.610	.944	1.047	.993	.762

Log catchability estimates

Age	82	83	84	85	86	87	88	89
1	-.907	-9.56	-8.69	-8.38	-7.63	-7.30	-7.56	-7.65
2	-7.59	-9.10	-7.59	-6.58	-6.38	-7.03	-7.43	-7.10
3		-9.04	-11.39	-10.23	-9.74	-9.66	-10.41	-9.62
4					-6.71	-6.92	-6.66	-6.77
5	-3.41	-4.68	-4.93	-3.66	-4.32	-4.84	-4.55	-4.79

SUMMARY STATISTICS										
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT	SE Intrcpt		
	q		F	F						
1	-8.22	.867	.0003	.0108	.000E+00	.000E+00	-8.224	.289		
2	-7.35	.887	.0006	.0150	.000E+00	.000E+00	-7.348	.293		
3	-10.00	.773	.0000	.0131	.000E+00	.000E+00	-9.999	.273		
4	-6.76	.124	.0012	.0194	.000E+00	.000E+00	-6.764	.055		
5	-4.42	.551	.0158	.0279	.000E+00	.000E+00	-4.423	.184		
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
	.019	.117	.648E-01	.117	.506					

Age	82	83	84	85	86	87	88	89
1	-8.54	-8.19	-8.71	-8.11	-7.79	-7.77	-7.59	-7.86
2	-7.17	-7.72	-7.28	-6.23	-6.52	-6.98	-7.25	-7.17
3		-8.89	-9.94	-9.68	-9.16	-9.18	-9.78	-9.47
4					-6.53	-6.32	-6.42	-6.43
5	-2.43	-2.24	-2.86	-1.74	-2.31	-2.51	-2.65	-2.30

SUMMARY STATISTICS										
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT	SE Intrcpt		
	q		F	F						
1	-8.07	.418	.0003	.1153	.000E+00	.000E+00	-8.070	.139		
2	-7.03	.492	.0009	.1636	.000E+00	.000E+00	-7.031	.164		
3	-9.44	.413	.0001	.1670	.000E+00	.000E+00	-9.441	.146		
4	-6.42	.095	.0016	.1437	.000E+00	.000E+00	-6.424	.043		
5	-2.38	.350	.1223	.1319	.000E+00	.000E+00	-2.379	.117		
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
	.142	.362E-01	.272E-01	.362E-01	.199					

Table 3.21 (cont'd)

Age 5	82,	83,	84,	85,	86,	87,	88,	89
Fleet								
1	-9.02	-7.64	-8.34	-8.48	-7.83	-8.23	-7.74	-7.83
2	-6.55	-6.93	-6.94	-6.54	-6.55	-7.14	-7.52	-7.00
3		-9.47	-9.11	-9.0P	-8.27	-9.21	-8.96	-8.97
4					-6.43	-5.90	-6.10	-6.36
5	-2.00	-1.54	-1.68	-.93	-1.06	-1.38	-1.75	-1.30

SUMMARY STATISTICS									
Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Inrcpt	
1	-8.01	.324	.0003	.4080	.000E+00	.000E+00	-8.014	.103	
2	-6.90	.364	.0010	.5454	.000E+00	.000E+00	-6.897	.121	
3	-9.01	.397	.0001	.4741	.000E+00	.000E+00	-9.009	.147	
4	-6.20	.273	.0020	.5801	.000E+00	.000E+00	-6.197	.122	
5	-1.44	.382	.3079	.4216	.000E+00	.000E+00	-1.456	.127	
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.491		.151	.737E-01	.151				.238	

Age 6	82,	83,	84,	85,	86,	87,	88,	89
Fleet								
1	-8.07	-7.36	-8.23	-8.62	-8.38	-8.45	-9.36	-7.82
2	-6.55	-6.87	-6.44	-6.59	-7.20	-7.47	-7.79	-7.05
3		-10.24	-3.72	-8.86	-7.56	-8.72	-9.36	-9.08
4					-6.08	-5.87	-6.45	-6.52
5	-1.66	-1.02	-1.23	-.79	-.61	-.68	-1.14	-1.15

SUMMARY STATISTICS									
Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Inrcpt	
1	-8.22	.335	.0003	.3711	.000E+00	.000E+00	-8.224	.112	
2	-7.02	.474	.0009	.5683	.000E+00	.000E+00	-7.021	.158	
3	-8.96	.855	.0001	.6214	.000E+00	.000E+00	-8.964	.302	
4	-6.23	.344	.0020	.7405	.000E+00	.000E+00	-6.232	.154	
5	-1.04	.362	.4687	.6237	.000E+00	.000E+00	-1.035	.121	
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.555		.180	.136	.190				.567	

Age 7	82,	83,	84,	85,	86,	87,	88,	89
Fleet								
1	-8.13	-8.45	-8.47	-8.60	-8.77	-9.15	-8.58	-7.73
2	-6.59	-7.17	-6.80	-6.52	-7.32	-8.03	-8.07	-6.78
3		-8.72	-8.88	-8.34	-7.93	-8.32	-8.73	-8.91
4					-5.73	-5.39	-5.65	-6.30
5	-1.48	-1.04	-.96	.30	-.73	-.56	-.96	-.58

SUMMARY STATISTICS									
Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Inrcpt	
1	-8.49	.447	.0002	.5390	.000E+00	.000E+00	-8.487	.149	
2	-7.16	.647	.0008	.7847	.000E+00	.000E+00	-7.159	.216	
3	-8.55	.382	.0002	1.6363	.000E+00	.000E+00	-8.552	.135	
4	-5.77	.428	.0031	1.9473	.000E+00	.000E+00	-5.768	.191	
5	-.75	.547	.6237	.9623	.000E+00	.000E+00	-.750	.182	
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
1.150		.208	.249	.249				1.423	

Table 3.21 (cont'd)

Age 8									
Fleet,	82,	83,	84,	85,	86,	87,	88,	89	
1	-8.70	-8.71	-9.73	-9.90	-9.44	-9.27	-8.72	-9.06	
2	-7.43	-7.51	-8.36	-7.60	-8.93	-7.26	-8.91	-7.45	
3		-10.17	-9.09	-8.19	-7.60	-8.59	-8.72	-9.06	
4					-4.33	-4.25	-4.47	-6.25	
5	-1.40	-1.22	-0.97	-0.69	-0.81	-1.06	-1.15	-1.03	

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-9.20	.511	.0001	.9362	.000E+00	.000E+00	-9.193	.170	
2	-7.99	.804	.0003	.6255	.000E+00	.000E+00	-7.992	.268	
3	-8.77	.860	.0002	1.4339	.000E+00	.000E+00	-8.777	.304	
4	-4.82	1.071	.0081	4.4814	.000E+00	.000E+00	-4.819	.479	
5	-1.04	.238	.4660	1.0579	.000E+00	.000E+00	-1.041	.079	
Fbar									
1.074	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.199		.155		.199		.606		

Age 9									
Fleet,	82,	83,	84,	85,	86,	87,	88,	89	
1	-9.46	-8.35	-10.13	-9.85	-9.36	-9.20	-9.59	-9.40	
2	-7.85	-7.14	-9.72	-7.55	-7.75	-7.59	-7.98	-7.79	
3		-9.44	-8.45	-8.47	-7.97	-8.10	-9.59	-9.40	
4					-4.01	-3.95	-4.29	-6.41	
5	-1.60	-1.03	-1.13	-0.80	-1.42	-1.15	-1.66	-1.05	

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-9.42	.557	.0001	.8722	.000E+00	.000E+00	-9.417	.186	
2	-7.35	.641	.0004	.3291	.000E+00	.000E+00	-7.354	.214	
3	-8.71	.829	.0002	1.7622	.000E+00	.000E+00	-8.713	.293	
4	-4.66	1.309	.0094	5.0540	.000E+00	.000E+00	-4.664	.585	
5	-1.23	.319	.3860	.7363	.000E+00	.000E+00	-1.229	.106	
Fbar									
.885	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.239		.200		.239		.702		

Age 10									
Fleet,	82,	83,	84,	85,	86,	87,	88,	89	
1	No data for this fleet at this age								
2	No data for this fleet at this age								
3		-8.94	-8.95	-8.53	-8.67	-8.04	-7.97	-8.00	
4					-5.67	-5.74	-3.37	-7.08	
5	-2.15	-1.95	-1.38	-1.49	-1.74	-0.98	-0.96	-1.84	

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	No data for this fleet at this age								
2	No data for this fleet at this age								
3	-8.43	.481	.0002	.4704	.000E+00	.000E+00	-8.426	.170	
4	-5.47	1.721	.0042	2.3542	.000E+00	.000E+00	-5.467	.770	
5	-1.56	.464	.2771	.7493	.000E+00	.000E+00	-1.561	.155	
Fbar									
.567	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.328		.330		.330		1.012		

Table 3.22 North-East Arctic Cod. Virtual Population Analysis from Tuning.

	FISHING MORTALITY COEFFICIENT			UNIT: Year-1		NATURAL MORTALITY COEFFICIENT = .20						
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.030	.024	.023	.041	.021	.039	.196	.214	.084	.166	.134	.146
4	.153	.207	.222	.142	.103	.167	.200	.496	.210	.312	.567	.224
5	.181	.407	.481	.333	.229	.298	.353	.537	.522	.478	.753	.669
6	.202	.467	.538	.571	.237	.385	.392	.577	.701	.572	.681	.847
7	.429	.401	.769	.621	.520	.316	.422	.445	.703	.696	.678	.845
8	.673	.523	.927	.839	.833	.670	.644	.488	.704	.887	.908	.936
9	.339	.778	1.144	.960	.933	1.133	1.010	.409	.614	.777	1.213	1.290
10	.625	.732	.991	1.001	.772	1.236	.738	.982	.478	.464	.774	.990
11	.309	.586	1.156	.699	.684	1.222	.590	.988	1.201	.314	.632	1.847
12	.931	.384	.941	.455	.545	.877	.641	.629	.818	1.055	.247	1.502
13	.872	1.319	.827	.675	.515	1.034	.431	1.306	1.421	.471	1.000	2.447
14	.882	.755	.979	.707	.629	1.087	.600	1.101	.979	.576	.663	1.696
15+	.882	.755	.979	.707	.629	1.087	.600	1.101	.979	.576	.663	1.696
(5-10)U	.575	.552	.808	.729	.587	.673	.593	.561	.620	.646	.835	.929
(10-14)U	.832	.755	.979	.707	.629	1.087	.600	1.101	.979	.576	.663	1.696
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.049	.031	.024	.064	.027	.020	.049	.023	.039	.027	.019	.034
4	.209	.129	.096	.201	.194	.121	.148	.194	.185	.189	.142	.179
5	.348	.355	.229	.297	.309	.289	.359	.480	.603	.431	.491	.468
6	.947	.624	.514	.548	.434	.376	.580	.766	.958	.942	.555	.812
7	.686	.674	.352	.793	.772	1.072	.997	.933	1.051	1.130	1.150	1.040
8	.753	.703	1.068	.998	1.008	1.184	1.101	1.213	.928	.933	1.074	1.044
9	1.053	.869	1.232	1.124	1.007	1.203	1.002	.933	1.034	.789	.885	.939
10	.950	1.089	.975	.686	.847	1.012	.700	.953	1.396	1.264	.567	1.081
11	1.257	1.314	1.092	.563	.496	.818	.615	.754	.639	.887	.730	.734
12	1.351	.848	.775	1.242	.295	.737	.536	1.307	1.201	.822	1.000	1.016
13	.343	1.666	1.415	.440	1.116	.383	.539	.554	.901	1.008	.750	.763
14	1.101	1.233	1.082	.734	.689	.732	.610	.944	1.047	.293	.762	.899
15+	1.101	1.233	1.082	.734	.689	.732	.610	.944	1.047	.293	.762	.899
(5-10)U	.718	.719	.815	.741	.738	.889	.790	.890	.995	.915	.787	
(10-14)U	1.101	1.233	1.082	.734	.689	.732	.610	.944	1.047	.293	.762	

Table 3.23 North-East Arctic Cod. Virtual Population Analysis from Tuning.

STOCK SIZE IN NUMBERS		UNIT: thousands										
BIOMASS TOTALS		UNIT: tonnes										
ALL VALUES ARE GIVEN FOR 1 JANUARY												
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	1292652	169744	111960	197049	404984	1015615	1818318	524996	622028	614210	547712	639572
4	1245222	1027215	135026	39582	154865	324571	799435	1223762	347149	463426	425997	243996
5	459788	375291	533846	38951	63618	114402	224811	536134	610066	230393	280759	197887
6	132406	314089	476203	346140	49657	41439	69546	129279	256504	296501	116939	108225
7	82631	88545	161197	227612	160060	32084	23077	38479	63738	104132	136954	48466
8	55975	44067	48533	61137	110140	77946	19153	12392	20179	25823	42505	56904
9	21701	23371	21393	15721	21655	35649	32650	8238	6230	8170	8712	14029
10	4512	7679	3791	5577	4923	6971	9397	9733	4431	2760	3076	2120
11	1260	1619	3023	2672	1679	1863	1659	3678	2984	2275	1421	1162
12	567	420	738	779	1087	694	450	753	1121	735	1361	618
13	420	183	234	236	405	516	253	194	328	405	210	871
14	74	144	40	84	98	198	143	135	26	65	207	63
15+	26	95	80	75	58	65	133	101	64	132	122	67
TOTAL NO	3297235	2552458	1651662	1035664	963232	1652013	2999025	2487873	1934899	1754028	1365975	1318991
SPS NO	84536	77576	82851	86331	130050	123903	63838	35223	35414	40367	57613	75834
TOT. BIOM	3950551	3973501	3412005	2420154	1862450	2045039	2964045	3064588	2732733	2510814	2146933	1793535
SPS BIOM	456203	435671	463438	466926	676839	674924	391198	232011	212984	230009	312448	400556
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	199187	140495	157945	159039	170031	382815	446536	817431	159791	148418	41799	0
4	452608	155318	111496	126238	122136	136403	307077	348189	653958	125798	118309	33571
5	163002	300813	111762	32743	34509	82353	98977	216831	234776	445008	85269	84014
6	82933	94228	172659	72782	50359	50791	50498	56539	109917	105178	236785	42731
7	37985	39320	41330	84546	34448	25409	23375	23136	21517	34526	33578	111264
8	17045	16074	16412	14430	51329	13037	7119	7062	7086	6160	9135	8708
9	13280	6573	5515	4619	4355	9362	3266	1938	1719	2294	1985	2554
10	3162	5222	2258	1555	1229	1303	2302	982	624	500	854	670
11	645	1071	1439	683	641	431	388	936	307	126	116	396
12	150	150	220	395	317	320	156	172	361	126	43	46
13	113	32	53	33	93	193	125	75	31	89	45	13
14	62	40	5	10	44	25	108	57	35	10	27	18
15+	73	12	2	10	11	25	91	2	13	24	31	22
TOTAL NO	975265	759278	622096	547140	499501	702457	939939	1473399	1190135	868257	527775	
SPS NO	39531	29105	26905	113107	94304	70332	70332	92625	143406	97050	58471	
TOT. BIOM	1388929	1238329	1036400	940841	763451	911330	1231204	1445957	1081623	693042	644109	
SPS BIOM	228210	168340	151170	372643	325638	280517	288185	238856	255652	183570	132708	

Table 3.24 North-East Arctic Cod.

At 11.40.20 19 OCTOBER 1989
 from 67 to 8° on ages 3 to 14
 with Terminal F of .898 on age 7 and Terminal S of .700

Initial sum of squared residuals was 226.116 and
 final sum of squared residuals is 73.191 after 120 iterations

Matrix of Residuals

Years	67/68	68/69											
Ages													
3/4	-.120	-.157											
4/5	.183	.573											
5/6	-.414	.550											
6/7	-.611	-.024											
7/8	-.312	-.710											
8/9	-.098	-.579											
9/10	.440	.227											
10/11	.203	-.286											
11/12	1.405	.254											
12/13	.001	-.793											
13/14	.697	1.350											
	.000	.000											
WTS	.001	.001											
Years	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79			
Ages													
3/4	-.313	.504	-.091	-.001	1.131	1.850	.355	.847	1.429	1.025			
4/5	.327	.246	.174	-.171	.236	1.209	.129	.477	1.291	.157			
5/6	.168	.626	.113	-.006	.192	.322	.303	.294	.690	.309			
6/7	-.278	-.010	-.148	-.265	-.085	-.290	.023	-.002	-.037	-.101			
7/8	-.423	-.636	-.173	-1.235	-.463	-.874	-.563	-.344	-.547	-.684			
8/9	-.312	-.373	.062	-.668	.145	-.740	-.557	-.236	-.372	-.826			
9/10	.208	.154	.369	.530	.369	-.570	-.162	.035	.450	.000			
10/11	-.160	-.080	-.258	.473	-.456	-.332	-.524	-.853	-.882	-.975			
11/12	1.217	.339	.546	1.175	.294	.688	.723	.206	-.300	1.024			
12/13	-.066	-.832	-.539	.180	-.809	-.918	.023	.153	-2.250	.168			
13/14	.219	.035	-.149	.883	-.603	1.564	1.303	-.225	.214	1.694			
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000			
WTS	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001			
Years	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89		WTS	
Ages													
3/4	.670	.487	-.470	.495	-.003	-.357	.485	-.324	.014	-.182	.000	.283	
4/5	.444	.321	-.218	.467	.712	-.157	.009	.013	.046	-.074	.000	.464	
5/6	-.169	.023	-.549	-.192	-.048	-.321	-.088	-.035	.095	.026	.000	.559	
6/7	-.185	-.141	-.361	-.279	-.407	-.347	-.159	-.014	.091	-.065	.000	1.000	
7/8	-.377	-.586	-.218	-.343	-.222	.099	.104	.009	-.095	.010	.000	.539	
8/9	-.416	-.688	-.016	-.077	.094	.237	.339	.217	-.264	.267	.000	.517	
9/10	.158	-.063	.739	.420	.378	.695	.356	-.173	-.164	.023	.000	.461	
10/11	-.463	-.115	.160	-.315	-.106	.138	-.363	-.036	.218	.185	.000	.468	
11/12	1.039	1.204	.585	.636	-.023	.692	-.180	.032	-.057	.193	.000	.358	
12/13	.173	-.498	.124	.200	-.763	-.164	-.358	.720	.022	-.377	.000	.288	
13/14	.040	1.324	1.231	-.503	1.015	-.546	-.113	-.433	.093	.444	.000	.238	
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	12.505		
WTS	.001	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000			
Fishing Mortalities (F)													
F-values	67	68	69										
	.6624	.7327	1.0466										
F-values	70	71	72	73	74	75	76	77	78	79			
	.8975	.7027	.9406	.8683	1.0091	1.0606	.9630	1.1318	1.4161	.9851			
F-values	80	81	82	83	84	85	86	87	88	89			
	.9630	.9545	.9194	.8220	.9364	.8949	1.0674	1.1716	1.0690	.8980			
Selection-at-age (S)													
S-values	3	4											
	.0306	.1624											
S-values	5	6	7	8	9	10	11	12	13	14			
	.4443	.7557	1.0000	1.0105	.9099	.9618	.6464	.8687	.6388	.7000			

Table 3.25

Title : NORTH-EAST ARCTIC COD
 At 11.40.22 19 OCTOBER 1989
 SEPERABLE FISHING MORTALITIES

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.020	.022	.032	.027	.022	.029	.027	.031	.032	.029	.035	.043
4	.108	.119	.170	.146	.114	.153	.141	.164	.172	.156	.184	.230
5	.294	.326	.465	.399	.312	.418	.386	.448	.471	.428	.503	.629
6	.501	.554	.791	.678	.531	.711	.656	.763	.801	.728	.855	1.070
7	.662	.733	1.047	.897	.703	.941	.868	1.009	1.061	.963	1.132	1.416
8	.669	.740	1.058	.907	.710	.950	.877	1.020	1.072	.973	1.144	1.431
9	.603	.667	.952	.817	.639	.856	.790	.918	.965	.876	1.030	1.289
10	.637	.705	1.007	.863	.676	.905	.835	.971	1.020	.926	1.089	1.362
11	.428	.474	.676	.580	.454	.608	.561	.652	.686	.622	.732	.915
12	.575	.637	.909	.780	.610	.817	.754	.877	.921	.837	.983	1.230
13	.423	.468	.669	.573	.449	.601	.555	.645	.678	.615	.723	.905
14	.464	.513	.733	.628	.492	.658	.608	.706	.742	.674	.792	.991
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	.030	.029	.029	.028	.025	.029	.027	.033	.036	.033	.027	
4	.160	.156	.155	.149	.134	.152	.145	.173	.190	.174	.146	
5	.438	.428	.424	.408	.365	.416	.398	.474	.521	.475	.399	
6	.744	.728	.721	.695	.621	.708	.676	.807	.885	.808	.679	
7	.985	.963	.955	.919	.822	.936	.895	1.067	1.172	1.069	.898	
8	.995	.973	.965	.929	.831	.946	.904	1.079	1.184	1.080	.907	
9	.896	.876	.869	.837	.748	.852	.814	.971	1.066	.973	.817	
10	.947	.926	.918	.884	.791	.901	.861	1.027	1.127	1.028	.864	
11	.637	.622	.617	.594	.531	.605	.578	.690	.757	.691	.580	
12	.856	.837	.829	.799	.714	.813	.777	.927	1.018	.929	.780	
13	.629	.615	.610	.587	.525	.598	.572	.682	.748	.683	.574	
14	.690	.674	.668	.644	.575	.655	.626	.747	.820	.748	.629	

Table 3.25 (cont'd)

Title : NORTH-EAST ARCTIC COD
 At 11.40.22 19 OCTOBER 1989
 SEPERABLE POPULATION NUMBERS Units: thousands

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	1367922	283130	213822	310743	526081	1117838	1797894	1817221	924569	345949	229225	519944
4	1290492	1097486	226667	169544	247522	421555	889238	1433390	1442570	732799	275013	181284
5	509914	948783	797712	156564	119979	180793	296234	632265	996125	994158	513084	187345
6	153967	311052	560952	410247	86031	71889	97461	164904	330623	509116	530626	254060
7	91123	76415	146384	208246	170460	41417	28913	41399	62978	121450	201331	184696
8	52495	38469	30068	42083	69492	69120	13238	9934	12356	17854	37960	53150
9	17905	22008	15021	8550	13912	27972	21876	4507	2934	3464	5524	9903
10	4206	8023	9251	4745	3093	6010	9731	8128	1473	915	1181	1615
11	1120	1821	3247	2768	1639	1288	1991	3456	2521	435	297	326
12	534	598	929	1351	1269	852	574	930	1474	1040	191	117
13	513	246	259	306	507	564	308	221	317	480	369	59
14	118	275	126	109	141	265	253	145	95	132	213	147
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	216985	138746	160873	185813	193474	383160	453386	736280	178258	134896	29332	
4	407640	172376	110296	127920	147910	154468	304843	361172	583441	140805	106889	
5	117923	284394	120692	77332	90202	105962	108622	215814	248627	394894	96904	
6	81762	62325	151792	64661	42082	51257	57228	59756	109966	120955	201074	
7	71338	31797	24646	60410	26426	18513	20681	23825	21837	37143	44149	
8	36695	21810	9938	7769	19723	9510	5942	6919	6708	5540	10441	
9	10404	11103	6748	3101	2512	7037	3023	1969	1926	1681	1540	
10	2235	3476	3785	2318	1100	973	2457	1096	610	543	520	
11	339	710	1127	1237	784	408	324	851	321	162	159	
12	107	147	312	498	559	377	183	149	349	123	66	
13	28	37	52	111	183	224	137	69	48	103	40	
14	19	12	16	23	51	89	101	63	28	19	43	

Table 3.26 North-East Arctic COD. Input data to the assessment. Weight (kg) at age in the catch.

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
1987	0.65	1.10	1.92	2.56	3.44	5.41	6.69	7.70	9.25	10.85	12.50	13.90	15.00
1988	0.53	0.83	1.35	2.27	3.51	5.40	7.47	8.95	11.24	14.23	13.90	15.00	

Table 3.27 North-East Arctic COD. Input data to the assessment. Weight (kg) at age in the stock.

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	0.46	0.91	1.71	2.94	4.17	5.04	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1986	0.32	0.93	1.57	2.52	3.83	5.30	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1987	0.21	0.50	1.25	2.12	3.46	5.22	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1988	0.19	0.36	0.70	1.58	2.70	4.30	6.17	7.70	9.25	10.85	12.50	13.90	15.00
1989	0.30	0.51	0.86	1.47	2.62	4.70	6.17	7.70	9.25	10.85	12.50	13.90	15.00

Table 3.28 Virtual Population Analysis.

NORTH-EAST ARCTIC COD

	CATCH IN NUMBERS											
	UNIT: thousands											
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	34467	3709	2307	7164	7754	35536	294262	91855	45282	85337	39594	78822
4	160048	174585	24545	10792	13739	45431	131493	437377	59798	114341	168609	45400
5	69235	267961	238511	25813	11831	26832	61000	203772	226646	79993	136335	88495
6	22061	107051	181239	137829	9527	12089	20569	47006	118567	118236	52925	56823
7	26295	26701	79363	96420	59290	7918	7248	12630	29522	47872	61821	25407
8	25139	16399	26989	31920	52003	34885	8328	4370	9353	13962	23338	31821
9	11323	11597	13463	8933	12093	22315	19130	2523	2617	4051	5659	9408
10	2329	3657	5092	3249	2434	4572	4499	5607	1555	936	1521	1227
11	687	657	1913	1232	762	1215	677	2127	1928	558	610	913
12	316	122	414	260	418	353	195	322	575	442	271	446
13	225	124	121	106	149	315	81	151	231	139	122	748
14	40	70	23	39	42	121	59	83	15	26	92	48
15+	14	46	46	35	25	40	55	62	37	53	54	51
TOTAL	352179	612679	574026	323792	170067	191622	547596	807885	496126	465946	490951	339609
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	8600	3911	3407	8948	3108	7027	19282	16942	5570	3550	721	
4	77484	17086	9466	20933	19594	14165	38322	55859	100391	19584	14258	
5	43677	81986	20803	19345	20473	18839	27216	75486	97318	142218	30224	
6	31943	40061	63433	28084	17656	20350	20342	27772	62371	59058	92282	
7	16815	17664	21788	42496	17004	15415	13588	13337	12901	21571	21184	
8	8274	7442	9933	8395	18329	8359	4385	4587	3942	3438	5548	
9	10974	3508	4267	2878	2545	6054	1904	1082	1021	1149	1072	
10	1785	3196	1311	708	646	764	1062	559	435	332	338	
11	427	678	882	271	229	221	163	455	140	68	55	
12	103	79	109	260	74	153	59	124	233	65	25	
13	59	24	37	27	58	56	51	29	17	52	22	
14	38	26	3	5	20	12	45	32	21	6	13	
15+	45	8	1	5	5	12	38	1	8	14	15	
TOTAL	200224	175669	135440	132355	99741	91427	126457	196265	284368	251205	165757	

Table 3.29 Virtual Population Analysis.

NORTH-EAST ARCTIC COD

	FISHING MORTALITY COEFFICIENT					UNIT: Year-1	NATURAL MORTALITY COEFFICIENT = .20					
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.030	.024	.023	.041	.021	.039	.196	.214	.084	.166	.134	.146
4	.153	.207	.222	.142	.103	.167	.200	.496	.210	.312	.567	.224
5	.181	.409	.481	.383	.229	.298	.353	.537	.522	.478	.753	.669
6	.202	.467	.538	.571	.237	.385	.392	.507	.701	.572	.681	.846
7	.429	.401	.769	.621	.520	.316	.422	.445	.703	.696	.678	.845
8	.673	.523	.927	.839	.833	.670	.644	.488	.704	.887	.908	.936
9	.839	.778	1.144	.960	.934	1.133	1.010	.409	.614	.777	1.213	1.290
10	.825	.732	.991	1.001	.772	1.236	.738	.982	.478	.464	.774	.990
11	.899	.586	1.156	.699	.684	1.222	.591	.988	1.201	.314	.632	1.847
12	.931	.384	.941	.455	.545	.807	.642	.630	.816	1.056	.247	1.502
13	.875	1.320	.828	.676	.516	1.084	.431	1.806	1.425	.470	1.000	2.447
14	.880	.760	.980	.710	.630	1.090	.600	1.100	.980	.580	.660	1.700
15+	.880	.760	.980	.710	.630	1.090	.600	1.100	.980	.580	.660	1.700
(5-10)U	.525	.552	.808	.729	.587	.673	.593	.561	.620	.646	.835	.929
(10-14)U	.882	.755	.979	.708	.629	1.088	.600	1.101	.980	.577	.663	1.697
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.049	.031	.024	.064	.020	.020	.047	.025	.035	.029	.004	.034
4	.208	.129	.098	.201	.196	.122	.146	.186	.201	.166	.157	.175
5	.348	.355	.229	.296	.309	.292	.360	.473	.564	.485	.410	.471
6	.547	.624	.514	.548	.483	.575	.590	.771	.932	.820	.680	.778
7	.659	.674	.852	.792	.771	1.069	.991	1.020	1.067	1.048	.814	1.031
8	.754	.701	1.068	.996	1.006	1.183	1.091	1.192	1.021	.971	.875	1.069
9	1.053	.871	1.224	1.123	1.001	1.196	1.000	.911	.983	1.001	.979	.974
10	.950	1.089	1.002	.675	.847	.996	.689	.959	1.295	1.088	.965	1.008
11	1.257	1.315	1.092	.577	.481	.815	.594	.731	.682	.716	.514	.681
12	1.351	.848	.775	1.243	.303	.697	.531	1.368	1.108	.805	.635	.953
13	.843	1.661	1.412	.440	1.117	.395	.530	.546	.684	.810	.718	.643
14	1.100	1.230	1.070	.730	.690	.740	.642	.763	1.015	.552	.483	.743
15+	1.100	1.230	1.070	.730	.690	.740	.642	.763	1.015	.552	.483	.743
(5-10)U	.718	.719	.815	.738	.736	.885	.787	.888	.977	.902	.787	
(10-14)U	1.100	1.228	1.070	.733	.688	.729	.597	.873	.957	.794	.663	

Table 3.30

NORTH-EAST ARCTIC COD

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	1292641	169753	111962	197049	404988	1015600	1818319	524953	622106	614216	347770	639681
4	1245203	1027205	135633	89583	154863	324574	799423	1223762	347115	468490	426002	249043
5	459785	875278	683840	88956	63619	114402	224814	536126	610066	230365	280813	197891
6	132404	314087	476197	346137	49660	41440	69546	129281	256500	296501	116917	108270
7	82630	88542	161196	227611	160058	32086	23077	38480	65739	104130	136954	48448
8	55975	44067	48532	61185	100142	77945	19154	12392	26179	25824	42504	56904
9	21700	23370	21393	15721	21654	35651	32650	8239	6230	8170	8712	14029
10	4512	7678	8791	5577	4928	6970	9398	9733	4481	2761	3076	2120
11	1259	1619	3022	2672	1679	1863	1658	3680	2984	2275	1421	1162
12	567	419	737	779	1087	694	450	752	1122	735	1362	618
13	420	183	234	235	404	516	253	194	328	406	209	871
14	74	143	40	84	98	198	143	135	26	65	208	63
15+	26	94	80	75	58	65	133	101	64	132	122	67
TOTAL NO	3297196	2552439	1651657	1035664	963239	1652004	2999019	2487827	1934941	1754069	1366069	1319166
SPS NO	84533	77574	82830	86328	130050	123903	63840	35225	35415	40367	57614	75834
TOT. BIOM	3850492	3973442	3411972	2420135	1862452	2045038	2964051	3064566	2732753	2510832	2147020	1793701
SPS BIOM	456181	435643	468425	465910	676834	674921	391210	232024	212993	230009	312464	400555
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	199194	140595	158131	157921	169611	386242	464306	757571	175499	135812	198754	0
4	452696	155324	111578	126390	121220	136059	309883	362737	604949	141933	107988	162083
5	163040	300885	111767	82816	84633	81605	98626	219177	246680	404907	98473	75567
6	82956	94258	172718	72787	50415	50892	49877	56310	111790	114870	204067	53505
7	38021	39323	41354	84594	34453	25454	23458	22633	21331	36036	41412	84644
8	17031	16104	16415	14449	31368	13041	7155	7128	6686	6011	10348	15023
9	18280	6562	6539	4621	4368	9394	3269	1967	1771	1972	1864	2532
10	3162	5222	2249	1575	1230	1315	2327	985	647	543	593	573
11	645	1001	1439	676	657	432	397	957	309	145	150	185
12	150	150	220	395	311	332	157	180	377	128	58	73
13	113	32	53	83	93	188	136	75	37	102	47	25
14	62	40	5	11	44	25	104	65	36	15	37	19
15+	73	12	2	11	11	25	88	2	14	36	43	40
TOTAL NO	975423	759507	622469	546327	498414	705004	959782	1429791	1174126	842510	663844	
SPS NO	39517	29123	26921	113183	94319	75192	70173	92972	142710	99597	57310	
TOT. BIOM	1389148	1238662	1087420	940727	763098	912227	1244177	1440832	1080733	686079	673116	
SPS BIOM	228146	168409	151259	372936	325977	280846	287891	239583	256816	188978	135298	

Table 3.32 North-East Arctic Cod.
Stock size and catch predictions. Weights are in '000 t.

1990			1991			1992			1993			1994			1995			1996		
Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. Stock (3+)	biom.	
596	147	$F_{0.1}$ 0.15	73	748	233															
		F_{max} 0.24	111	707	212	135	847	291	160	1,006	372	191	1,173	435	216	1,353	515	254	1,508	593
		F_{low} 0.32	143	673	194															
		F_{med} 0.46	194	621	168	198	679	188	210	761	207	230	857	215	251	964	236	289	1,050	264
		$F_{high} =$																		
		F_{89} 0.78	288	524	120	236	526	103	222	572	96	229	643	90	251	720	96	289	772	109
Recruitment: 171 mill. (est)			222 mill. (est)			273 mill. (est)			330 mill.			330 mill.			330 mill.			330 mill.		

Table 4.1 North-East Arctic HADDOCK.
Total nominal catch (t) by fishing areas.

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	69,865	26,006	714	96,585
1987 ¹	109,429	38,182	3,048	150,659
1988 ¹	43,833	47,276	662	91,771

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	51.7	18.1	12.8	13.2	0.7
1987	77.8	31.6	22.1	16.1	3.0
1988 ¹	27.4	16.4	34.1	13.2	0.6

¹ Provisional.

Table 4.3 North-East Arctic HADDOCK.
Nominal catch (t) by countries (Sub-area I and Divisions IIa+b combined).

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	893	33	75	1,079	48,314	22	431	45,738	-	96,585
1987	464	26	83	3,106	69,333	99	563	76,980	-	150,654
1988 ¹	1,081	113	78	1,324	57,334	72	435	32,293	41	91,771

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	0.27	1.00	-	0.01	-	0.11	-
1986	0.56	1.05	-	0.02	-	0.20	-
1987	0.63	0.90	-	0.01	-	0.28	-
1988 ¹	0.40	0.70	-	0.02	-	0.42	-

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		1987		1988	
	Norway	USSR	Norway	USSR	Norway	USSR	Norway	USSR	Norway	USSR
2	1.17	0.66	0.81	0.25	0.62	0.27	0.43	0.27	0.66	-
3	1.58	1.35	1.32	0.81	1.17	0.54	1.02	0.47	0.77	0.44
4	1.99	1.90	1.91	1.46	1.51	0.98	1.32	0.69	0.87	0.74
5	2.42	2.48	2.35	2.51	2.24	1.50	1.72	1.09	1.10	0.98
6	2.64	3.13	2.66	2.84	2.54	2.25	2.60	1.93	1.48	1.35
7	2.89	3.12	2.85	3.23	2.62	2.63	2.99	2.75	2.04	1.52
8	3.16	3.57	3.14	3.29	3.04	3.03	3.24	2.72	2.52	-
9	3.41	3.86	3.38	3.90	3.17	3.65	3.14	3.34	2.83	4.04
10	3.51	3.98	3.72	4.03	3.51	3.80	3.51	2.83	3.18	-
11	4.04	4.77	3.81	6.75	3.72	-	3.93	2.40	3.25	3.80
12	4.04	-	3.22	(5.20)	3.98	-	4.00	-	3.73	3.70
13	3.84	-	3.72	4.78	4.06	-	3.48	-	3.82	-
14	4.19	-	4.19	-	4.14	-	4.10	-	3.76	-
15+	4.36	5.37	4.06	-	4.06	6.45	5.28	4.52	4.78	-

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

NORTH-EAST ARCTIC HADDOCK : recruits as 3 year-olds (inc. data for ages 0 1 2 & 3)										
10 33 2	(No. of surveys		No. of years		VPA		Column		No.)	
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	170	163	96	59	0.60	-	-	-	-	755
1976	134	6	13	4	0.38	-	-	-	267	149
1977	18	1	1	0.3	0.33	-	-	-	111	11
1978	6	0.3	0.3	0.3	0.12	-	-	2.3	17	-
1979	8	0.3	0.3	0.3	0.20	-	4.8	1.8	-	25
1980	4	0.3	0.3	-	0.15	0.3	0.9	4.1	2	4
1981	7	0.3	0.3	8	0.03	0.5	5.7	15.2	3	10
1982	283	23	59	63	0.38	314.5	355.8	380.2	-	1000
1983	401	40	79	239	0.62	663.2	616.2	314.0	2148	1972
1984	73	9	19	18	0.78	167.8	135.0	149.3	1034	502
1985	-	5	2	3	0.27	77.9	31.9	23.9	346	29
1986	-	1	1	1	0.39	15.2	8.3	8.1	37	7
1987	-	0.1	1	-	0.10	5.0	3.1	-	8	8
1988	-	2	-	-	0.13	0.5	-	-	20	-
1989	-	-	-	-	0.14	-	-	-	-	-

R-T-1	USSR	Bottom	trawl	survey,	age	1				
R-T-2	USSR	"	"	"	age	2				
R-T-3	USSR	"	"	"	age	3				
R-23-3	USSR	"	"	"	"	IIB, age 3				
INT06P	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 33 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 = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	1.7918	1.181	1.700	.7671	28	3.8167	.92398	.96152	.03904
R-T-2	1.0986	.977	1.762	.8955	28	2.8356	.57271	.60513	.09857
R-T-3	1.3863	1.034	1.599	.7009	27	3.0321	1.03682	1.09861	.02991
INTOGP	.2390	13.004	.144	.5180	20	3.2521	1.61742	1.68843	.01266
N-BST1	4.3682	.676	1.486	.9631	5	4.4399	.45504	.50188	.14330
N-BST2	3.4935	.798	.777	.9818	6	3.5642	.29562	.31970	.35316
N-BST3	3.2149	.910	.354	.9016	7	3.2782	.68458	.73324	.06714
N-BSA1	5.8493	.687	.422	.8657	7	4.4419	.74497	.81953	.05374
N-BSA2	3.4012	.774	.229	.9157	9	2.8625	.55805	.60109	.09990
N-BSA3	3.0445	.893	-.417	.9106	10	2.3004	.58475	.63878	.08846
MEAN						3.8661	1.59935	1.59935	.01411

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	.6931	1.164	1.700	.7943	28	2.5069	.86848	.92818	.04286
R-T-2	.6931	.965	1.759	.9147	28	2.4275	.52127	.56082	.11740
R-T-3	.6931	1.023	1.574	.7065	27	2.2831	1.04439	1.14401	.02821
INTOGP	.3293	12.548	.199	.5567	20	4.3310	1.52278	1.59407	.01453
N-BST1	2.7850	.676	1.485	.9627	5	3.3682	.45786	.50660	.14387
N-BST2	2.2300	.798	.775	.9817	6	2.5547	.29735	.33100	.33701
N-BST3	2.2083	.912	.342	.9019	7	2.3549	.68742	.75359	.06502
N-BSA1	3.6376	.684	.438	.8679	7	2.9241	.74655	.80715	.05667
N-BSA2	2.0794	.773	.224	.9177	9	1.8328	.55670	.63462	.09168
N-BSA3	2.9957	.891	-.420	.9116	10	2.2509	.58781	.64530	.08867
MEAN						3.8205	1.61957	1.61957	.01408

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	.0953	1.151	1.700	.8197	28	1.8098	.81724	.90605	.05687
R-T-2	.6931	.955	1.756	.9308	28	2.4176	.47531	.51408	.17665
R-T-3									
INTOGP	.0953	12.182	.243	.5860	20	1.4039	1.46464	1.62719	.01763
N-BST1	1.7918	.676	1.483	.9622	5	2.6946	.46245	.52886	.16691
N-BST2	1.4110	.799	.772	.9816	6	1.8985	.29998	.34900	.38328
N-BST3									
N-BSA1	2.1972	.679	.456	.8705	7	1.9479	.74984	.84939	.06471
N-BSA2	2.1972	.773	.218	.9200	9	1.9158	.55537	.63258	.11667
N-BSA3									
MEAN						3.7803	1.64377	1.64377	.01728

Table 4.7 (cont'd)

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1	1.0986	1.147	1.696	.8422	28	2.9562	.77437	.82450	.22249
R-T-2									
R-T-3									
INTOGP	.1222	11.943	.264	.6024	20	1.7237	1.45334	1.60495	.05872
N-BST1	.4055	.676	1.480	.9616	5	1.7541	.46937	.58116	.44783
N-BST2									
N-BST3									
N-BSA1	3.0445	.674	.476	.8735	7	2.5286	.75576	.83486	.21701
N-BSA2									
N-BSA3									
MEAN						3.7506	1.67430	1.67430	.05396

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
R-T-1									
R-T-2									
R-T-3									
INTOGP	.1310	11.820	.262	.6071	20	1.8107	1.48693	1.65031	.51862
N-BST1									
N-BST2									
N-BST3									
N-BSA1									
N-BSA2									
N-BSA3									
MEAN						3.7349	1.71295	1.71295	.48138

Yearclass	Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE	
1965	4.35	77.62	.25	.39	3.04 21.00 1.58	
1966	3.52	33.82	.33	.36	2.89 18.00 1.09	
1967	4.78	119.54	.30	.26	5.11 165.00 .88	
1968	3.66	38.78	.32	.34	4.58 98.00 1.07	
1969	6.61	742.95	.37	.44	6.93 1026.00 1.16	
1970	5.98	397.20	.33	.47	5.60 271.00 1.44	
1971	4.71	111.32	.31	.16	4.01 55.00 .52	
1972	4.42	82.78	.34	.25	3.91 50.00 .72	
1973	4.85	128.15	.35	.29	4.04 57.00 .82	
1974	5.50	244.86	.37	.31	4.74 115.00 .84	
1975	6.60	732.67	.41	.52	5.14 171.00 1.28	
1976	4.42	83.17	.44	.24	4.91 135.00 .55	
1977	3.42	30.47	.47	.43	2.94 19.00 .92	
1978	3.04	20.89	.47	.37	1.95 7.00 .79	
1979	2.77	16.03	.52	.36	2.20 9.00 .69	
1980	2.24	9.37	.48	.36	1.61 5.00 .76	
1981	3.19	24.22	.33	.39	2.08 8.00 1.17	
1982	5.94	379.57	.44	.31	5.65 284.00 .71	
1983	6.26	521.10	.35	.29	6.00 402.00 .82	
1984	4.86	128.64	.19	.16	4.30 74.00 .85	
1985	3.46	31.76	.19	.20		1.06
1986	2.61	13.54	.19	.15		.79
1987	2.15	8.56	.22	.15		.69
1988	2.30	9.93	.39	.31		.79
1989	2.74	15.44	1.19	.96		.81

Table 4.8 North-East Arctic HADDOCK.
Results from the Norwegian bottom trawl survey in the
Barents Sea in January-March. Index of number of fish
by age.

Year	Age								Total
	1	2	3	4	5	6	7	8	
1981	0.3	4.8	2.3	9.5	2.0	6.1	0.7	+	25.7
1982	0.5	-	1.8	2.1	2.2	5.5	2.7	0.2	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	1037.4
1985	167.8	616.2	380.2	7.2	0.4	0.2	0.3	0.3	1172.6
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
1988	5.0	8.3	23.9	72.5	134.1	19.0	0.2	-	263.0
1989	9.5	3.1	8.1	17.0	32.7	32.8	3.2	-	106.4

Table 4.9 North-East Arctic Haddock.
Results from the USSR trawl survey in the Barents Sea and adjacent waters in November-December (numbers per hour trawling).

Year	Age											Total	
	0	1	2	3	4	5	6	7	8	9	Older		
<u>Sub-area 1</u>													
1983	39.9	97.3	16.5	0.8	0.7	+						1.1	156.3
1984	9.7	100.2	110.6	2.8	0.4	0.2	+					0.7	224.6
1985	3.9	19.1	213.4	168.8	0.8	0.2	0.1	-				0.3	406.6
1986	0.2	2.3	16.6	58.1	27.6	0.1	+	+	+			-	105.0
1987	0.4	1.4	2.5	12.5	34.2	8.6	+	+	-	+		-	59.8
1988	1.9	0.4	1.1	2.8	6.2	11.6	1.1	+	+	+		-	25.2
<u>Division IIa</u>													
1983	5.4	5.5	0.1	0.2	0.3	0.1						1.0	12.6
1984	4.9	14.4	5.6	0.1	0.1	0.1	-					0.2	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
1987	-	-	-	-	0.3	0.3	-	-	-	-		-	0.6
1988	1.0	0.1	-	+	0.2	0.5	0.2	-	-	-		-	2.1
<u>Division IIb</u>													
1983	22.1	9.9	0.2	0.1	+	+						0.1	32.4
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
1987	-	-	0.1	0.7	1.4	0.5	+	-	-	-		-	2.8
1988	0.2	-	-	+	0.3	1.1	0.2	-	+	-		-	1.9
1983	29.8	59.2	9.5	0.5	0.4	+						0.8	100.2
1984	6.4	58.6	58.4	1.5	0.2	0.1	+					0.3	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
1987	0.3	0.9	1.7	8.3	22.5	5.7	+	+	-	+		-	39.4
1988	1.3	0.3	0.7	1.7	4.0	7.6	0.8	+	+	+		-	16.4

Table 4.10 North-East Arctic HADDOCK.
Results from the Norwegian acoustic survey in the
Barents Sea in January-March. Stock numbers in millions.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10	
1981	2	25	14	66	160	50	2	1	+	+	320
1982	3	4	7	10	12	29	14	1	+	+	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	1	4,233
1986	346	502	1,720	751	2	1	1	+	+	+	3,323
1987	37	29	175	640	166	+	+	+	-	+	1,049
1988	8	7	20	70	150	23	+	-	-	+	279
1989	20	8	19	34	61	64	6	-	-	+	213

Table 4.11 North-East Arctic HADDOCK.
Results from the USSR acoustic survey in the Barents Sea
and adjacent waters in September-October. Stock numbers in
millions.

Year	Age											Total
	0	1	2	3	4	5	6	7	8	9	Older	
1985 ¹	194	434	1,468	636	3	1	+	-	-	-	1	2,737
1986 ¹	34	37	208	917	910	2	+	+	+	-	+	2,109
1987	6	16	29	62	197	61	+	-	-	+	12	383
1988	2	1	3	18	83	301	46	-	-	-	+	454

¹ November-December.

Table 4.12 North-East Arctic HADDOCK.
Results from the Norwegian acoustic survey in the Barents
Sea and the Svalbard region in September-October. Stock
numbers in millions.

Year	Age										Total
	1	2	3	4	5	6	7	8	Older		
1986	89	197	267	95	-	-				1	650
1987	5	25	89	276	69	+	+			+	463
1988	171	19	5	17	35	4	-	-	-	-	252

Table 4.13 North-East Arctic HADDOCK.
Length data (cm) from surveys. USSR surveys in 1984-1988 in November-December and Norwegian surveys in 1987, 1988 and 1989 in January-February.

Age	USSR					Norway		
	1984	1985	1986	1987	1988	1987	1988	1989
0+ (1)	16.5	16.1	17.0	-	17.3	13.9	13.5	16.3
1+ (2)	24.1	22.4	20.7	21.5	23.2	21.6	24.3	22.5
2+ (3)	35.8	30.9	28.1	27.8	29.7	30.2	29.3	32.0
3+ (4)	44.4	44.1	35.4	32.3	33.7	39.2	36.2	36.8
4+ (5)	56.4	53.8	46.7	37.3	39.3	47.0	42.7	43.0
5+ (6)	62.8	61.3	62.0	48.6	46.2	62.5	50.1	47.3
6+ (7)	64.8	64.7	-	-	51.2	-	56.6	53.6

Table 4.14 North-East Arctic HADDOCK.
Weight data (g) from surveys. USSR surveys in 1984-1987 in November-December and Norwegian surveys in 1987 and 1988 in January-February.

Age	USSR				Norway	
	1984	1985	1986	1987	1987	1988
0+ (1)	36	37	38	-	24	25
1+ (2)	127	105	88	95	91	120
2+ (3)	438	282	209	196	273	350
3+ (4)	815	817	419	330	542	450
4+ (5)	1,777	1,530	919	497	934	730
5+ (6)	2,395	2,262	2,240	1,055	2,197	1,140
6+ (7)	2,688	2,263	-	-	-	1,560

Table 4.15 North-East Arctic HADDOCK.
Maturity at age from USSR data.

Age	Maturity at age in percent								
	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	1	9	17	7	2	+	-	-	-
4	12	55	70	14	8	22	1	3	-
5	64	73	100	35	80	53	21	33	-
6	73	93	99	47	93	86	53	51	-
7	96	96	99	74	96	86	100	-	-
8	100	100	100	82	91	100	100	-	-
9	100	93	-	89	96	83	-	-	-
10	-	-	-	-	-	100	100	-	-

Table 4.16 Tuning Data.

NORTHEAST ARCTIC HADDOCK : SURVEY DATA

104

Norw Bar Sea Trawl

83,89

1,1

3,8

1, 4.1, 3.6, 1.9, 2.3, 3.9, 1.6

1, 15.2, 1.6, 0.7, 0.2, 0.3, 0.4

1, 380.2, 7.2, 0.4, 0.2, 0.3, 0.3

1, 314.0, 123.0, 0.4, 0.1, 0.1, 0.2

1, 149.3, 312.8, 62.0, 0.1, 0.2, 0.05

1, 23.9, 72.5, 134.1, 19.0, 0.2, 0.01

1, 8.1, 17.0, 32.7, 32.8, 3.2, 0.01

Norw Bar Sea Acoustic

83,89

1,1

3,8

1, 7, 9, 5, 4, 10, 5

1, 53, 15, 7, 2, 2, 2

1, 1187, 33, 2, 1, 1, 1

1, 1720, 751, 2, 1, 1, 0.05

1, 175, 640, 166, 0.1, 0.1, 0.05

1, 20, 70, 150, 23, 0.1, 0.01

1, 19, 34, 61, 64, 6, 0.01

USSR Trawlsurvey Tr/Ac

84,89

1,1

3,8

1, 9.5, 0.5, 0.4, 0.05, 0.05, 0.6

1, 58.4, 1.5, 0.2, 0.1, 0.05, 0.05

1, 134.3, 90.0, 0.4, 0.1, 0.1, 0.01

1, 10.7, 36.3, 16.4, 0.1, 0.05, 0.05

1, 1.7, 8.3, 22.5, 5.7, 0.05, 0.05

1, 0.7, 1.7, 4.0, 7.6, 0.8, 0.05

USSR Acousticsurvey Tr/Ac

86,89

1,1

3,8

1, 1468, 636, 3, 1, 0.05, 0.01

1, 208, 917, 910, 2, 0.05, 0.05

1, 29, 62, 197, 61, 0.05, 0.01

1, 3, 18, 83, 301, 46, 0.01

Norway Eff Catch I From here data is not included in the tuning

83,88

1,1

3,7

11.7, 60, 439, 165, 186, 360

08.2, 76, 130, 137, 20, 31

06.0, 971, 51, 45, 32, 10

13.9, 347, 5097, 53, 15, 5

11.2, 248, 2305, 2199, 2, 1

14.0, 6, 711, 3680, 1161, 1

Norway Eff Catch II

83,88

1,1

3,7

35.7, 77, 368, 298, 610, 1215

40.0, 6, 92, 188, 100, 219

31.8, 329, 99, 184, 207, 91

43.7, 297, 3663, 174, 122, 95

49.3, 247, 2218, 5176, 174, 62

51.3, 10, 1377, 10425, 5553, 106

Table 4.17

VPA Version 2.1 - May 1983

Module run at 12.20.26 27 SEPTEMBER 1989

DISAGGREGATED qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,Norw Bar Sea Trawl , has terminal q estimated as the mean

Fleet 2 ,Norw Bar Sea Acousti, has terminal q estimated from trend

Fleet 3 ,USSR Trawlsurvey Tr, has terminal q estimated as the mean

Fleet 4 ,USSR Acousticsurvey , has terminal q estimated from trend

FLEETS COMBINED BY ** VARIANCE **

Terminal Fs estimated using Laurec/Sneperd method

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age F = 1.000 average of 4 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age,	83,	84,	85,	86,	87,	88,	89,
3,	.193,	.085,	.150,	.056,	.059,	.049,	.444,
4,	.437,	.371,	.319,	.431,	.276,	.187,	.252,
5,	.477,	.343,	.439,	.514,	.821,	.255,	.480,
6,	.359,	.301,	.555,	.620,	.642,	.856,	.262,
7,	.415,	.348,	.579,	.577,	.858,	1.227,	.617,
8,	.423,	.562,	.543,	.573,	.416,	.529,	.974,
9,	.197,	.437,	.766,	.528,	.664,	.198,	.540,
10,	.376,	.440,	.809,	.732,	.421,	.889,	.710,
11,	.493,	1.019,	.655,	.531,	.649,	1.003,	.710,
12,	.261,	2.736,	.572,	1.519,	1.074,	1.539,	1.970,
13,	.377,	1.158,	.701,	.827,	.702,	.907,	.783,

Log catchability estimates

Age	83	84	85	86	87	88	89
1,	-6.79,	-5.87,	-6.40,	-7.28,	-6.10,	-6.47,	-5.57
2,	-6.26,	-4.62,	-5.26,	-5.58,	-5.94,	-6.64,	-4.72
3,	,	-6.34,	-8.27,	-8.13,	-8.74,	-9.11,	-8.02
4,	,	,	,	-5.74,	-5.77,	-6.27,	-6.56

Fleet	SUMMARY STATISTICS				SLOPE	SE Slope	INTRCPT	SE Intrcpt
	Pred.	SE(q)	Partial	Raised				
	q		F	F				
1	-6.35	.615	.0017	.2026	.000E+00	.000E+00	-6.353	.213
2	-5.57	.816	.0038	.1884	.000E+00	.000E+00	-5.574	.289
3	-8.10	1.033	.0003	.4087	.000E+00	.000E+00	-8.101	.391
4	-6.09	.447	.0023	.7141	.000E+00	.000E+00	-6.087	.200
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)			Variance ratio	
	.400	.315	.352	.352			1.252	

Table 4.17 (cont'd)

Age 4							
Fleet,	83,	84,	85,	86,	87,	88,	89
1	-7.11	-7.26	-6.22	-7.06	-6.93	-6.51	-6.46
2	-6.20	-5.02	-4.70	-5.25	-6.21	-6.54	-5.77
3		-8.42	-7.79	-7.37	-9.08	-8.67	-8.76
4				-5.41	-5.85	-6.66	-6.40

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-6.79	.420	.0011	.1815	.000E+00	.000E+00	-6.791	.149	
2	-5.67	.742	.0035	.2789	.000E+00	.000E+00	-5.669	.262	
3	-8.35	.700	.0002	.3821	.000E+00	.000E+00	-8.349	.265	
4	-6.08	.627	.0023	.3480	.000E+00	.000E+00	-6.083	.280	
Fbar									
.252	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.288		.186		.288		.416		

Age 5							
Fleet,	83,	84,	85,	86,	87,	88,	89
1	-6.88	-8.16	-8.04	-8.50	-6.94	-7.31	-6.78
2	-5.92	-5.85	-6.43	-6.89	-5.96	-7.20	-6.16
3		-8.71	-8.74	-8.50	-8.27	-9.09	-8.88
4				-6.49	-4.25	-6.92	-5.85

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-7.52	.752	.0005	.2302	.000E+00	.000E+00	-7.516	.266	
2	-6.34	.560	.0018	.3988	.000E+00	.000E+00	-6.344	.198	
3	-8.70	.311	.0002	.5763	.000E+00	.000E+00	-8.700	.118	
4	-5.88	1.308	.0028	.4663	.000E+00	.000E+00	-5.879	.585	
Fbar									
.480	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.251		.172		.251		.470		

Age 6							
Fleet,	83,	84,	85,	86,	87,	88,	89
1	-7.42	-8.54	-8.77	-8.71	-9.12	-7.09	-8.26
2	-6.86	-6.23	-7.16	-6.41	-9.12	-6.90	-7.59
3		-9.92	-9.46	-8.71	-9.12	-8.29	-9.72
4				-6.41	-6.12	-5.92	-6.04

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-8.27	.800	.0003	.2591	.000E+00	.000E+00	-8.271	.283	
2	-7.18	1.033	.0008	.3948	.000E+00	.000E+00	-7.182	.365	
3	-9.20	.672	.0001	.4397	.000E+00	.000E+00	-9.205	.254	
4	-6.12	.231	.0022	.2419	.000E+00	.000E+00	-6.123	.103	
Fbar									
.262	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio		
	.207		.111		.207		.290		

Table 4.17 (cont'd)

Age 7 Fleet,	83,	84,	85,	86,	87,	88,	89
1	-7.51,	-8.90,	-7.51,	-8.70,	-7.10,	-7.35,	-7.91
2	-6.67,	-7.00,	-6.30,	-6.40,	-7.79,	-8.04,	-7.28
3		-10.69,	-9.30,	-8.70,	-8.48,	-8.73,	-9.30
4				-9.39,	-8.48,	-8.73,	-5.25

SUMMARY STATISTICS							
Fleet,	Pred,	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT, SE
q			F	F		Slope	Intercpt
1	-7.87	.733	.0004	.6454	.000E+00	.000E+00	-7.863 .259
2	-7.07	.718	.0009	.7647	.000E+00	.000E+00	-7.070 .254
3	-9.20	.869	.0001	.6810	.000E+00	.000E+00	-9.200 .323
4	-7.96	2.069	.0003	.0408	.000E+00	.000E+00	-7.963 .925
Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.617	.432		.337		.432		.610

Age 8 Fleet,	85,	84,	85,	86,	87,	88,	89
1	-7.20,	-9.21,	-8.27,	-7.14,	-8.69,	-9.17,	-9.01
2	-6.06,	-7.60,	-7.06,	-8.52,	-8.69,	-9.17,	-9.01
3		-8.81,	-10.06,	-10.13,	-8.69,	-7.56,	-7.40
4				-10.13,	-8.69,	-9.17,	-9.01

SUMMARY STATISTICS							
Fleet,	Pred,	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT, SE
q			F	F		Slope	Intercpt
1	-8.38	.953	.0002	1.8286	.000E+00	.000E+00	-8.384 .337
2	-8.02	1.230	.0003	2.6585	.000E+00	.000E+00	-8.017 .433
3	-8.77	1.263	.0002	.2473	.000E+00	.000E+00	-8.775 .477
4	-9.23	.694	.0001	.7680	.000E+00	.000E+00	-9.251 .310
Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.974	.473		.422		.473		.796

Table 4.18 Virtual Population Analysis from Tuning.

NORTH-EAST ARCTIC HADDOCK

	FISHING MORTALITY COEFFICIENT			UNIT: Year-1		NATURAL MORTALITY COEFFICIENT = .20						
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.062	.037	.102	.168	.023	.286	.336	.222	.258	.323	.768	.364
4	.305	.403	.148	.233	.269	.385	.601	.343	.576	.651	1.282	.644
5	.425	.565	.508	.205	.184	1.063	.949	.421	.518	.616	.945	.895
6	.496	.463	.556	.510	.147	.963	.469	.638	.447	.708	.504	.455
7	.504	.642	.406	.481	.421	.411	.303	.579	.511	.800	.638	.696
8	.555	.646	.428	.410	.343	.620	.179	.500	.339	.645	.535	.453
9	.347	.459	.418	.305	.301	.560	.305	.429	.213	.762	.325	.665
10	.284	.547	.419	.333	.261	.621	.203	.748	.150	.921	.516	.280
11	.537	.261	.237	.408	.282	.421	.189	.667	.407	.542	2.299	.791
12	.915	1.021	.169	.221	.653	.856	.250	.650	.203	1.544	.385	.434
13	.521	.572	.311	.317	.374	.614	.237	.623	.243	.942	.881	.542
14+	.521	.572	.311	.317	.374	.614	.237	.623	.243	.942	.881	.542
(4-7)U	.432	.518	.405	.357	.255	.705	.580	.495	.513	.694	.842	.673
(7-13)U	.521	.572	.311	.317	.374	.614	.237	.623	.243	.942	.881	.542
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.156	.038	.101	.125	.193	.085	.130	.056	.059	.048	.400	.073
4	.510	.312	.211	.275	.437	.371	.319	.431	.276	.187	.252	.303
5	.973	.694	.562	.473	.477	.363	.439	.514	.921	.255	.480	.507
6	.966	.826	.912	.708	.359	.301	.555	.620	.642	.856	.262	.669
7	.528	.432	.790	.597	.415	.348	.579	.577	.858	1.227	.617	.910
8	.534	.746	.557	.673	.423	.562	.543	.573	.416	.529	.974	.515
9	.503	.451	.574	.547	.197	.437	.766	.528	.664	.198	.560	.539
10	.561	.613	.247	.630	.576	.440	.809	.732	.421	.989	.710	.713
11	.578	.724	.519	.562	.493	1.019	.655	.531	.649	1.003	.710	.709
12	.687	.875	.826	1.577	.241	2.736	.572	1.519	1.074	1.539	1.170	1.176
13	.582	.665	.541	.838	.377	1.158	.701	.827	.702	.907	.783	.784
14+	.582	.665	.541	.838	.377	1.158	.701	.827	.702	.907	.783	.784
(4-7)U	.744	.566	.619	.513	.422	.341	.473	.536	.649	.631	.403	
(7-13)U	.582	.666	.542	.831	.377	1.158	.701	.827	.702	.907	.783	

Table 4.19 Virtual Population Analysys from Tuning.

NORTH-EAST ARCTIC HADDOCK

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	290493	19889	17203	163919	95474	1017574	269592	53573	48486	55626	113788	169874
4	172976	223471	15690	12714	113483	76380	526132	157659	35146	30669	32974	43238
5	42772	104436	122275	11077	8243	71006	42567	281185	91624	16169	13091	7492
6	72075	22904	48574	60225	7386	5616	20090	13488	151174	44680	7150	4164
7	24545	55952	11807	22802	29606	5220	1756	10289	5835	79195	18019	3538
8	4144	12143	15492	6427	11546	15915	2833	1062	4721	2865	29138	7798
9	816	1949	5212	8267	3491	6708	7007	1939	527	2755	1231	13969
10	733	472	1009	2810	4990	2115	3138	4227	1034	349	1052	728
11	408	483	224	543	1649	3148	931	2097	1638	729	114	514
12	138	195	304	144	296	1018	1691	631	881	892	347	9
13	73	45	58	210	95	126	354	1078	270	589	156	193
14+	19	48	8	77	14	100	68	337	468	82	182	170
TOTAL NO	609246	421987	237856	289215	276271	1204926	976160	527565	341805	234601	217242	251687
SPS NO	84527	94063	87039	73518	59387	56532	69255	100108	117533	106828	55944	32430
TOT. BIOM	712290	641935	474820	420112	381976	1018362	1020596	818171	651414	466283	312822	276581
SPS BIOM	203032	227430	220163	208596	177367	165025	148061	222296	287317	299925	171291	105438
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	133859	18746	5549	8265	4411	6161	267290	518664	75845	17373	5136	0
4	96602	93791	14782	4105	5971	2978	4633	192204	401546	58552	13551	1721
5	18526	47480	56250	9797	2552	3158	1683	2757	102231	249362	39762	8624
6	2506	5755	19411	26237	4999	1297	1835	888	1350	36811	158277	20154
7	2164	781	2062	6385	10585	2859	786	862	391	582	12901	99700
8	1444	1044	415	766	2878	5722	1653	361	396	136	140	5657
9	4757	694	405	195	320	1544	2671	736	166	214	66	43
10	5884	2008	362	187	92	215	816	1017	379	70	144	31
11	451	2750	891	251	82	42	114	298	400	204	24	58
12	191	207	1092	434	108	41	13	48	143	171	61	9
13	5	79	71	391	73	69	2	6	9	40	30	16
14+	131	34	110	65	318	292	123	14	41	20	64	35
TOTAL NO	265375	173366	101379	57057	32389	24378	281619	717904	582899	363535	229054	
SPS NO	24471	26140	57311	42951	26937	12604	14916	47780	28126	104257	107578	
TOT. BIOM	283854	241873	189640	119590	71225	53117	159371	358953	317259	350478	216401	
SPS BIOM	71705	65516	123672	102887	66964	39262	32105	57106	31723	123627	111984	

Table 4.21

Title : NORTH-EAST ARCTIC HADDOCK
At 18.12.07 19 OCTOBER 1989
SEPERABLE FISHING MORTALITIES

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.062	.075	.057	.053	.042	.106	.056	.087	.055	.114	.105	.081
4	.265	.322	.243	.227	.181	.452	.237	.370	.236	.486	.449	.346
5	.451	.547	.414	.385	.308	.766	.404	.630	.401	.827	.763	.589
6	.556	.675	.510	.475	.380	.948	.498	.777	.495	1.020	.941	.727
7	.640	.777	.587	.547	.438	1.090	.573	.894	.565	1.174	1.083	.836
8	.465	.564	.427	.398	.318	.792	.416	.650	.414	.853	.787	.608
9	.417	.506	.383	.357	.285	.711	.374	.583	.371	.765	.706	.545
10	.562	.682	.515	.480	.384	.957	.503	.785	.500	1.030	.950	.734
11	.546	.662	.501	.466	.373	.930	.488	.762	.486	1.001	.923	.713
12	.886	1.075	.813	.758	.606	1.510	.793	1.238	.780	1.625	1.499	1.158
13	.556	.675	.510	.475	.380	.948	.498	.777	.495	1.020	.941	.727

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	.083	.076	.073	.083	.052	.061	.071	.071	.071	.062	.055
4	.353	.327	.314	.353	.224	.261	.302	.305	.302	.267	.236
5	.601	.556	.534	.600	.381	.444	.513	.519	.513	.453	.402
6	.741	.686	.658	.741	.470	.548	.633	.641	.633	.559	.496
7	.853	.789	.758	.852	.541	.630	.728	.737	.729	.643	.571
8	.620	.574	.551	.619	.393	.458	.529	.536	.530	.468	.415
9	.556	.515	.494	.556	.353	.411	.475	.481	.475	.419	.372
10	.748	.693	.665	.748	.475	.553	.640	.647	.640	.565	.501
11	.727	.673	.646	.727	.461	.537	.621	.629	.621	.548	.487
12	1.181	1.093	1.049	1.180	.750	.873	1.009	1.021	1.000	.891	.790
13	.741	.686	.658	.741	.470	.548	.633	.641	.633	.559	.496

Title : NORTH-EAST ARCTIC HADDOCK
At 18.12.07 19 OCTOBER 1989
SEPERABLE POPULATION NUMBERS Units: thousands

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	266801	30940	17688	146892	82178	1039934	326402	62176	7743	11705	29399	67008
4	159710	205300	23496	13680	114055	64488	766053	252804	46687	5999	8553	21673
5	51556	100297	121841	15082	8929	77896	33605	494664	14292	30187	3020	4472
6	76487	26889	47516	65962	8399	5371	29583	18377	215775	78344	10812	1153
7	24676	35903	11211	23355	33570	4701	1765	14722	6920	107699	23132	3455
8	3950	10651	13521	5102	11064	17744	1294	787	4931	3206	27268	5415
9	726	2031	4960	7225	2807	6591	6577	698	337	2669	1118	13166
10	582	397	1002	2769	4140	1728	2651	3706	319	190	1017	452
11	370	272	162	490	1402	2309	543	1312	1385	159	56	322
12	130	176	115	80	252	791	746	273	501	698	48	18
13	69	44	49	42	31	112	143	276	65	187	112	9

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	107891	37494	7904	7522	3830	6634	229861	393934	72070	16048	19320
4	65691	81330	28437	6013	5670	2975	5109	175369	300287	54984	12345
5	12548	37779	48012	17009	3458	3710	1876	3093	105785	181791	34484
6	2031	5635	17737	23050	7639	1934	1948	919	1507	51839	94601
7	457	793	2323	7517	8998	3908	915	847	397	655	24266
8	1226	159	295	892	2624	4288	1703	362	332	157	282
9	2860	540	74	139	393	1450	2220	821	173	160	80
10	4825	1343	264	37	65	226	787	1131	416	88	86
11	178	1869	550	111	14	33	106	340	485	180	41
12	129	70	781	236	44	7	16	47	148	213	85
13	5	32	19	224	59	17	3	5	14	44	72

Table 4.22 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
1987	0.64	0.86	1.33	2.45	2.98	3.23	3.70	4.41	5.40	6.40	7.40	8.00
1988	0.58	0.84	1.05	1.43	1.96	2.52	2.83	3.18	3.25	3.73	3.82	3.76

Table 4.23 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	0.24	0.48	0.93	2.22	2.86	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1988	0.27	0.39	0.61	1.10	1.56	3.33	3.70	4.41	5.40	6.40	7.40	8.00
1989	0.28	0.44	0.70	1.02	1.43	2.24	2.68	3.01	3.22	3.49	3.78	3.79

Table 4.24 Virtual Population Analysis.

NORTH-EAST ARCTIC HADDOCK

CATCH IN NUMBERS

UNIT: thousands

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	15918	657	1520	23004	1979	230229	70204	9684	10037	13989	55967	47311
4	41373	67632	1963	2408	24359	22246	258773	41701	14089	13449	22043	18812
5	13505	41267	44526	1870	1258	42849	24018	88111	33871	6808	7368	4076
6	25736	7748	18956	21995	918	3196	6872	5827	49712	20789	2586	1389
7	8878	15599	3611	7948	9279	1606	418	4138	2135	40044	7781	1626
8	1617	5292	4925	1974	3056	6736	422	382	1236	1247	11043	2596
9	218	655	1624	1978	826	2630	1680	617	92	1349	311	6215
10	176	182	315	726	1043	896	525	2043	131	193	388	162
11	155	101	43	166	369	988	146	935	500	279	96	258
12	76	115	43	26	130	538	340	276	147	652	101	3
13	27	18	14	52	27	53	68	458	53	331	84	74
14+	7	19	2	19	4	42	13	143	92	46	98	65
TOTAL	107686	139285	77542	62166	43248	312009	363479	154315	112095	99176	107866	82587
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	17540	627	486	883	704	456	29548	25596	3928	746	943	
4	35290	22878	2561	900	1930	841	1153	61470	88297	9079	2746	
5	10645	21794	22124	3372	884	836	546	1013	52611	51009	13837	
6	1429	2971	10685	12203	1374	307	715	376	586	19464	33229	
7	812	250	1034	2625	3282	765	316	346	207	380	5394	
8	546	504	162	344	906	2250	634	144	123	51	80	
9	1466	230	162	75	52	499	1312	295	74	35	25	
10	2310	842	72	80	37	70	416	484	119	38	67	
11	181	1299	330	91	29	25	50	112	175	119	11	
12	87	111	564	320	21	36	5	35	87	125	39	
13	2	35	27	204	21	44	1	3	4	22	15	
14+	53	15	42	34	91	185	57	7	19	11	32	
TOTAL	70361	51556	38249	21131	9331	6314	34753	89881	146230	81079	56418	

Table 4.25 Virtual Population Analys. From Separable VPA.

NORTH-EAST ARCTIC HADDOCK

	FISHING MORTALITY COEFFICIENT					UNIT: Year-1	NATURAL MORTALITY COEFFICIENT = .20					
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.062	.037	.102	.168	.023	.286	.336	.222	.258	.323	.768	.364
4	.305	.403	.148	.233	.269	.385	.601	.343	.576	.651	1.282	.644
5	.424	.565	.508	.205	.184	1.063	.949	.421	.518	.616	.945	.895
6	.495	.462	.556	.510	.147	.963	.469	.638	.446	.708	.504	.455
7	.504	.642	.408	.480	.421	.411	.303	.579	.511	.800	.638	.696
8	.555	.647	.428	.410	.343	.620	.179	.500	.339	.645	.535	.454
9	.346	.458	.419	.304	.300	.559	.305	.428	.213	.763	.325	.664
10	.285	.545	.418	.334	.260	.618	.203	.748	.150	.920	.517	.280
11	.537	.263	.236	.407	.283	.420	.188	.666	.407	.541	2.298	.792
12	.914	1.020	.170	.219	.650	.862	.249	.644	.202	1.544	.384	.433
13	.520	.570	.310	.320	.370	.610	.240	.620	.240	.940	.880	.540
14+	.520	.570	.310	.320	.370	.610	.240	.620	.240	.940	.880	.540
(4- 7)U	.432	.518	.405	.357	.255	.705	.580	.495	.513	.694	.842	.672
(9-13)U	.520	.571	.311	.317	.373	.614	.237	.621	.243	.942	.881	.542
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.155	.037	.100	.126	.190	.080	.122	.073	.060	.051	.080	.077
4	.510	.311	.210	.271	.443	.363	.296	.399	.381	.193	.269	.317
5	.972	.694	.560	.468	.466	.349	.426	.460	.712	.396	.502	.498
6	.965	.825	.909	.703	.353	.291	.572	.591	.531	.634	.487	.582
7	.528	.431	.787	.593	.410	.339	.549	.608	.776	.804	.358	.684
8	.534	.746	.555	.668	.419	.551	.524	.524	.453	.438	.385	.485
9	.503	.451	.574	.544	.195	.430	.737	.497	.565	.223	.400	.506
10	.560	.613	.247	.629	.571	.434	.786	.677	.382	.646	.862	.623
11	.578	.722	.520	.563	.492	.997	.640	.502	.559	.832	.389	.633
12	.690	.874	.823	1.583	.241	2.698	.546	1.417	.953	1.046	.735	.991
13	.580	.670	.540	.830	.380	1.160	.661	.757	.583	.682	.320	.671
14+	.580	.670	.540	.830	.380	1.160	.661	.757	.583	.682	.320	.671
(4- 7)U	.744	.565	.617	.509	.418	.336	.461	.514	.600	.507	.404	
(9-13)U	.582	.666	.541	.830	.376	1.144	.674	.770	.609	.686	.541	

Table 4.26 Virtual Population Analysis. From Separable VPA.

NORTH-EAST ARCTIC HADDOCK

STOCK SIZE IN NUMBERS UNIT: thousands

BIO MASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	290491	19893	17203	163914	95473	1017593	269590	53573	48488	55630	113797	169945
4	172982	223469	15694	12714	113479	76380	626147	157657	35146	30670	32977	43246
5	42789	104441	122274	11080	8243	71003	42567	281197	91622	16169	13091	7494
6	72092	22918	48578	60224	7388	5616	20089	13489	151184	44678	7150	4165
7	24532	35966	11818	22805	29606	5222	1756	10288	5835	79204	18017	3537
8	4151	12132	15504	6436	11549	15915	2834	1062	4720	2865	29145	7796
9	818	1951	5203	8276	3498	6710	7008	1941	527	2754	1231	13975
10	779	474	1010	2803	4998	2122	3140	4227	1035	349	1052	729
11	408	480	225	544	1643	3154	936	2098	1638	730	114	514
12	138	195	302	146	297	1013	1696	635	882	893	348	9
13	73	45	58	208	96	127	350	1083	273	590	156	194
14+	19	48	8	76	14	100	67	338	474	82	182	170
TOTAL NO	609271	422012	237876	289228	276284	1204955	976180	527587	341826	234613	217260	251773
SPS NO	84589	94073	87053	73532	59402	56544	69264	100122	117549	106836	55950	32436
TOT. BIOM	712328	641981	474866	420148	382028	1018420	1020645	818269	651517	466318	312855	276663
SPS BIOM	203027	227448	220197	208629	177420	165074	148098	222380	287410	299956	171315	105463
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	134098	18874	5620	8193	4471	6538	282892	401744	73754	16442	13580	0
4	96659	93987	14887	4163	5912	3027	4942	204975	305826	56840	12788	10268
5	18593	47526	56390	9883	2599	3109	1723	3009	112657	171130	38361	8001
6	2507	5758	19447	26367	5069	1335	1795	921	1556	45264	94332	19012
7	2164	782	2067	6413	10691	2916	817	830	418	749	19660	47457
8	1444	1045	416	770	2902	5808	1700	386	370	157	274	11252
9	4055	693	406	196	323	1563	2741	824	187	193	83	153
10	5888	2007	361	187	93	218	832	1074	411	87	126	46
11	451	2754	890	231	82	43	115	310	447	229	37	44
12	190	207	1095	433	108	41	13	50	154	209	82	21
13	5	78	71	394	73	69	2	6	10	49	60	32
14+	132	34	110	66	316	292	129	14	47	24	128	112
TOTAL NO	266187	173745	101759	57294	32638	24960	297702	614144	495836	291373	179513	
SPS NO	24479	26167	57462	43195	27153	12789	15419	50860	29584	82960	81603	
TOT. BIOM	284082	242275	190203	120181	71828	53956	167541	337018	281544	296215	163562	
SPS BIOM	71727	65568	123966	103428	67552	39791	32867	60531	34122	109935	89163	

Table 4.27

List of input variables for the ICES prediction program.

PREDICTION OF NORTH-EAST ARCTIC HADDOCK AT W689

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

The number of recruits per year is as follows:

Year	Recruitment
1990	9000.0
1991	10000.0
1992	15000.0
1993	45000.0
1994	45000.0
1995	45000.0
1996	45000.0

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

		1990			1991			1992		
age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock	weight in the catch	weight in the stock	weight in the catch	weight in the stock
3:	9000.0	.11	.20	.00	.470	.270	.510	.300	.460	.270
4:	10268.0	.43	.20	.03	.720	.500	.720	.470	.770	.510
5:	8001.0	.81	.20	.33	.800	.650	.930	.770	.880	.720
6:	19012.0	1.00	.20	.51	1.060	.980	1.030	.950	1.180	1.090
7:	47457.0	1.15	.20	1.00	1.230	1.130	1.240	1.140	1.200	1.100
8:	11252.0	.86	.20	1.00	1.700	1.580	1.440	1.340	1.450	1.340
9:	153.0	.75	.20	1.00	2.400	2.250	1.950	1.820	1.670	1.550
10:	46.0	1.01	.20	1.00	3.250	3.060	2.710	2.550	2.230	2.080
11:	44.0	.96	.20	1.00	4.270	4.050	3.630	3.430	3.060	2.880
12:	21.0	1.59	.20	1.00	4.750	4.510	4.730	4.490	4.040	3.830
13:	32.0	1.00	.20	1.00	5.240	4.990	5.240	4.990	5.220	4.970
14+:	112.0	1.00	.20	1.00	5.490	5.490	5.490	5.490	5.490	5.490

		1993		1994		1995-1996	
		weight in the catch	weight in the stock	weight in the catch	weight in the stock	weight in the catch	weight in the stock
		.420	.240	.420	.240	.420	.240
		.710	.460	.650	.420	.650	.420
		.940	.770	.870	.710	.870	.650
		1.120	1.040	1.190	1.100	1.190	1.030
		1.370	1.260	1.310	1.210	1.310	1.200
		1.410	1.310	1.600	1.480	1.600	1.420
		1.680	1.560	1.630	1.520	1.630	1.710
		1.920	1.790	1.920	1.790	1.920	1.750
		2.530	2.370	2.190	2.050	2.190	2.050
		3.420	3.230	2.850	2.680	2.850	2.350
		4.490	4.260	3.820	3.620	3.820	3.020
		5.470	5.470	4.030	4.710	4.030	4.050

Table 4.28 North-East Arctic Haddock.
Stock size and catch predictions. Weights are in '000 t.

1990			1991			1992			1993			1994			1995			1996					
Stock (3+)	Spawn. biom.	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	
104	84	$F_{0.1}$	0.13	14	93	80	11	85	72	9	86	65	10	91	58	11	98	56	13	110	62		
		F_{med}	0.35	35	73	61	21	57	44	15	53	33	14	55	25	14	61	23	17	68	25		
		F_{89}	0.40	39	70	58	22	52	40	16	48	28	14	51	21	14	56	19	18	63	21		
Recruitment: 9 mill. (est)			10 mill. (est)			15 mill. (est)			45 mill.			45 mill.			45 mill.			45 mill.					

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	1979	1980	1981	1982	1983
Denmark	-	-	-	-	-
Faroe Islands	1,117	532	236	339	539
France	2,601	1,016	194	82	418
German Dem.Rep.	2,435	-	-	-	-
Germany, Fed.Rep.	14,823	12,511	8,413	7,224	4,933
Norway	141,346	128,878	166,139	159,643	149,556
Spain	685	780	-	-	33
UK (Engl.& Wales)	1,170	794	395	731	1,251
UK (Scotland)	-	-	-	1	-
USSR	3	43	121	14	206
Total	164,180	144,554	175,498	168,034	156,936

Country	1984	1985	1986	1987	1988 ¹
Denmark	-	-	-	1	-
Faroe Islands	503	490	426	-	167
France	431	657	308	576	404
German Dem.Rep.	6	11	-	-	1
Germany, Fed.Rep.	4,532	1,837	3,470	4,909	4,539
Norway	152,818	103,899	66,152	85,710	108,347
Spain	-	-	-	-	-
UK (Engl.& Wales)	335	202	54	54	436
UK (Scotland)	-	+	21	3	6
USSR	161	51	27	426	130
Total	158,786	107,147	70,458	91,679	114,050

¹ Provisional figures.

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

Year	Vessel size (m)						
	<9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0-34.9	>35
<u>Number of vessels</u>							
1977	85 ²	35	88	66	9	6	4
1978	62 ²	42	80	72	6	8	5
1979	105 ²	51	94	72	11	8	6
1980	78	73	118	96	18	11	10
1981	122	81	109	89	7	6	10
1982	101	100	107	98	11	7	5
1983	49	85	88	80	4	4	4
1984	34	62	72	69	5	6	4
1985	15	30	45	57	9	4	3
1986	11	14	30	43	9	5	7
1987	32	30	44	46	10	3	2
1988 ¹	30	36	43	43	9	3	2
<u>Catch (tonnes)</u>							
1977	1,137 ²	1,082	19,179	25,324	1,709	3,705	241
1978	629 ²	1,485	14,174	21,224	1,596	3,808	690
1979	1,246 ²	2,195	17,783	27,057	2,798	5,730	594
1980	924	3,481	16,838	27,551	3,710	5,224	1,300
1981	1,599	4,834	19,551	29,108	1,924	4,647	783
1982	1,991	5,699	22,538	35,969	3,028	5,334	941
1983	805	4,692	14,428	28,348	1,447	3,516	561
1984	186	1,553	7,095	20,668	1,638	2,239	2,836
1985	204	874	3,072	18,328	3,011	2,908	2,472
1986	50	275	956	3,581	1,000	1,383	260
1987	606	1,585	6,893	16,766	4,052	3,424	709
1988 ¹	1,128	3,034	8,352	16,856	5,512	3,446	579
<u>Catch per vessel (tonnes)</u>							
1977	13 ²	31	218	384	190	618	60
1978	10 ²	35	177	295	266	476	138
1979	12 ²	43	189	376	254	716	99
1980	12	48	143	287	206	475	130
1981	13	60	179	327	275	775	78
1982	20	57	211	367	275	762	188
1983	16	55	164	354	362	879	140
1984	5	25	99	300	328	373	709
1985	14	29	68	322	335	727	824
1986	5	20	32	83	111	277	37
1987	19	53	157	364	405	1,141	355
1988 ¹	38	84	194	392	612	1,149	290

¹ Preliminary.

² Estimate.

Table 5.3 Catch, effort, and catch per unit effort for Norwegian trawlers.

Year	Catch (t)	Effort (h)	CPUE (kg/h)
1976	12,982	21,615	601
1977	15,583	29,308	532
1978	12,506	27,094	462
1979	16,609	24,258	685
1980	27,618	39,290	703
1981	43,682	49,191	888
1982	30,358	33,164	915
1983	38,846	37,856	1,026
1984	56,128	60,282	931
1985	29,260	39,894	733
1986	20,897	25,037	835
1987 ²	8,631	11,860	728
1988 ²	13,409	16,686	804

¹ Including only days with more than 50% saithe on trips with more than 50% saithe in the catches.

² Preliminary.

Table 5.4 North-East Arctic SAITHE. Norwegian effort indices.

Year	Purse seine ¹	Trawl ²
1976	-	36.8
1977	206	52.7
1978	214	51.3
1979	199	42.7
1980	215	57.4
1981	203	71.0
1982	213	58.2
1983	161	57.7
1984	124	85.5
1985	98	63.7
1986	96	45.2
1987	94	30.1
1988	112	49.1

¹ No. of vessels 20-24.9 m.

² Hours trawling ('000).

Both categories raised to total Norwegian landings for the gear.

Table 5.5 Tuning data.

NORTHEAST ARCTIC SALTHER : EFFORT AND CATCH DATA

102								
Norw Purse Seine								
77,88								
1,1								
3,9								
206,	81152,	8694,	2144,	133,	9,	1,	1	
214,	37652,	8788,	2126,	456,	88,	1,	1	
199,	41942,	6706,	6575,	1362,	363,	5,	15	
215,	23353,	15280,	3280,	1683,	681,	258,	3	
203,	68716,	57704,	2219,	154,	36,	1,	1	
213,	28360,	43980,	250,	140,	1,	1,	1	
161,	12402,	9775,	12090,	463,	179,	105,	39	
124,	21699,	3842,	2144,	1363,	21,	8,	1	
98,	28815,	2688,	1096,	340,	95,	31,	1	
96,	9869,	593,	181,	108,	51,	30,	5	
94,	12364,	32183,	386,	19,	2,	1,	1	
112,	4754,	32768,	11521,	77,	6,	4,	1	
Norw Trawl								
76,88								
1,1								
3,9								
36.8,	11184,	583,	1080,	1137,	869,	612,	332	
52.7,	4557,	9047,	3260,	202,	660,	322,	361	
51.3,	488,	3104,	3440,	1400,	319,	591,	254	
42.7,	7374,	6538,	2340,	762,	845,	419,	294	
57.4,	10270,	10301,	1726,	2891,	1392,	406,	24	
71.0,	5680,	12137,	10877,	1901,	1053,	1351,	83	
58.2,	1719,	10344,	10006,	5519,	420,	306,	215	
57.7,	3341,	10024,	14949,	2189,	1720,	535,	181	
85.5,	14876,	25819,	7038,	7161,	656,	744,	180	
63.7,	10070,	6177,	3844,	3877,	2446,	441,	564	
45.2,	4388,	8150,	4078,	3172,	2044,	779,	208	
30.1,	470,	7862,	2452,	1169,	1405,	189,	153	
49.1,	2494,	3936,	15962,	3675,	784,	426,	337	

Table 5.6

North-East Arctic Saithe.
Results from tuning analysis.

Module run at 19.29.18 21 SEPTEMBER 1989

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,Norw Purse Seine , has terminal q estimated as the mean

Fleet 2 ,Norw Trawl , has terminal q estimated as the mean

FLEETS COMBINED BY ** VARIANCE **

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 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

Fishing mortalities

Age,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,
1,	.000,	.000,	.009,	.002,	.003,	.001,	.001,	.003,	.000,	.000,	.000,	.001,	.000,
2,	.217,	.215,	.198,	.208,	.058,	.074,	.138,	.109,	.112,	.006,	.019,	.075,	.074,
3,	.875,	.767,	.600,	.448,	.517,	.406,	.373,	.200,	.683,	.654,	.082,	.131,	.300,
4,	.658,	.636,	.504,	.650,	.524,	.584,	.640,	.473,	.728,	.426,	.355,	.268,	.538,
5,	.521,	.476,	.503,	.524,	.583,	.680,	.861,	.796,	.470,	.335,	.398,	.193,	.294,
6,	.421,	.246,	.405,	.332,	.478,	.479,	.606,	.534,	.712,	.388,	.365,	.368,	.453,
7,	.385,	.383,	.277,	.494,	.429,	.357,	.247,	.468,	.363,	.553,	.337,	.535,	.335,
8,	.352,	.279,	.279,	.295,	.446,	.528,	.297,	.480,	.560,	.453,	.412,	.158,	.272,
9,	.432,	.298,	.292,	.339,	.066,	.211,	.218,	.297,	.444,	.605,	.382,	.324,	.238,
10,	.344,	.271,	.298,	.215,	.309,	.173,	.229,	.174,	.369,	.179,	.743,	.535,	.339,
11,	.318,	.145,	.299,	.142,	.321,	.166,	.105,	.279,	.449,	.313,	.259,	1.358,	.406,
12,	.411,	.108,	.328,	.202,	.325,	.106,	.103,	.149,	.341,	.481,	.117,	.587,	.276,
13,	.801,	.167,	.177,	.125,	.288,	.162,	.124,	.212,	.206,	.201,	.117,	.404,	.214,
14,	.461,	.198,	.279,	.205,	.262,	.164,	.156,	.222,	.362,	.356,	.323,	.642,	.295,

Log catchability estimates

Age 3

Fleet,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,		-5.79,	-6.14,	-6.49,	-6.59,	-6.41,	-6.55,	-7.02,	-5.85,	-5.54,	-7.37,	-6.94,	-6.72
2,	-6.15,	-7.31,	-9.06,	-6.68,	-6.09,	-7.86,	-8.06,	-7.30,	-5.86,	-6.16,	-7.93,	-9.07,	-6.54

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1	-6.49	.657	.1697	.3773	.000E+00	.000E+00	-6.492	.182
2	-7.24	.859	.1140	.1499	.000E+00	.000E+00	-7.236	.306
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.300	.570	.399	.570	.490				

Age 4

Fleet,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,		-7.15,	-7.20,	-6.97,	-6.89,	-4.88,	-6.20,	-6.72,	-7.30,	-6.93,	-8.68,	-6.30,	-6.62
2,	-7.98,	-5.75,	-6.81,	-5.46,	-5.96,	-5.39,	-6.35,	-5.67,	-5.02,	-5.67,	-5.11,	-6.57,	-6.92

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1	-6.74	.981	.1329	.1769	.000E+00	.000E+00	-6.737	.272
2	-6.07	.859	.1140	1.2632	.000E+00	.000E+00	-6.065	.230
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.538	.646	.974	.974	2.274				

Table 5.6 (cont'd)

Age 5														
Fleet,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88	
1,		-7.62,	-7.82,	-6.70,	-6.94,	-7.97,	-9.47,	-6.31,	-7.30,	-7.56,	-9.00,	-8.61,	-7.02	
2,		-6.25,	-5.84,	-5.91,	-6.20,	-6.26,	-5.33,	-4.48,	-5.07,	-5.74,	-5.87,	-5.13,	-5.87	

SUMMARY STATISTICS									
Fleet,	Pred.	SE(q)	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1,	-7.69	.986	.0511	.1499	.000E+00	.000E+00	-7.693	.273	
2,	-5.66	.547	.1710	.3625	.000E+00	.000E+00	-5.660	.146	
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
.294	.478	.375	.178	.613					

Age 6													
Fleet,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,		-9.47,	-8.57,	-7.57,	-7.44,	-9.21,	-9.93,	-7.65,	-7.27,	-8.27,	-9.31,	-10.64,	-9.88
2,		-6.51,	-7.69,	-6.02,	-6.61,	-5.58,	-5.64,	-4.96,	-5.07,	-5.24,	-5.41,	-5.17,	-5.39

SUMMARY STATISTICS									
Fleet,	Pred.	SE(q)	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1,	-8.77	1.178	.0174	1.3833	.000E+00	.000E+00	-8.768	.327	
2,	-5.73	.817	.1596	.2653	.000E+00	.000E+00	-5.729	.218	
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
.453	.671	.773	.773	1.327					

Age 7													
Fleet,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,		-12.47,	-9.46,	-8.08,	-7.76,	-10.60,	-13.72,	-8.66,	-9.82,	-8.85,	-9.57,	-12.63,	11.42
2,		-5.93,	-6.81,	-6.75,	-5.69,	-5.73,	-6.18,	-6.38,	-5.37,	-6.01,	-5.17,	-5.13,	4.94

SUMMARY STATISTICS									
Fleet,	Pred.	SE(q)	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1,	-10.25	2.003	.0039	1.0747	.000E+00	.000E+00	-10.255	.566	
2,	-5.83	.616	.1440	.3004	.000E+00	.000E+00	-5.832	.165	
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
.335	.589	.358	.589	.370					

Age 8													
Fleet,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,		-13.89,	-14.17,	-11.77,	-7.82,	-13.56,	-13.71,	-8.23,	-10.80,	-8.60,	-9.29,	-13.01,	-11.50
2,		-6.31,	-6.75,	-6.36,	-5.81,	-6.05,	-5.30,	-6.69,	-5.58,	-5.90,	-5.51,	-5.23,	-6.63

SUMMARY STATISTICS									
Fleet,	Pred.	SE(q)	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1,	-11.36	2.472	.0013	.3112	.000E+00	.000E+00	-11.362	.686	
2,	-6.01	.530	.1202	.2698	.000E+00	.000E+00	-6.012	.142	
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
.272	.518	.292E-01	.518	.003					

Age 9													
Fleet,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,		-13.92,	-13.44,	-10.88,	-11.97,	-12.78,	-13.02,	-9.27,	-11.96,	-11.86,	-9.78,	-12.10,	-12.79
2,		-6.53,	-6.67,	-6.48,	-6.36,	-8.57,	-7.31,	-6.35,	-6.70,	-6.40,	-5.10,	-5.30,	-5.93

SUMMARY STATISTICS									
Fleet,	Pred.	SE(q)	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1,	-11.98	1.463	.0007	.5364	.000E+00	.000E+00	-11.981	.406	
2,	-6.45	.894	.0776	.1761	.000E+00	.000E+00	-6.450	.239	
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
.238	.763	.496	.763	.422					

Table 5.7

Title : NORTH-EAST ARCTIC SAITHE
 At 10.05.08 25 SEPTEMBER 1989
 from 78 to 88 on ages 2 to 14
 with Terminal F of .363 on age 4 and Terminal S of .500

Initial sum of squared residuals was 85.723 and
 final sum of squared residuals is 39.420 after 88 iterations

Matrix of Residuals

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages												
2/ 3	.834	.937	-.381	-.075	1.284	.155	-.229	-1.132	-.176	.171	.000	.446
3/ 4	.437	.398	-.344	-.016	.292	-.616	.839	1.174	-.626	-1.049	.000	.458
4/ 5	-.347	.105	-.458	-.453	-.076	.046	.430	-.141	.629	-.435	.000	.841
5/ 6	.109	.054	.029	.077	.711	.516	-.195	-.289	.273	-1.093	.000	.646
6/ 7	-.595	-.530	-.100	.229	.196	.374	-.049	-.252	-.260	-.237	.000	1.000
7/ 8	-.477	.064	-.412	-.164	-.799	-.018	-.640	.205	.896	-.521	.000	.602
8/ 9	-.556	1.200	.440	-.617	-.173	.216	-.302	.019	.403	-.781	.000	.540
9/10	.034	.074	-1.354	-.387	.076	-.090	.553	.002	.014	-.166	.000	.648
10/11	.613	-.307	.527	.293	-.121	-.678	.009	-.438	.457	-.476	.000	.700
11/12	-.074	-1.135	.622	-.115	-.774	-.291	-.489	.542	-.714	1.841	.000	.368
12/13	.778	-.354	.536	-.479	-.829	-.264	.210	1.340	-1.025	1.045	.000	.394
13/14	.166	-.259	.926	.308	-.131	.172	-.311	-.051	-.832	.845	.000	.601
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.888	
WTS	.001	.001	.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

F-values	78											
	.6755											
F-values	79	80	81	82	83	84	85	86	87	88		
	.6051	.6429	.5755	.4905	.4878	.5715	.4113	.3486	.4229	.3630		

Selection-at-age (S)

S-values	2	3	4									
	.1153	.6058	1.0000									
S-values	5	6	7	8	9	10	11	12	13	14		
	.9170	.8797	.7140	.6106	.5043	.4529	.4802	.3417	.3088	.5000		

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

NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0 + 1 + 2 + 3)																						
16 33 2			No. of surveys No. of years VPA Column No.)																			
1957	791	-	-	-	-	12	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1958	919	-	-	-	-	16	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1959	731	-	-	-	-	18	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1960	474	-	-	-	-	9	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1961	359	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1962	778	-	-	-	-	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1963	1584	-	-	-	-	21	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1964	1273	-	-	-	-	49	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1965	170	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1966	112	-	-	-	-	2	1	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1967	127	-	-	-	-	1	1	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1968	405	-	-	-	-	7	1	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1969	1016	-	-	-	-	11	6	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1970	1819	25	54	60	42	70	85	2.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971	524	7	9	6	3	37	24	0.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972	622	5	4	34	15	54	17	0.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1973	614	16	5	15	2	70	5	1.43	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	348	1	1	4	1	6	1	0.29	-	-	-	-	-	-	-	-	-	-	-	-	-	104
1975	640	60	1	44	1	93	4	0.90	-	-	-	-	-	-	-	-	-	-	-	-	-	882
1976	199	1	1	1	1	4	1	0.13	-	-	-	-	-	-	-	-	-	-	-	-	45	235
1977	140	1	1	2	1	2	1	0.49	-	-	-	-	-	-	-	-	-	-	-	-	28	14
1978	159	1	2	1	1	1	3	0.22	-	-	8.6	-	-	-	-	-	9.0	-	-	16	-	58
1979	153	1	1	1	1	1	8	0.40	-	11.0	16.1	-	22.2	22.2	-	-	-	-	-	-	73	71
1980	158	1	1	1	1	1	8	0.13	0.7	0.9	10.8	0.1	4.0	6.2	3	4	-	-	-	-	4	17
1981	377	1	1	1	1	4	4	0.10	0.1	5.9	60.2	1.5	5.1	5.6	-	-	-	-	-	-	15	174
1982	428	1	8	8	15	8	10	0.59	44.6	126.6	90.3	14.6	42.7	74.3	-	-	-	-	-	-	506	550
1983	753	4	9	11	7	45	41	1.69	355.3	148.9	556.0	52.2	133.1	164.0	232.2	27.0	50.1	47.0	69	578	1246	
1984	-	1	1	2	8	7	15	1.55	7.3	93.0	95.8	27.0	50.1	47.0	69	578	1246	-	-	-	-	
1985	-	3	10	2	3	4	6	2.46	82.5	89.3	69.5	3.5	26.2	15.6	625	-	-	-	-	1	47	79
1986	-	1	2	1	1	2	5	0.17	0.7	4.5	17.7	17.9	3.3	2.6	-	-	-	-	-	1	23	31
1988	-	1	1	-	-	-	-	0.35	1.1	-	-	-	-	-	-	-	-	-	-	1	?	-
1989	-	-	-	-	-	-	-	0.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R-1-1	USSR Bottom trawl survey, area J, age 1																					
R-2B-1	USSR " " " " " IIB, age 1																					
R-1-2	USSR " " " " " I, age 2																					
R-2B-2	USSR " " " " " IIB, age 2																					
R-1-3	USSR " " " " " I, age 3																					
R-2B-3	USSR " " " " " IIB, age 3																					
INTOSP	International 0-group survey																					
N-RST1	Norwegian Barents sea, Bottom trawl survey, age 1																					
N-RST2	Norwegian " " " " " " " age 2																					
N-RST3	Norwegian " " " " " " " age 3																					
N-RVT1	Norwegian Svalbard area " " " " " " " age 1																					
N-RVT2	Norwegian " " " " " " " age 2																					
N-RVT3	Norwegian " " " " " " " age 3																					
N-RSA1	Norwegian Barents sea Acoustic survey age 1																					
N-RSA2	Norwegian " " " " " " " age 2																					
N-RSA3	Norwegian " " " " " " " age 3																					

Table 3.22 North-East Arctic Cod. Virtual Population Analysis from Tuning.

	FISHING MORTALITY COEFFICIENT			UNIT: Year-1		NATURAL MORTALITY COEFFICIENT = .20						
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.030	.024	.023	.041	.021	.039	.196	.214	.084	.166	.134	.146
4	.153	.207	.222	.142	.103	.167	.200	.496	.210	.312	.567	.224
5	.181	.407	.481	.333	.229	.298	.353	.537	.522	.478	.753	.669
6	.202	.467	.538	.571	.237	.385	.392	.577	.701	.572	.681	.847
7	.429	.401	.769	.621	.520	.316	.422	.445	.703	.696	.678	.845
8	.673	.523	.927	.839	.833	.670	.644	.488	.704	.887	.908	.936
9	.339	.778	1.144	.960	.933	1.133	1.010	.409	.614	.777	1.213	1.290
10	.625	.732	.991	1.001	.772	1.236	.738	.982	.478	.464	.774	.990
11	.309	.586	1.156	.699	.684	1.222	.590	.988	1.201	.314	.632	1.847
12	.931	.384	.941	.455	.545	.877	.641	.629	.818	1.055	.247	1.502
13	.872	1.319	.827	.675	.515	1.034	.431	1.306	1.421	.471	1.000	2.447
14	.882	.755	.979	.707	.629	1.087	.600	1.101	.979	.576	.663	1.696
15+	.882	.755	.979	.707	.629	1.087	.600	1.101	.979	.576	.663	1.696
(5-10)U	.575	.552	.808	.729	.587	.673	.593	.561	.620	.646	.835	.929
(10-14)U	.832	.755	.979	.707	.629	1.087	.600	1.101	.979	.576	.663	1.696
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.049	.031	.024	.064	.027	.020	.049	.023	.039	.027	.019	.034
4	.209	.129	.096	.201	.194	.121	.148	.194	.185	.189	.142	.179
5	.348	.355	.229	.297	.309	.289	.359	.480	.603	.431	.491	.468
6	.347	.624	.514	.548	.434	.376	.580	.766	.958	.942	.555	.812
7	.660	.674	.352	.793	.772	1.072	.997	.933	1.051	1.130	1.150	1.040
8	.753	.703	1.068	.998	1.008	1.184	1.101	1.213	.928	.933	1.074	1.044
9	1.053	.869	1.232	1.124	1.007	1.203	1.002	.933	1.034	.789	.885	.939
10	.950	1.089	.975	.686	.847	1.012	.700	.953	1.396	1.264	.567	1.081
11	1.257	1.314	1.092	.563	.496	.818	.615	.754	.639	.887	.730	.734
12	1.351	.848	.775	1.242	.295	.737	.536	1.307	1.201	.822	1.000	1.016
13	.343	1.666	1.415	.440	1.116	.383	.539	.554	.901	1.008	.750	.763
14	1.101	1.233	1.082	.734	.689	.732	.610	.944	1.047	.293	.762	.899
15+	1.101	1.233	1.082	.734	.689	.732	.610	.944	1.047	.293	.762	.899
(5-10)U	.718	.719	.815	.741	.738	.889	.790	.890	.995	.915	.787	
(10-14)U	1.101	1.233	1.082	.734	.689	.732	.610	.944	1.047	.293	.762	

Table 3.23 North-East Arctic Cod. Virtual Population Analysis from Tuning.

STOCK SIZE IN NUMBERS		UNIT: thousands										
BIOMASS TOTALS		UNIT: tonnes										
ALL VALUES ARE GIVEN FOR 1 JANUARY												
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	1292652	169744	111960	197049	404984	1015615	1818318	524996	622028	614210	547712	639572
4	1245222	1027215	135026	39582	154865	324571	799435	1223762	347149	463426	425997	243996
5	459788	375291	533846	38951	63618	114402	224811	536134	610066	230393	280759	197887
6	132406	314089	476203	346140	49657	41439	69546	129279	256504	296501	116939	108225
7	82631	88545	161197	227612	160060	32084	23077	38479	63738	104132	136954	48466
8	55975	44067	48533	61137	110140	77946	19153	12392	20179	25823	42505	56904
9	21701	23371	21393	15721	21655	35649	32650	8238	6230	8170	8712	14029
10	4512	7679	3791	5577	4923	6971	9397	9733	4431	2760	3076	2120
11	1260	1619	3023	2672	1679	1863	1659	3678	2984	2275	1421	1162
12	567	420	738	779	1087	694	450	753	1121	735	1361	618
13	420	183	234	236	405	516	253	194	328	405	210	871
14	74	144	40	84	98	198	143	135	26	65	207	63
15+	26	95	80	75	58	65	133	101	64	132	122	67
TOTAL NO	3297235	2552458	1651662	1035664	963232	1652013	2999025	2487873	1934899	1754028	1365975	1318991
SPS NO	84536	77576	82851	86331	130050	123903	63838	35223	35414	40367	57613	75834
TOT. BIOM	3950551	3973501	3412005	2420154	1862450	2045039	2964045	3064588	2732733	2510814	2146933	1793535
SPS BIOM	456203	435671	463438	465926	676839	674924	391198	232011	212984	230009	312448	400556
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	199187	140495	157945	159039	170031	382815	446536	817431	159791	148418	41799	0
4	452608	155318	111496	126238	122136	136403	307077	348189	653958	125798	118309	33571
5	163002	300813	111762	32743	34509	82353	98977	216831	234776	445008	85269	84014
6	82933	94228	172659	72782	50359	50791	50498	56539	109917	105178	236785	42731
7	37985	39320	41330	84546	34448	25409	23375	23136	21517	34526	33578	111264
8	17045	16074	16412	14430	51329	13037	7119	7062	7086	6160	9135	8708
9	13280	6573	5515	4619	4355	9362	3266	1938	1719	2294	1985	2554
10	3162	5222	2258	1555	1229	1303	2302	982	624	500	854	670
11	645	1071	1439	683	641	431	388	936	307	126	116	396
12	150	150	220	395	317	320	156	172	361	126	43	46
13	113	32	53	33	93	193	125	75	31	89	45	13
14	62	40	5	10	44	25	108	57	35	10	27	18
15+	73	12	2	10	11	25	91	2	13	24	31	22
TOTAL NO	975265	759278	622096	547140	499501	702457	939939	1473399	1190135	868257	527775	
SPS NO	39531	29105	26905	113107	94304	70332	70332	92625	143406	97050	58471	
TOT. BIOM	1388429	1238329	1036400	940041	763451	911330	1231204	1445957	1081623	693042	644109	
SPS BIOM	228210	168340	151170	372643	325638	280517	288185	238856	255652	183570	132708	

Table 3.25

Title : NORTH-EAST ARCTIC COD
 At 11.40.22 19 OCTOBER 1989
 SEPERABLE FISHING MORTALITIES

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.020	.022	.032	.027	.022	.029	.027	.031	.032	.029	.035	.043
4	.108	.119	.170	.146	.114	.153	.141	.164	.172	.156	.184	.230
5	.294	.326	.465	.399	.312	.418	.386	.448	.471	.428	.503	.629
6	.501	.554	.791	.678	.531	.711	.656	.763	.801	.728	.855	1.070
7	.662	.733	1.047	.897	.703	.941	.868	1.009	1.061	.963	1.132	1.416
8	.669	.740	1.058	.907	.710	.950	.877	1.020	1.072	.973	1.144	1.431
9	.603	.667	.952	.817	.639	.856	.790	.918	.965	.876	1.030	1.289
10	.637	.705	1.007	.863	.676	.905	.835	.971	1.020	.926	1.089	1.362
11	.428	.474	.676	.580	.454	.608	.561	.652	.686	.622	.732	.915
12	.575	.637	.909	.780	.610	.817	.754	.877	.921	.837	.983	1.230
13	.423	.468	.669	.573	.449	.601	.555	.645	.678	.615	.723	.905
14	.464	.513	.733	.628	.492	.658	.608	.706	.742	.674	.792	.991
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	.030	.029	.029	.028	.025	.029	.027	.033	.036	.033	.027	
4	.160	.156	.155	.149	.134	.152	.145	.173	.190	.174	.146	
5	.438	.428	.424	.408	.365	.416	.398	.474	.521	.475	.399	
6	.744	.728	.721	.695	.621	.708	.676	.807	.885	.808	.679	
7	.985	.963	.955	.919	.822	.936	.895	1.067	1.172	1.069	.898	
8	.995	.973	.965	.929	.831	.946	.904	1.079	1.184	1.080	.907	
9	.896	.876	.869	.837	.748	.852	.814	.971	1.066	.973	.817	
10	.947	.926	.918	.884	.791	.901	.861	1.027	1.127	1.028	.864	
11	.637	.622	.617	.594	.531	.605	.578	.690	.757	.691	.580	
12	.856	.837	.829	.799	.714	.813	.777	.927	1.018	.929	.780	
13	.629	.615	.610	.587	.525	.598	.572	.682	.748	.683	.574	
14	.690	.674	.668	.644	.575	.655	.626	.747	.820	.748	.629	

Table 3.25 (cont'd)

Title : NORTH-EAST ARCTIC COD
 At 11.40.22 19 OCTOBER 1989
 SEPERABLE POPULATION NUMBERS Units: thousands

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	1367922	283130	213822	310743	526081	1117838	1797894	1817221	924569	345949	229225	519944
4	1290492	1097486	226667	169544	247522	421555	889238	1433390	1442570	732799	275013	181284
5	509914	948783	797712	156564	119979	180793	296234	632265	996125	994158	513084	187345
6	153967	311052	560952	410247	86031	71889	97461	164904	330623	509116	530626	254060
7	91123	76415	146384	208246	170460	41417	28913	41399	62978	121450	201331	184696
8	52495	38469	30068	42083	69492	69120	13238	9934	12356	17854	37960	53150
9	17905	22008	15021	8550	13912	27972	21876	4507	2934	3464	5524	9903
10	4206	8023	9251	4745	3093	6010	9731	8128	1473	915	1181	1615
11	1120	1821	3247	2768	1639	1288	1991	3456	2521	435	297	326
12	534	598	929	1351	1269	852	574	930	1474	1040	191	117
13	513	246	259	306	507	564	308	221	317	480	369	59
14	118	275	126	109	141	265	253	145	95	132	213	147
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	216985	138746	160873	185813	193474	383160	453386	736280	178258	134896	29332	
4	407640	172376	110296	127920	147910	154468	304843	361172	583441	140805	106889	
5	117923	284394	120692	77332	90202	105962	108622	215814	248627	394894	96904	
6	81762	62325	151792	64661	42082	51257	57228	59756	109966	120955	201074	
7	71338	31797	24646	60410	26426	18513	20681	23825	21837	37143	44149	
8	36695	21810	9938	7769	19723	9510	5942	6919	6708	5540	10441	
9	10404	11103	6748	3101	2512	7037	3023	1969	1926	1681	1540	
10	2235	3476	3785	2318	1100	973	2457	1096	610	543	520	
11	339	710	1127	1237	784	408	324	851	321	162	159	
12	107	147	312	498	559	377	183	149	349	123	66	
13	28	37	52	111	183	224	137	69	48	103	40	
14	19	12	16	23	51	89	101	63	28	19	43	

Table 3.28 Virtual Population Analysis.

NORTH-EAST ARCTIC COD

	CATCH IN NUMBERS											
	UNIT: thousands											
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	34467	3709	2307	7164	7754	35536	294262	91855	45282	85337	39594	78822
4	160048	174585	24545	10792	13739	45431	131493	437377	59798	114341	168609	45400
5	69235	267961	238511	25813	11831	26832	61000	203772	226646	79993	136335	88495
6	22061	107051	181239	137829	9527	12089	20569	47006	118567	118236	52925	56823
7	26295	26701	79363	96420	59290	7918	7248	12630	29522	47872	61821	25407
8	25139	16399	26989	31920	52003	34885	8328	4370	9353	13962	23338	31821
9	11323	11597	13463	8933	12093	22315	19130	2523	2617	4051	5659	9408
10	2329	3657	5092	3249	2434	4572	4499	5607	1555	936	1521	1227
11	687	657	1913	1232	762	1215	677	2127	1928	558	610	913
12	316	122	414	260	418	353	195	322	575	442	271	446
13	225	124	121	106	149	315	81	151	231	139	122	748
14	40	70	23	39	42	121	59	83	15	26	92	48
15+	14	46	46	35	25	40	55	62	37	53	54	51
TOTAL	352179	612679	574026	323792	170067	191622	547596	807885	496126	465946	490951	339609
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	8600	3911	3407	8948	3108	7027	19282	16942	5570	3550	721	
4	77484	17086	9466	20933	19594	14165	38322	55859	100391	19584	14258	
5	43677	81986	20803	19345	20473	18839	27216	75486	97318	142218	30224	
6	31943	40061	63433	28084	17656	20350	20342	27772	62371	59058	92282	
7	16815	17664	21788	42496	17004	15415	13588	13337	12901	21571	21184	
8	8274	7442	9933	8395	18329	8359	4385	4587	3942	3438	5548	
9	10974	3508	4267	2878	2545	6054	1904	1082	1021	1149	1072	
10	1785	3196	1311	708	646	764	1062	559	435	332	338	
11	427	678	882	271	229	221	163	455	140	68	55	
12	103	79	109	260	74	153	59	124	233	65	25	
13	59	24	37	27	58	56	51	29	17	52	22	
14	38	26	3	5	20	12	45	32	21	6	13	
15+	45	8	1	5	5	12	38	1	8	14	15	
TOTAL	200224	175669	135440	132355	99741	91427	126457	196265	284368	251205	165757	

Table 3.29 Virtual Population Analysis.

NORTH-EAST ARCTIC COD

	FISHING MORTALITY COEFFICIENT					UNIT: Year-1	NATURAL MORTALITY COEFFICIENT = .20					
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.030	.024	.023	.041	.021	.039	.196	.214	.084	.166	.134	.146
4	.153	.207	.222	.142	.103	.167	.200	.496	.210	.312	.567	.224
5	.181	.409	.481	.383	.229	.298	.353	.537	.522	.478	.753	.669
6	.202	.467	.538	.571	.237	.385	.392	.507	.701	.572	.681	.846
7	.429	.401	.769	.621	.520	.316	.422	.445	.703	.696	.678	.845
8	.673	.523	.927	.839	.833	.670	.644	.488	.704	.887	.908	.936
9	.839	.778	1.144	.960	.934	1.133	1.010	.409	.614	.777	1.213	1.290
10	.825	.732	.991	1.001	.772	1.236	.738	.982	.478	.464	.774	.990
11	.899	.586	1.156	.699	.684	1.222	.591	.988	1.201	.314	.632	1.847
12	.931	.384	.941	.455	.545	.807	.642	.630	.816	1.056	.247	1.502
13	.875	1.320	.828	.676	.516	1.084	.431	1.806	1.425	.470	1.000	2.447
14	.880	.760	.980	.710	.630	1.090	.600	1.100	.980	.580	.660	1.700
15+	.880	.760	.980	.710	.630	1.090	.600	1.100	.980	.580	.660	1.700
(5-10)U	.525	.552	.808	.729	.587	.673	.593	.561	.620	.646	.835	.929
(10-14)U	.882	.755	.979	.708	.629	1.088	.600	1.101	.980	.577	.663	1.697
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.049	.031	.024	.064	.020	.020	.047	.025	.035	.029	.004	.034
4	.208	.129	.098	.201	.196	.122	.146	.186	.201	.166	.157	.175
5	.348	.355	.229	.296	.309	.292	.360	.473	.564	.485	.410	.471
6	.547	.624	.514	.548	.483	.575	.590	.771	.932	.820	.680	.778
7	.659	.674	.852	.792	.771	1.069	.991	1.020	1.067	1.048	.814	1.031
8	.754	.701	1.068	.996	1.006	1.183	1.091	1.192	1.021	.971	.875	1.069
9	1.053	.871	1.224	1.123	1.001	1.196	1.000	.911	.983	1.001	.979	.974
10	.950	1.089	1.002	.675	.847	.996	.689	.959	1.295	1.088	.965	1.008
11	1.257	1.315	1.092	.577	.481	.815	.594	.731	.682	.716	.514	.681
12	1.351	.848	.775	1.243	.303	.697	.531	1.368	1.108	.805	.635	.953
13	.843	1.661	1.412	.440	1.117	.395	.530	.546	.684	.810	.718	.643
14	1.100	1.230	1.070	.730	.690	.740	.642	.763	1.015	.552	.483	.743
15+	1.100	1.230	1.070	.730	.690	.740	.642	.763	1.015	.552	.483	.743
(5-10)U	.718	.719	.815	.738	.736	.885	.787	.888	.977	.902	.787	
(10-14)U	1.100	1.228	1.070	.733	.688	.729	.597	.873	.957	.794	.663	

Table 3.32 North-East Arctic Cod.
Stock size and catch predictions. Weights are in '000 t.

1990			1991			1992			1993			1994			1995			1996		
Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. stock (3+)	biom.	Catch	Stock Spawn. biom. Stock (3+)	biom.	
596	147	$F_{0.1}$ 0.15	73	748	233															
		F_{max} 0.24	111	707	212	135	847	291	160	1,006	372	191	1,173	435	216	1,353	515	254	1,508	593
		F_{low} 0.32	143	673	194															
		F_{med} 0.46	194	621	168	198	679	188	210	761	207	230	857	215	251	964	236	289	1,050	264
		$F_{high} =$																		
		F_{89} 0.78	288	524	120	236	526	103	222	572	96	229	643	90	251	720	96	289	772	109
Recruitment: 171 mill. (est)			222 mill. (est)			273 mill. (est)			330 mill.			330 mill.			330 mill.			330 mill.		

Table 4.18 Virtual Population Analysis from Tuning.

NORTH-EAST ARCTIC HADDOCK

	FISHING MORTALITY COEFFICIENT			UNIT: Year-1			NATURAL MORTALITY COEFFICIENT = .20					
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.062	.037	.102	.168	.023	.286	.336	.222	.258	.323	.768	.364
4	.305	.403	.148	.233	.269	.385	.601	.343	.576	.651	1.282	.644
5	.425	.565	.508	.205	.184	1.063	.949	.421	.518	.616	.945	.895
6	.496	.463	.556	.510	.147	.963	.469	.638	.447	.708	.504	.455
7	.504	.642	.406	.481	.421	.411	.303	.579	.511	.800	.638	.696
8	.555	.646	.428	.410	.343	.620	.179	.500	.339	.645	.535	.453
9	.347	.459	.418	.305	.301	.560	.305	.429	.213	.762	.325	.665
10	.284	.547	.419	.333	.261	.621	.203	.748	.150	.921	.516	.280
11	.537	.261	.237	.408	.282	.421	.189	.667	.407	.542	2.299	.791
12	.915	1.021	.169	.221	.653	.856	.250	.650	.203	1.544	.385	.434
13	.521	.572	.311	.317	.374	.614	.237	.623	.243	.942	.881	.542
14+	.521	.572	.311	.317	.374	.614	.237	.623	.243	.942	.881	.542
(4-7)U	.432	.518	.405	.357	.255	.705	.580	.495	.513	.694	.842	.673
(9-13)U	.521	.572	.311	.317	.374	.614	.237	.623	.243	.942	.881	.542
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.156	.038	.101	.125	.193	.085	.130	.056	.059	.048	.400	.073
4	.510	.312	.211	.275	.437	.371	.319	.431	.276	.187	.252	.303
5	.973	.694	.562	.473	.477	.363	.439	.514	.921	.255	.480	.507
6	.966	.826	.912	.708	.359	.301	.555	.620	.642	.856	.262	.669
7	.528	.432	.790	.597	.415	.348	.579	.577	.858	1.227	.617	.910
8	.534	.746	.557	.673	.423	.562	.543	.573	.416	.529	.974	.515
9	.503	.451	.574	.547	.197	.437	.766	.528	.664	.198	.560	.539
10	.561	.613	.247	.630	.576	.440	.809	.732	.421	.989	.710	.713
11	.578	.724	.519	.562	.493	1.019	.655	.531	.649	1.003	.710	.709
12	.687	.875	.826	1.577	.241	2.736	.572	1.519	1.074	1.539	1.170	1.176
13	.582	.665	.541	.838	.377	1.158	.701	.827	.702	.907	.783	.784
14+	.582	.665	.541	.838	.377	1.158	.701	.827	.702	.907	.783	.784
(4-7)U	.744	.566	.619	.513	.422	.341	.473	.536	.649	.631	.403	
(9-13)U	.582	.666	.542	.831	.377	1.158	.701	.827	.702	.907	.783	

Table 4.19 Virtual Population Analysys from Tuning.

NORTH-EAST ARCTIC HADDOCK

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	290493	19889	17203	163919	95474	1017574	269592	53573	48486	55626	113788	169874
4	172976	223471	15690	12714	113483	76380	526132	157659	35146	30669	32974	43238
5	42772	104436	122275	11077	8243	71006	42567	281185	91624	16169	13091	7492
6	72075	22904	48574	60225	7386	5616	20090	13488	151174	44680	7150	4164
7	24545	55952	11807	22802	29606	5220	1756	10289	5835	79195	18019	3538
8	4144	12143	15492	6427	11546	15915	2833	1062	4721	2865	29138	7798
9	816	1949	5212	8267	3491	6708	7007	1939	527	2755	1231	13969
10	733	472	1009	2810	4990	2115	3138	4227	1034	349	1052	728
11	408	483	224	543	1649	3148	931	2097	1638	729	114	514
12	138	195	304	144	296	1018	1691	631	881	892	347	9
13	73	45	58	210	95	126	354	1078	270	589	156	193
14+	19	48	8	77	14	100	68	337	468	82	182	170
TOTAL NO	609246	421987	237856	289215	276271	1204926	976160	527565	341805	234601	217242	251687
SPS NO	84527	94063	87039	73518	59387	56532	69255	100108	117533	106828	55944	32430
TOT. BIOM	712290	641935	474820	420112	381976	1018362	1020596	818171	651414	466283	312822	276581
SPS BIOM	203032	227430	220163	208596	177367	165025	148061	222296	287317	299925	171291	105438
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	133859	18746	5549	8265	4411	6161	267290	518664	75845	17373	5136	0
4	96602	93791	14782	4105	5971	2978	4633	192204	401546	58552	13551	1721
5	18526	47480	56250	9797	2552	3158	1683	2757	102231	249362	39762	8624
6	2506	5755	19411	26237	4999	1297	1835	888	1350	36811	158277	20154
7	2164	781	2062	6385	10585	2859	786	862	391	582	12901	99700
8	1444	1044	415	766	2878	5722	1653	361	396	136	140	5657
9	4757	694	405	195	320	1544	2671	736	166	214	66	43
10	5884	2008	362	187	92	215	816	1017	379	70	144	31
11	451	2750	891	251	82	42	114	298	400	204	24	58
12	191	207	1092	434	108	41	13	48	143	171	61	9
13	5	79	71	391	73	69	2	6	9	40	30	16
14+	131	34	110	65	318	292	123	14	41	20	64	35
TOTAL NO	265375	173366	101379	57057	32389	24378	281619	717904	582899	363535	229054	
SPS NO	24471	26140	57311	42951	26937	12604	14916	47780	28126	104257	107578	
TOT. BIOM	283854	241873	189640	119590	71225	53117	159371	358953	317259	350478	216401	
SPS BIOM	71705	65516	123672	102887	66964	39262	32105	57106	31723	123627	111984	

Table 4.24 Virtual Population Analysis.

NORTH-EAST ARCTIC HADDOCK

CATCH IN NUMBERS

UNIT: thousands

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	15918	657	1520	23004	1979	230229	70204	9684	10037	13989	55967	47311
4	41373	67632	1963	2408	24359	22246	258773	41701	14089	13449	22043	18812
5	13505	41267	44526	1870	1258	42849	24018	88111	33871	6808	7368	4076
6	25736	7748	18956	21995	918	3196	6872	5827	49712	20789	2586	1389
7	8878	15599	3611	7948	9279	1606	418	4138	2135	40044	7781	1626
8	1617	5292	4925	1974	3056	6736	422	382	1236	1247	11043	2596
9	218	655	1624	1978	826	2630	1680	617	92	1349	311	6215
10	176	182	315	726	1043	896	525	2043	131	193	388	162
11	155	101	43	166	369	988	146	935	500	279	96	258
12	76	115	43	26	130	538	340	276	147	652	101	3
13	27	18	14	52	27	53	68	458	53	331	84	74
14+	7	19	2	19	4	42	13	143	92	46	98	65
TOTAL	107686	139285	77542	62166	43248	312009	363479	154315	112095	99176	107866	82587
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
3	17540	627	486	883	704	456	29548	25596	3928	746	943	
4	35290	22878	2561	900	1930	841	1153	61470	88297	9079	2746	
5	10645	21794	22124	3372	884	836	546	1013	52611	51009	13837	
6	1429	2971	10685	12203	1374	307	715	376	586	19464	33229	
7	812	250	1034	2625	3282	765	316	346	207	380	5394	
8	546	504	162	344	906	2250	634	144	123	51	80	
9	1466	230	162	75	52	499	1312	295	74	35	25	
10	2310	842	72	80	37	70	416	484	119	38	67	
11	181	1299	330	91	29	25	50	112	175	119	11	
12	87	111	564	320	21	36	5	35	87	125	39	
13	2	35	27	204	21	44	1	3	4	22	15	
14+	53	15	42	34	91	185	57	7	19	11	32	
TOTAL	70361	51556	38249	21131	9331	6314	34753	89881	146230	81079	56418	

Table 4.25 Virtual Population Analys. From Separable VPA.

NORTH-EAST ARCTIC HADDOCK

	FISHING MORTALITY COEFFICIENT					UNIT: Year-1	NATURAL MORTALITY COEFFICIENT = .20					
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	.062	.037	.102	.168	.023	.286	.336	.222	.258	.323	.768	.364
4	.305	.403	.148	.233	.269	.385	.601	.343	.576	.651	1.282	.644
5	.424	.565	.508	.205	.184	1.063	.949	.421	.518	.616	.945	.895
6	.495	.462	.556	.510	.147	.963	.469	.638	.446	.708	.504	.455
7	.504	.642	.408	.480	.421	.411	.303	.579	.511	.800	.638	.696
8	.555	.647	.428	.410	.343	.620	.179	.500	.339	.645	.535	.454
9	.346	.458	.419	.304	.300	.559	.305	.428	.213	.763	.325	.664
10	.285	.545	.418	.334	.260	.618	.203	.748	.150	.920	.517	.280
11	.537	.263	.236	.407	.283	.420	.188	.666	.407	.541	2.298	.792
12	.914	1.020	.170	.219	.650	.862	.249	.644	.202	1.544	.384	.433
13	.520	.570	.310	.320	.370	.610	.240	.620	.240	.940	.880	.540
14+	.520	.570	.310	.320	.370	.610	.240	.620	.240	.940	.880	.540
(4- 7)U	.432	.518	.405	.357	.255	.705	.580	.495	.513	.694	.842	.672
(9-13)U	.520	.571	.311	.317	.373	.614	.237	.621	.243	.942	.881	.542
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1985-88
3	.155	.037	.100	.126	.190	.080	.122	.073	.060	.051	.080	.077
4	.510	.311	.210	.271	.443	.363	.296	.399	.381	.193	.269	.317
5	.972	.694	.560	.468	.466	.349	.426	.460	.712	.396	.502	.498
6	.965	.825	.909	.703	.353	.291	.572	.591	.531	.634	.487	.582
7	.528	.431	.787	.593	.410	.339	.549	.608	.776	.804	.358	.684
8	.534	.746	.555	.668	.419	.551	.524	.524	.453	.438	.385	.485
9	.503	.451	.574	.544	.195	.430	.737	.497	.565	.223	.400	.506
10	.560	.613	.247	.629	.571	.434	.786	.677	.382	.646	.862	.623
11	.578	.722	.520	.563	.492	.997	.640	.502	.559	.832	.389	.633
12	.690	.874	.823	1.583	.241	2.698	.546	1.417	.953	1.046	.735	.991
13	.580	.670	.540	.830	.380	1.160	.661	.757	.583	.682	.320	.671
14+	.580	.670	.540	.830	.380	1.160	.661	.757	.583	.682	.320	.671
(4- 7)U	.744	.565	.617	.509	.418	.336	.461	.514	.600	.507	.404	
(9-13)U	.582	.666	.541	.830	.376	1.144	.674	.770	.609	.686	.541	

Table 4.26 Virtual Population Analysis. From Separable VPA.

NORTH-EAST ARCTIC HADDOCK

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	290491	19893	17203	163914	95473	1017593	269590	53573	48488	55630	113797	169945
4	172982	223469	15694	12714	113479	76380	626147	157657	35146	30670	32977	43246
5	42789	104441	122274	11080	8243	71003	42567	281197	91622	16169	13091	7494
6	72092	22918	48578	60224	7388	5616	20089	13489	151184	44678	7150	4165
7	24532	35966	11818	22805	29606	5222	1756	10288	5835	79204	18017	3537
8	4151	12132	15504	6436	11549	15915	2834	1062	4720	2865	29145	7796
9	818	1951	5203	8276	3498	6710	7008	1941	527	2754	1231	13975
10	779	474	1010	2803	4998	2122	3140	4227	1035	349	1052	729
11	408	480	225	544	1643	3154	936	2098	1638	730	114	514
12	138	195	302	146	297	1013	1696	635	882	893	348	9
13	73	45	58	208	96	127	350	1083	273	590	156	194
14+	19	48	8	76	14	100	67	338	474	82	182	170
TOTAL NO	609271	422012	237876	289228	276284	1204955	976180	527587	341826	234613	217260	251773
SPS NO	84589	94073	87053	73532	59402	56544	69264	100122	117549	106836	55950	32436
TOT. BIOM	712328	641981	474866	420148	382028	1018420	1020645	818269	651517	466318	312855	276663
SPS BIOM	203027	227448	220197	208629	177420	165074	148098	222380	287410	299956	171315	105463
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3	134098	18874	5620	8193	4471	6538	282892	401744	73754	16442	13580	0
4	96659	93987	14887	4163	5912	3027	4942	204975	305826	56840	12788	10268
5	18593	47526	56390	9883	2599	3109	1723	3009	112657	171130	38361	8001
6	2507	5758	19447	26367	5069	1335	1795	921	1556	45264	94332	19012
7	2164	782	2067	6413	10691	2916	817	830	418	749	19660	47457
8	1444	1045	416	770	2902	5808	1700	386	370	157	274	11252
9	4055	693	406	196	323	1563	2741	824	187	193	83	153
10	5888	2007	361	187	93	218	832	1074	411	87	126	46
11	451	2754	890	231	82	43	115	310	447	229	37	44
12	190	207	1095	433	108	41	13	50	154	209	82	21
13	5	78	71	394	73	69	2	6	10	49	60	32
14+	132	34	110	66	316	292	129	14	47	24	128	112
TOTAL NO	266187	173745	101759	57294	32638	24960	297702	614144	495836	291373	179513	
SPS NO	24479	26167	57462	43195	27153	12789	15419	50860	29584	82960	81603	
TOT. BIOM	284082	242275	190203	120181	71828	53956	167541	337018	281544	296215	163562	
SPS BIOM	71727	65568	123966	103428	67552	39791	32867	60531	34122	109935	89163	

Table 4.28 North-East Arctic Haddock.
Stock size and catch predictions. Weights are in '000 t.

1990			1991			1992			1993			1994			1995			1996					
Stock (3+)	Spawn. biom.	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	Stock (3+)	Spawn. biom.	Catch	
104	84	$F_{0.1}$	0.13	14	93	80	11	85	72	9	86	65	10	91	58	11	98	56	13	110	62		
		F_{med}	0.35	35	73	61	21	57	44	15	53	33	14	55	25	14	61	23	17	68	25		
		F_{89}	0.40	39	70	58	22	52	40	16	48	28	14	51	21	14	56	19	18	63	21		
Recruitment: 9 mill. (est)					10 mill. (est)			15 mill. (est)			45 mill.			45 mill.			45 mill.			45 mill.			

Table 5.7

Title : NORTH-EAST ARCTIC SAITHE
 At 10.05.08 25 SEPTEMBER 1989
 from 78 to 88 on ages 2 to 14
 with Terminal F of .363 on age 4 and Terminal S of .500

Initial sum of squared residuals was 85.723 and
 final sum of squared residuals is 39.420 after 88 iterations

Matrix of Residuals

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	WTS	
Ages												
2/ 3	.834	.937	-.381	-.075	1.284	.155	-.229	-1.132	-.176	.171	.000	.446
3/ 4	.437	.398	-.344	-.016	.292	-.616	.839	1.174	-.626	-1.049	.000	.458
4/ 5	-.347	.105	-.458	-.453	-.076	.046	.430	-.141	.629	-.435	.000	.841
5/ 6	.109	.054	.029	.077	.711	.516	-.195	-.289	.273	-1.093	.000	.646
6/ 7	-.595	-.530	-.100	.229	.196	.374	-.049	-.252	-.260	-.237	.000	1.000
7/ 8	-.477	.064	-.412	-.164	-.799	-.018	-.640	.205	.896	-.521	.000	.602
8/ 9	-.556	1.200	.440	-.617	-.173	.216	-.302	.019	.403	-.781	.000	.540
9/10	.034	.074	-1.354	-.387	.076	-.090	.553	.002	.014	-.166	.000	.648
10/11	.613	-.307	.527	.293	-.121	-.678	.009	-.438	.457	-.476	.000	.700
11/12	-.074	-1.135	.622	-.115	-.774	-.291	-.489	.542	-.714	1.841	.000	.368
12/13	.778	-.354	.536	-.479	-.829	-.264	.210	1.340	-1.025	1.045	.000	.394
13/14	.166	-.259	.926	.308	-.131	.172	-.311	-.051	-.832	.845	.000	.601
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.888	
WTS	.001	.001	.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

F-values	78										
	.6755										
F-values	79	80	81	82	83	84	85	86	87	88	
	.6051	.6429	.5755	.4905	.4878	.5715	.4113	.3486	.4229	.3630	

Selection-at-age (S)

S-values	2	3	4							
	.1153	.6058	1.0000							
S-values	5	6	7	8	9	10	11	12	13	14
	.9170	.8797	.7140	.6106	.5043	.4529	.4802	.3417	.3088	.5000

Table 5.8 Virtual Population Analysis.

NORTH-EAST ARCTIC SAITHE

CATCH IN NUMBERS

UNIT: thousands

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	1711	907	486	127	137	484	24	0	0	65	0
2	45758	28334	18226	10467	17225	11638	14624	2216	3311	3867	4911
3	48969	61963	40796	83954	34733	17244	41466	48917	22115	17869	10570
4	27685	23328	36644	21822	65052	23768	33233	11974	12895	49829	43615
5	12476	14122	9211	21528	13060	32700	12064	7189	6062	4339	33834
6	4534	4400	6379	3619	8212	3226	11204	5279	4525	3118	6110
7	1468	2901	3200	2550	1054	3008	1135	3740	2805	3490	1636
8	1848	963	1338	2008	1251	1177	1772	775	1399	755	956
9	938	1356	147	369	461	760	560	878	351	620	765
10	976	438	730	279	263	247	557	134	454	257	382
11	655	305	411	252	120	204	387	274	128	253	99
12	681	281	454	89	112	123	150	214	67	158	17
13	284	168	257	144	76	161	117	55	31	148	31
14	231	222	239	95	97	94	170	126	56	98	62
15+	299	216	268	49	43	178	73	32	3	140	0
TOTAL	148513	139904	118786	147352	141896	95012	117536	81803	54202	85006	102988

Table 5.8 Virtual Population Analysis.

NORTH-EAST ARCTIC SAITHE

CATCH IN NUMBERS

UNIT: thousands

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	1711	907	486	127	137	484	24	0	0	65	0
2	45758	28334	18226	10467	17225	11638	14624	2216	3311	3867	4911
3	48969	61963	40796	83954	34733	17244	41466	48917	22115	17869	10570
4	27685	23328	36644	21822	65052	23768	33233	11974	12895	49829	43615
5	12476	14122	9211	21528	13060	32700	12064	7189	6062	4339	33834
6	4534	4400	6379	3619	8212	3226	11204	5279	4525	3118	6110
7	1468	2901	3200	2550	1054	3008	1135	3740	2805	3490	1636
8	1848	963	1338	2008	1251	1177	1772	775	1399	755	956
9	938	1356	147	369	461	760	560	878	351	620	765
10	976	438	730	279	263	247	557	134	454	257	382
11	655	305	411	252	120	204	387	274	128	253	99
12	681	281	454	89	112	123	150	214	67	158	17
13	284	168	257	144	76	161	117	55	31	148	31
14	231	222	239	95	97	94	170	126	56	98	62
15+	299	216	268	49	43	178	73	32	3	140	0
TOTAL	148513	139904	118786	147352	141896	95012	117536	81803	54202	85006	102988

Table 5.9 Sum of Products Check.

NORTH-EAST ARCTIC SAITHE
CATEGORY: TOTAL

	MEAN WEIGHT AT AGE IN THE CATCH											UNIT: kilogram
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
1	.250	.250	.180	.290	.360	.180	.180	.180	.180	.180	.180	
2	.340	.340	.450	.430	.510	.600	.530	.380	.320	.340	.340	
3	.710	.710	.790	.730	.770	1.050	.710	.750	.590	.530	.630	
4	1.110	1.110	1.270	1.400	1.120	1.330	1.260	1.330	1.220	.840	.840	
5	1.630	1.630	2.030	2.050	2.020	1.860	2.020	2.070	1.970	1.660	1.260	
6	2.330	2.330	2.550	2.760	2.610	2.800	2.700	2.630	2.300	2.320	2.310	
7	3.160	3.160	3.290	3.300	3.270	4.000	3.880	3.280	2.870	2.970	3.930	
8	4.030	4.030	4.340	4.380	3.910	4.180	4.470	3.960	3.720	4.000	5.270	
9	4.870	4.870	5.150	5.950	4.690	5.330	5.360	4.540	4.300	4.720	5.750	
10	5.630	5.630	5.750	6.390	5.630	5.680	6.060	5.550	4.690	5.440	5.440	
11	6.440	6.440	6.110	6.610	7.180	7.310	6.280	6.880	5.840	5.790	8.070	
12	7.110	7.110	5.940	6.890	7.210	8.680	6.890	8.140	6.390	6.280	9.810	
13	7.820	7.820	6.640	6.750	7.000	8.540	8.200	6.060	8.110	7.020	11.800	
14	8.920	8.920	7.730	7.130	8.030	8.570	9.140	9.660	7.550	8.360	10.520	
15+	9.500	9.500	9.470	7.660	9.440	10.370	6.470	13.720	10.080	8.480	12.000	

Table 5.10 Virtual Population Analysis.

NORTH-EAST ARCTIC SAITHE

	FISHING MORTALITY COEFFICIENT					NATURAL MORTALITY COEFFICIENT = .20					
	UNIT: Year-1										
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	.009	.002	.003	.001	.001	.003	.000	.000	.000	.000	.000
2	.193	.203	.056	.074	.131	.103	.107	.009	.020	.054	.042
3	.588	.432	.499	.388	.369	.188	.631	.609	.122	.143	.204
4	.489	.627	.494	.549	.593	.465	.660	.373	.317	.438	.607
5	.478	.499	.547	.611	.762	.685	.458	.285	.328	.167	.605
6	.386	.307	.442	.430	.500	.425	.532	.372	.293	.280	.372
7	.276	.458	.385	.318	.213	.344	.259	.338	.346	.396	.232
8	.275	.294	.396	.445	.254	.390	.350	.284	.204	.147	.172
9	.314	.333	.066	.180	.172	.241	.325	.292	.200	.131	.217
10	.343	.236	.301	.172	.188	.131	.280	.120	.242	.221	.111
11	.378	.171	.364	.161	.104	.218	.310	.216	.160	.206	.124
12	.364	.276	.411	.124	.100	.147	.246	.282	.075	.303	.019
13	.230	.142	.438	.220	.148	.203	.204	.134	.060	.235	.089
14	.337	.283	.308	.286	.226	.275	.342	.352	.196	.270	.146
15+	.337	.283	.308	.286	.226	.275	.342	.352	.196	.270	.146
(3- 8)U	.415	.436	.460	.457	.448	.416	.481	.377	.268	.260	.365

Table 5.11 Virtual Population Analysis.

NORTH-EAST ARCTIC SAITHE

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	209410	452516	198938	188455	160222	194958	319999	224586	99166	160866	0	0
2	286748	169905	369670	162437	154179	131055	159181	261971	183876	81190	131647	0
3	120304	193567	113598	286211	123549	110705	96804	117139	212482	147555	62983	103350
4	78339	54689	102905	56456	158978	69969	75109	42187	52159	154029	104704	42050
5	35950	39332	23920	51420	26688	71969	35980	31798	23790	31117	81421	46718
6	15538	18252	19550	11338	22847	10200	29716	18643	19571	14031	21568	36402
7	6683	8652	10989	10286	6037	11349	5457	14297	10524	11956	8684	12173
8	8441	4151	4483	6125	6130	3994	6590	3447	8346	6097	6656	5638
9	3822	5249	2533	2469	3214	3894	2214	3804	2125	5573	4311	4588
10	3684	2286	3080	1941	1689	2216	2504	1309	2325	1424	4004	2841
11	2279	2140	1478	1865	1338	1146	1592	1549	951	1495	935	2934
12	2449	1278	1477	841	1300	987	755	955	1022	663	996	676
13	1520	1394	794	802	608	963	698	483	590	776	401	800
14	886	989	990	419	527	429	644	466	346	455	502	300
15+	1147	962	1110	216	234	813	276	118	19	650	0	355
TOTAL NO	777201	955364	855514	781283	667540	614647	737517	722753	617291	617877	428813	
SPS NO	46450	45354	46483	36304	43925	35992	50445	45071	45818	43121	48058	
TOT. BIOM	574289	609910	648599	665221	621012	618167	564507	513802	458527	469890	467915	
SPS BIOM	193471	176765	177450	147338	157603	161280	186494	162141	145973	154087	192934	

Table 5.12

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 3 to 8

The number of recruits per year is as follows:

Year	Recruitment
1989	200000.0
1990	200000.0
1991	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

		1989			1990			1991		
age	1989 stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock	weight in the catch	weight in the stock	weight in the catch	weight in the stock
1	200000.0	.00	.20	.00	.220	.220	.220	.220	.220	.220
2	163746.0	.05	.20	.00	.420	.420	.420	.420	.420	.420
3	103350.0	.28	.20	.00	.630	.630	.730	.730	.730	.730
4	42050.0	.46	.20	.00	1.000	1.000	1.000	1.000	1.170	1.170
5	46718.0	.43	.20	.00	1.260	1.260	1.500	1.500	1.500	1.500
6	36402.0	.41	.20	1.00	1.750	1.750	1.750	1.750	2.000	2.000
7	12173.0	.33	.20	1.00	3.400	3.400	2.580	2.580	2.580	2.580
8	5638.0	.28	.20	1.00	4.230	4.230	4.230	4.230	3.410	3.410
9	4588.0	.23	.20	1.00	5.070	5.070	5.070	5.070	5.070	5.070
10	2841.0	.21	.20	1.00	5.630	5.630	5.630	5.630	5.630	5.630
11	2934.0	.22	.20	1.00	6.650	6.650	6.650	6.650	6.650	6.650
12	676.0	.16	.20	1.00	7.330	7.330	7.330	7.330	7.330	7.330
13	800.0	.14	.20	1.00	7.790	7.790	7.790	7.790	7.790	7.790
14	300.0	.23	.20	1.00	8.560	8.560	8.560	8.560	8.560	8.560
15+	355.0	.23	.20	1.00	9.720	9.720	9.720	9.720	9.720	9.720

Table 5.13 North-East Arctic SAITHE.
Effects of different levels of fishing mortality on catch, stock biomass
and spawning stock biomass.

Factor	1989				Option	1990				1991	
	Ref.F	Stock biom.	Spawn. stock biom.	Catch		Ref.F	Stock biom.	Spawn. stock biom.	Catch	Stock biom.	Spawn. stock biom.
1.3	0.46	484	205	120	F _{0.1}	0.17	475	182	48	563	190
				=TAC	F _{low}	0.25			69	536	177
					F _{max}	0.28			76	527	172
					F _{med}	0.36			93	505	161
					F ₈₈	0.37			95	503	161
					F _{high}	0.41			105	490	154
					F ₈₉	0.46			125	478	148

The data unit of the biomass and the catch is '000 t.

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 in Sub-area I, Division IIA
and IIB combined as officially reported to ICES.

Country	1979	1980	1981	1982	1983
Denmark	-	-	-	-	-
Faroe Islands	-	-	206	-	-
France	1,142	1,297	537	841	798
German Dem.Rep.	16,162	8,448	4,614	4,463	3,394
Germany, Fed.Rep.	11,913	7,992	4,688	3,182	3,395
Norway	9,025	8,472	9,249	10,045	11,083
Poland	261	87	26	-	-
Portugal	1,100	271	-	-	-
Spain	1,375	1,965	930	72	222
UK (England & Wales)	1,756	1,307	470	336	182
UK (Scotland)	-	-	-	-	-
USSR	70,451	72,802	81,652	112,810	105,459
Total	113,620²	102,765²	102,372	131,749	124,533

Country	1984	1985	1986	1987	1988 ¹
Denmark	-	-	-	+	-
Faroe Islands	-	-	29	450 ³	575 ³
France	2,970	3,326	2,719	1,611	720 ³
German Dem.Rep.	4,168	3,260	1,323	417	989
Germany, Fed.Rep.	3,289	3,306	3,561	5,412	1,360
Norway	18,650	20,456	23,251	18,052	24,260
Poland	-	-	-	-	-
Portugal	1,806	2,056	1,591	1,175	500
Spain	25	38	-	25	26
UK (England & Wales)	716	167	129	230	468
UK (Scotland)	-	-	14	9	2
USSR	69,689	59,943	20,694	7,215	9,139
Total	101,313	92,552	53,311	34,596	38,039

¹ Provisional figures.

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

³ As reported to Norwegian authorities.

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	1979	1980	1981	1982	1983
France	7	1	16	-	-
Germany, Fed.Rep.	-	-	7	10	-
Norway	1,374	736	543	732	580
Portugal	-	170	-	-	-
UK (England & Wales)	462	295	61	77	48
UK (Scotland)	-	-	-	-	-
USSR	639	33	1,220	1,750	4,023
Total	2,482	1,235	1,847	2,569	4,651

Country	1984	1985	1986	1987	1988 ¹
France	-	-	-	-	-
Germany, Fed.Rep.	1	143	50	10	6
Norway	1,472	2,378	4,245	2,331	5,549
Portugal	-	-	-	-	-
UK (England & Wales)	22	43	32	14	20
UK (Scotland)	-	-	3	-	-
USSR	532	368	1,066	769	199
Total	2,027	2,932	5,396	3,124	5,774

¹ Provisional 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	1979	1980	1981	1982	1983
Faroe Islands	-	-	206	-	-
France	1,134	1,296	521	841	798
German Dem.Rep.	12,439	7,460	2,205	2,760	2,500
Germany, Fed.Rep.	11,913	7,992	4,681	3,172	3,395
Norway	7,637	7,734	8,704	9,140	10,500
Poland	261	78	26	-	-
Portugal	1,100	89	-	-	-
Spain	1,125	1,500	620	-	-
UK (England & Wales)	1,195	967	409	259	134
UK (Scotland)	-	-	-	-	-
USSR	29,519	46,762	56,130	63,125	82,836
Total	66,323	73,878	73,502	79,297	100,163

Country	1984	1985	1986	1987	1988 ¹
Faroe Islands	-	-	29	450 ²	570 ²
France	2,970	3,326	2,719	1,611	700 ²
German Dem.Rep.	2,570	2,800	1,252	375	879
Germany, Fed.Rep.	3,288	2,972	3,319	3,562	1,319
Norway	17,111	18,062	18,704	15,410	18,538
Poland	-	-	-	-	-
Portugal	1,134	1,327	1,273	1,156	467
Spain	-	-	-	-	-
UK (England & Wales)	672	120	94	205	412
UK (Scotland)	-	-	11	8	2
USSR	63,342	59,047	19,099	4,953	7,598
Total	91,087	87,654	46,500	27,730	30,485

¹ Provisional figures.

² As reported to Norwegian authorities.

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

Country	1979	1980	1981	1982	1983
Denmark	-	-	-	-	-
Faroe Islands	-	-	-	-	-
France	1	-	-	-	-
German Dem.Rep.	3,723	988	2,409	1,703	894
Germany, Fed.Rep.	-	-	-	-	-
Norway	14	2	2	173	3
Poland	-	9	-	-	-
Portugal	-	12	-	-	-
Spain	250	465	310	72	222
UK (England & Wales)	99	45	+	+	-
UK (Scotland)	-	-	-	-	-
USSR	40,293	26,007	24,302	47,935	18,600
Non-members	435 ²	124 ²	-	-	-
Total	44,815	27,652	27,023	49,883	19,719

Country	1984	1985	1986	1987	1988 ¹
Denmark	-	-	-	+	-
Faroe Islands	-	-	-	-	5 ²
France	-	-	-	-	20 ²
German Dem.Rep.	1,598	460	71	42	110
Germany, Fed.Rep.	-	190	192	1,840	35
Norway	67	16	302	311	173
Poland	-	-	-	-	-
Portugal	672	729	318	19	33
Spain	25	38	-	25	26
UK (England & Wales)	22	4	3	11	36
UK (Scotland)	-	-	+	1	-
USSR	5,815	528	529	1,493	1,342
Total	8,199	1,965	1,415	3,742	1,780

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	1979	1980	1981	1982	1983
<u>S. marinus</u>	26,475	23,411	20,826	16,366	19,260
<u>S. mentella</u>	87,145	79,354	81,546	115,383	105,273
Total	113,620	102,765	102,372	131,749	124,533

Species	1984	1985	1986	1987	1988 ¹
<u>S. marinus</u>	28,379	29,484	30,199	24,078	23,752
<u>S. mentella</u>	72,934	63,068	23,112	10,518	14,287
Total	101,313	92,552	53,311	34,596	38,039

¹ Provisional figures.

Table 6.6 Redfish in Sub-area IV (North Sea).
Nominal catch (t) by countries as officially reported to ICES. Not included in the assessment.

Country	1984	1985	1986	1987	1988 ¹
Denmark	5	6	24	16	31
Faroes Islands	-	24	-	-	-
France	77	690	578	833	-
Germany, Fed. Rep.	554	162	183	70	134
Norway	594	1,204	1,048	411	1,067
UK (England & Wales)	45	8	35	16	125
UK (Scotland)	1	+	1	55	9
Total	1,276	2,094	1,869	1,401	1,366

¹ Provisional figures.

Table 6.7 *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)		Total effort (USSR units)	
	RT ¹	PST ²	Freezer trawler	Factory trawler FVS IV	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	1.01	-	-	251,653	236.703
1976	0.99	1.26	-	-	271,653	213.442
1977	0.77	1.00	-	-	190,084	146.365
1978	0.63	0.86	-	-	147,002	107.688
1979	0.56	0.93	-	-	155,616	93.704
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	-	105,113	63.068
1986	0.43	0.68	7.90	-	53,749	33.988
1987	-	0.70	-	7.30	-	15.026
1988	-	0.70	-	11.78	-	20.410

¹ Side trawlers, 800-1000 HP. For 1986, side trawlers (SRTM), 1000 HP., are included.

² Stern trawlers. For 1975-1979, the PST data have been calculated from RT data.

Table 6.8 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	average
1984	-	732	poor
1985	-	795	poor
1986	-	702	poor
1987	-	631	poor
1988	-	949	poor
1989	-	698	-

¹ On the basis of the abundance of age groups 1+ to 6+.

Table 6.10 Sebastes mentella.
Recruitment at age 6 (in millions).
Results from the analysis using RCRTINX2,
and data from the USSR².

Year class	No. of points			Adopted	Log S.E.	USSR
	5	4	3			
1976	222	216	189	222	0.50	-
1977	154	98	123	98	0.48	-
1978	134	133	131	134	0.42	-
1979	163	158	157	163	0.41	-
1980	256	246	244	256	0.44	121
1981	303	298	298	303	0.43	155
1982	484	472	477	484	0.51	255
1983	387	369	370	387	0.63	274
1984	187	193	193	187	0.56	248
1985	n.a. ¹	174	172	174	0.75	194
1986	n.a. ¹	n.a. ¹	167	167	0.75	105

¹Not adopted.

²Calculated from population fecundity (Serebrjakov, 1984).

Table 6.11 Sebastes mentella.
Maturity ogives from the USSR. Samples from research
vessels. Sexes combined.

Age	Average	Average	Average	1986	1987	1988	1989
	1966-1972	1975-1983	1984-1985				
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.009	0.000	0.000	0.000	0.000	0.000
8	0.030	0.016	0.000	0.000	0.000	0.000	0.000
9	0.060	0.101	0.013	0.006	0.083	0.000	0.000
10	0.080	0.195	0.140	0.017	0.182	0.028	0.074
11	0.220	0.300	0.304	0.132	0.278	0.125	0.178
12	0.360	0.540	0.528	0.377	0.616	0.297	0.473
13	0.550	0.702	0.739	0.822	0.821	0.562	0.684
14	0.720	0.862	0.896	0.795	0.926	0.760	0.716
15	0.850	0.966	0.938	0.862	0.938	0.855	0.794
16	0.880	0.994	0.975	0.875	1.000	1.000	1.000
17	0.950	1.000	1.000	1.000	1.000	1.000	1.000
18	0.970	1.000	1.000	1.000	1.000	1.000	1.000

Table 6.12

SEBASTES MENTELLA - EFFORT AND CATCH DATA

101

USSR PSY TRAWLERS

86,88

1,1

0,18

24076,587,2315,4522,8434,13164,5747,2610,522,309,52

5693,637,1598,1808,1161,1151,2235,880,396,126,80

11221,1191,958,1773,2962,1513,3692,2031,690,496,166

Table 6.13

Module run at 11.06.36 25 SEPTEMBER 1989

DISAGGREGATED qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1, USSR PST-TRAWLERS, has terminal q estimated as the mean

FLEETS COMBINED BY ** VARIANCE **

Terminal populations from weighted Separable populations

Regression weights

, 1.000, 1.000, 1.000,

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

Fishing mortalities

Age,	86,	87,	88,
6,	.082,	.001,	.000,
7,	.007,	.003,	.001,
8,	.008,	.007,	.004,
9,	.024,	.042,	.026,
10,	.080,	.084,	.078,
11,	.144,	.084,	.105,
12,	.209,	.110,	.145,
13,	.429,	.161,	.258,
14,	.387,	.149,	.234,
15,	.349,	.114,	.194,
16,	.290,	.130,	.180,
17,	.513,	.118,	.235,
18,	.393,	.134,	.220,

Log catchability estimates

Age 9

Fleet, 86, 87, 88

1, -14.51, -12.80, -13.56

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt	
1	-13.62	.991	.0136	.0248	.000E+00	.000E+00	-13.622	.496	
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio					
.025	.991	0.000	.991	0.000					

Table 6.13 (cont'd)

Age 10
 Fleet, 86, 87, 88

 1, -13.01, -12.10, -12.47

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Intrcpt
	q		F	F			
1	-12.53	.530	.0408	.0741	.000E+00	.000E+00	-12.526, .265
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
.074	.530	0.000	.530	0.000			

Age 11
 Fleet, 86, 87, 88

 1, -12.41, -12.10, -12.18

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Intrcpt
	q		F	F			
1	-12.23	.186	.0549	.0997	.000E+00	.000E+00	-12.229, .093
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
.100	.186	0.000	.186	0.000			

Age 12
 Fleet, 86, 87, 88

 1, -12.01, -11.83, -11.85

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Intrcpt
	q		F	F			
1	-11.90	.111	.0765	.1390	.000E+00	.000E+00	-11.897, .055
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
.139	.111	0.000	.111	0.000			

Age 13
 Fleet, 86, 87, 88

 1, -11.24, -11.44, -11.28

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Intrcpt
	q		F	F			
1	-11.32	.126	.1363	.2475	.000E+00	.000E+00	-11.320, .063
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
.248	.126	0.000	.126	0.000			

Table 6.13 (cont'd)

Age 14
 Fleet, 86, 87, 88
 1, -11.36, -11.53, -11.38

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q	q	F	F	F	Slope	Slope	Intrcpt	Intrcpt
1	-11.42	.107	.1233	.2239	.000E+00	.000E+00	-11.420	.054
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.224	.107	0.000	.107	0.000				

Age 15
 Fleet, 86, 87, 88
 1, -11.47, -11.79, -11.56

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q	q	F	F	F	Slope	Slope	Intrcpt	Intrcpt
1	-11.61	.188	.1022	.1855	.000E+00	.000E+00	-11.608	.094
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.185	.188	0.000	.188	0.000				

Age 16
 Fleet, 86, 87, 88
 1, -11.74, -11.66, -11.64

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q	q	F	F	F	Slope	Slope	Intrcpt	Intrcpt
1	-11.68	.061	.0951	.1726	.000E+00	.000E+00	-11.680	.031
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.173	.612E-01	0.000	.612E-01	0.000				

Age 17
 Fleet, 86, 87, 88
 1, -11.10, -11.77, -11.37

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q	q	F	F	F	Slope	Slope	Intrcpt	Intrcpt
1	-11.41	.385	.1242	.2256	.000E+00	.000E+00	-11.413	.192
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.226	.385	0.000	.385	0.000				

Table 6.14

Title : SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB
 At 15.46.55 27 SEPTEMBER 1989
 from 78 to 88 on ages 6 to 18
 with Terminal F of .210 on age 13 and Terminal S of .600

Initial sum of squared residuals was 205.399 and
 final sum of squared residuals is 128.160 after 119 iterations

Matrix of Residuals

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	WTS	
Ages												
6/ 7	-.519	.570	.397	1.728	-1.287	.812	-6.721	.246	4.032	1.544	.001	.057
7/ 8	.776	.745	.992	.886	.423	-.757	-2.443	1.111	.450	1.258	.001	.141
8/ 9	1.348	.860	1.009	.853	1.186	.872	-.738	.666	-1.320	-.006	.000	.181
9/10	1.245	.902	.817	.533	.728	.249	-.738	.376	-.912	.603	.000	.229
10/11	.493	.445	.317	.309	.786	-.115	-.682	.323	-.248	.487	.000	.368
11/12	.018	.221	-.086	.132	.293	-.183	-.159	.165	.022	.097	.000	1.000
12/13	-.085	.395	-.081	.016	-.052	-.127	.323	-.126	.047	-.135	.000	.836
13/14	-.509	-.068	-.824	-.291	-.563	-.366	.938	-.426	.308	-.228	.000	.317
14/15	-.322	-1.038	-.809	-.483	-1.003	-.205	1.120	-.668	.339	-.221	.000	.242
15/16	-.654	-1.818	-.197	-.720	-.834	.192	1.081	-.385	.032	-.497	.000	.211
16/17	-.592	-1.179	.200	-.995	-.865	.532	1.171	-.567	-.137	-.655	.000	.214
17/18	-1.190	-1.568	-.200	-.949	-.633	.959	.640	-.286	.141	-1.000	.000	.196
	.001	.001	.000	.000	.000	-.001	.000	.000	.000	.000	-.710	
WTS	.100	.100	.100	.100	.100	1.000	1.000	1.000	1.000	1.000		
Fishing Mortalities (F)												
F-values	.78											
	.8659											
F-values	.79	.80	.81	.82	.83	.84	.85	.86	.87	.88		
	.8389	.6984	.6750	.8032	.8802	.7777	1.2357	.4348	.1947	.2100		
Selection-at-age (S)												
S-values	.6	.7	.8									
	.0010	.0048	.0174									
S-values	.9	.10	.11	.12	.13	.14	.15	.16	.17	.18		
	.0568	.1740	.3121	.5370	1.0000	1.0000	1.1095	1.0601	.9491	.6000		

Table 6.15

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB
CATEGORY: TOTAL

CATCH IN NUMBERS	UNIT: thousands											
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
6	48	0	0	7	31	0	0	466	172	606	5834	18891
7	285	0	0	0	94	0	0	792	1660	4847	19417	29815
8	1592	27	7	15	409	33	114	5728	4865	15451	42425	59395
9	2163	279	15	89	524	131	284	3586	9729	28781	82480	78241
10	1141	532	182	192	838	620	681	2049	4636	30144	108462	110712
11	1545	465	285	355	933	2122	1590	1770	2633	19843	119075	112524
12	1972	731	343	436	954	3428	4429	3865	3148	10603	57231	93144
13	2471	1223	394	554	849	3983	4884	4564	5208	8634	29651	49550
14	2804	1927	489	864	618	3526	5451	4704	5666	8634	20894	26134
15	1996	2007	496	768	482	2808	4940	4098	4578	6514	16499	13881
16	2067	1741	628	931	807	3983	7496	4704	5380	5908	13465	9839
17	1592	1422	613	694	451	2743	4486	3632	3777	3332	13668	6300
18	1473	944	540	665	849	3559	7382	3167	2747	2878	12207	7233
19	1069	837	949	702	786	2318	4770	1816	1316	1666	6757	3486
20	689	532	649	369	555	1567	3918	885	973	2121	7112	3168
21	404	346	693	347	440	784	2385	373	630	757	5113	1818
22	261	186	598	251	514	653	1874	279	114	454	2242	1715
23	71	66	248	89	199	327	1590	47	10	151	735	1041
24+	95	13	117	44	42	65	397	47	10	151	407	211
TOTAL	23738	13278	7246	7372	10375	32650	56671	46572	57252	151475	563674	627098
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	0	2905	3633	1065	932	5	20	0	98	29	0	0
7	2418	30158	20497	7412	3000	854	86	34	571	117	0	0
8	17175	65162	43553	26296	8620	4775	1987	525	2009	216	109	0
9	33454	53391	46996	44131	26716	12554	4576	2106	4949	1049	1055	347
10	52102	33569	37469	40441	48290	47348	16695	7969	17096	3079	3145	1685
11	49617	19909	26298	27089	39206	57134	31310	22092	31564	5921	2679	3219
12	53938	17242	20717	19950	33394	46529	51099	36763	41511	10701	3580	3744
13	33287	9270	16341	11172	21178	37731	48307	47096	33190	15930	6213	6378
14	19095	7410	6059	6400	11853	15506	29973	25468	10519	7051	3702	6703
15	12605	5456	3589	5607	6038	9492	17132	12002	4243	2495	1459	3687
16	5796	4134	3465	6801	2697	5780	8347	4336	1971	704	656	1797
17	4874	2134	2465	3441	2172	3368	5238	1499	658	390	210	901
18	5499	1545	1964	3001	1344	2160	2055	517	343	81	66	301
19	3155	666	1719	1406	632	1624	505	127	52	22	0	44
20	3941	1061	1906	796	802	1191	89	94	0	20	0	53
21	2955	423	1962	145	359	691	79	251	0	11	0	0
22	2531	308	560	145	117	344	0	0	0	7	0	0
23	1002	301	324	27	0	258	0	0	0	4	0	0
24+	322	158	108	27	0	76	0	0	0	3	0	0
TOTAL	303766	255202	239625	205352	207350	247420	217498	160879	148774	47829	22874	28859

Table 6.17

SEBASTES MENTELLA IN FISHING AREAS IIA AND IIB

	FISHING MORTALITY COEFFICIENT					NATURAL MORTALITY COEFFICIENT = .10					
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
6	.008	.014	.006	.008	.000	.000	.000	.002	.022	.001	.000
7	.064	.061	.033	.019	.008	.001	.000	.012	.003	.001	.001
8	.165	.111	.093	.044	.035	.022	.008	.030	.005	.003	.001
9	.192	.154	.141	.116	.075	.038	.027	.090	.018	.029	.010
10	.211	.179	.173	.202	.275	.121	.078	.275	.067	.060	.053
11	.212	.227	.170	.226	.345	.263	.208	.434	.130	.069	.073
12	.281	.316	.240	.291	.403	.522	.492	.652	.228	.097	.117
13	.297	.414	.251	.383	.546	.840	1.183	1.000	.495	.180	.224
14	.322	.288	.251	.406	.474	1.010	1.439	.823	.519	.180	.268
15	.395	.228	.417	.353	.585	1.329	1.469	.902	.409	.170	.245
16	.401	.416	.761	.322	.593	1.457	1.496	.941	.315	.159	.290
17	.429	.393	.831	.517	.738	1.632	1.066	.876	.420	.130	.303
18	.518	.784	1.037	.820	1.342	1.321	.602	.659	.213	.103	.249
19+	.518	.784	1.037	.820	1.342	1.321	.602	.659	.213	.103	.249
(10-15)U	.286	.275	.250	.310	.438	.681	.812	.681	.308	.126	.163

Table 6.18 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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
6	406904	270652	184344	118597	81940	88252	53453	48857	1380	2022	4992	0
7	513373	365420	241442	165789	106425	74137	79835	48366	44115	1221	1829	4516
8	449240	435859	311166	211420	147160	95485	67001	72205	43221	39805	1104	1654
9	321314	344617	353008	256571	183107	128617	84509	60125	63424	38903	35914	998
10	185345	240053	267194	277503	206777	153753	112028	74465	49702	56391	34198	32166
11	109389	135845	181637	203370	205255	142182	123263	93795	51161	42046	48036	29342
12	73878	80083	97960	138632	146809	131553	98946	90563	54965	40668	35499	40406
13	37777	50492	52815	69707	93764	88745	70657	54717	42687	39579	33397	28564
14	28203	25390	30203	37189	43001	49129	34683	19581	18209	23540	29914	24166
15	17495	18492	17226	21256	22417	24223	16189	7445	7783	9800	17785	20708
16	13101	10659	13326	10274	13509	11302	5802	3371	2732	4678	7482	12594
17	6405	7937	6362	5632	6739	6754	2382	1177	1190	1805	3610	5066
18	3997	3774	4845	2507	3040	2915	1195	743	443	707	1433	2412
19+	7547	12642	4111	3563	5888	954	1091	113	367	0	462	1337
TOTAL NO	2173970	2001914	1765640	1522008	1265831	998002	772723	620374	541697	599056	776506	
SPS NO	251817	286020	310614	344212	356620	308766	221863	139106	109282	95956	110172	
TOT. BIOM	598473	521724	500874	463590	428876	325396	222454	182554	141936	159298	188959	
SPS BIOM	132579	148252	154832	166678	183257	148220	94227	65387	54269	48878	54717	

Ignored

Table 6.19

List of input variables for the ICES prediction program.

SEBASTES MENTELLA

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
1989	274000.0
1990	248000.0
1991	194000.0

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
6	274000.0	.0002	.10	.00	.144	.144
7	231910.0	.0010	.10	.00	.180	.180
8	126777.0	.0037	.10	.00	.180	.188
9	89701.0	.0119	.10	.04	.204	.206
10	49077.0	.0365	.10	.07	.276	.278
11	42492.0	.07	.10	.17	.323	.328
12	40409.0	.12	.10	.42	.431	.414
13	28565.0	.22	.10	.66	.511	.490
14	24166.0	.27	.10	.77	.556	.546
15	20708.0	.25	.10	.84	.614	.599
16	12594.0	.29	.10	1.00	.750	.748
17	5066.0	.30	.10	1.00	.848	.828
18	2412.0	.25	.10	1.00	1.002	.952
19+	1337.0	.25	.10	1.00	1.095	1.043

Table 6.20

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

SEBASTES MENTELLA

Year 1989					Year 1990					Year 1991		
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	
1.1	.18	225	58	18	.2	.04	254	61	4	290	77	
					.5	.08	F _{0.1}		9	285	73	
					1.0	.16	F ₈₈ =F _{med}		17	276	66	
					1.1	.18	F ₈₉ =F _{max}		18	275	65	
					3.4	.55	F _{high}		46	246	42	

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 10 to 15

Table 6.21 *Sebastes marinus*.

Catch (percentage of total international catch) and catch per unit effort for Norwegian stern trawlers and total international effort (Norwegian units)¹.

Year	Catch (t)	CPUE (kg/tonnage x hours)	Effort (tonnage-hours x '000)
1981	1,723 (8.3%)	2.07	10,061
1982	3,033 (18.5%)	2.99	5,474
1983	4,459 (23.2%)	2.66	7,241
1984	6,930 (24.4%)	1.80	15,766
1985	6,653 (22.6%)	1.60	18,428
1986	7,650 (25.3%)	2.07	14,589
1987	3,426 (14.2%)	1.93	12,476
1988 ²	5,293 (22.3%)	1.71	13,890

¹ Only including trips with more than 50% *S. marinus* in the catches.

² Provisional figures.

Table 6.22 Sebastes marinus 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
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	530
6	0	0	0	0	0	0	0	0	0	0	0	2884
7	0	0	0	0	0	0	0	0	0	0	0	5710
8	0	0	0	0	0	0	0	0	0	0	0	12162
9	0	0	0	0	0	0	0	0	0	0	0	10250
10	0	0	0	0	0	0	0	0	0	0	0	9515
11	0	0	0	0	0	0	0	0	0	0	0	5963
12	256	41	44	43	51	62	46	261	590	387	693	5008
13	322	118	94	32	35	122	41	332	570	455	868	1686
14	805	370	199	74	97	229	107	633	913	1049	1638	2670
15	1531	863	406	165	209	444	239	1137	1527	2079	2984	2991
16	3505	2952	1363	550	666	1232	886	2563	3266	5479	7397	6775
17	1529	1737	919	364	556	723	594	1261	1441	2757	3563	2707
18	2321	2753	1536	611	954	1138	935	2014	2157	4164	5117	3938
19	2231	2718	1695	684	1223	997	990	2046	1892	3528	4402	3417
20	445	503	310	131	223	185	185	385	342	638	775	614
21	2223	2471	1459	753	1456	1003	858	1732	1420	2359	2829	2475
22	1624	1687	951	555	1084	750	595	1112	849	1373	1721	1529
23	1758	2158	1167	898	1518	921	779	1251	1123	1527	1813	1814
24	1741	1924	1241	1266	2259	966	1123	1121	1248	1103	1432	1672
25	958	960	896	993	1845	716	776	746	884	702	930	1106
26	637	615	723	887	1667	623	636	585	729	530	617	918
27	460	406	504	644	1362	526	426	429	568	369	701	822
28+	328	405	432	614	1038	347	431	377	508	332	589	624
TOTAL	22674	22681	13939	9264	16243	10984	9647	17985	20027	28331	38269	87789

Table 6.22 (cont'd)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	86	0	0	0	0	0	0	0	0	0	0	0
4	428	0	0	0	0	0	0	0	0	0	0	0
5	1839	20	0	10	10	0	0	0	0	0	0	0
6	1831	13	0	11	7	0	0	0	0	0	0	0
7	1621	30	12	13	125	0	0	0	0	0	0	0
8	4179	328	73	87	225	0	0	0	0	88	6	0
9	4620	641	101	180	434	3	0	0	0	157	5	94
10	4501	930	149	352	779	36	0	0	0	197	10	207
11	2359	615	145	517	885	179	8	0	66	145	25	281
12	3306	2003	723	768	1224	816	86	199	880	251	123	357
13	2557	2788	914	571	952	814	249	101	1009	838	332	771
14	4242	5453	3422	2368	1704	1961	581	601	2697	3150	413	1338
15	5334	6404	3276	3677	2502	2364	1358	1623	5720	3697	1281	1196
16	6072	5880	3554	3502	2485	2636	2186	1425	5300	5264	1735	832
17	2372	2569	1726	1073	868	1333	831	701	2275	2827	1141	1197
18	3452	3669	2212	2341	2399	1989	2241	4572	4421	7309	1409	2647
19	3115	2719	2237	1364	1274	1174	1314	1624	2632	3188	1570	3089
20	964	1538	1814	1330	1457	1309	1109	2124	1818	1866	1635	2710
21	2408	1716	2237	1829	1392	2121	1803	4551	2242	3237	2810	2647
22	1170	382	959	1040	734	927	864	1475	1168	496	1372	1513
23	1464	491	946	1507	1007	715	643	2599	975	447	1678	1891
24	1318	411	959	968	550	353	929	1651	1006	282	1111	1387
25	923	241	673	519	407	129	656	825	162	0	658	946
26	772	175	630	383	273	48	924	702	161	0	2090	504
27	666	155	541	341	41	18	330	225	0	0	0	378
28+	677	141	239	39	36	0	0	0	0	0	0	316
TOTAL	62286	39312	27542	24790	21770	18925	16112	24998	32532	33439	19404	24301

Table 6.23

Title : SEBASTES MARINUS IN FISHING AREAS I AND IJA
 At 09.40.34 28 SEPTEMBER 1989
 from 78 to 88 on ages 11 to 23
 with Terminal F of .140 on age 18 and Terminal S of 1.000

Initial sum of squared residuals was 170.768 and
 final sum of squared residuals is 66.760 after 109 iterations

Matrix of Residuals

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	WTS	
Ages												
11/12	.816	-.474	.352	1.436	1.732	-1.416	-4.675	.071	.904	-.753	.000	.175
12/13	.949	.618	.189	.953	1.377	.828	-.113	.631	-.361	-.750	.000	.485
13/14	.110	-.416	-.534	-.022	.686	.263	-1.639	-.431	.765	-.179	.000	.470
14/15	.372	.018	.060	-.069	.275	-.324	-1.068	-.090	.483	-.319	.000	.734
15/16	-.090	-.515	-.029	-.329	-.550	.122	-.527	-.237	-.213	.641	.000	.893
16/17	.013	.212	.434	-.194	-.017	.768	-.328	-.198	.039	.070	.000	1.000
17/18	.307	.075	-.401	-.283	-.325	-.715	-.357	-.628	.589	.209	.000	.762
18/19	-.248	-.032	.118	.368	-.285	.422	1.151	-.039	.516	-.627	.000	.646
19/20	-.086	.254	-.307	-.126	-.394	-.133	.735	.236	-.095	-.136	.000	.986
20/21	-.246	.348	.337	.150	-.144	-.443	1.387	-.095	-.561	.518	.000	.573
21/22	-.712	-.295	-.121	-.483	-.345	-.238	1.418	.580	-.731	.228	.000	.494
22/23	-1.059	-.380	.129	.266	.254	-.417	1.591	1.185	-1.642	.419	.000	.337

-.001 -.001 -.001 -.001 .000 .000 .000 .000 .000 .000 .000 -.012

WTS .100 .100 .100 .100 .100 .100 .100 1.000 1.000 1.000

Fishing Mortalities (F)

78
 F-values .0726

79 80 81 82 83 84 85 86 87 88
 F-values .0511 .0446 .0397 .0407 .0292 .0466 .1277 .1396 .0778 .1400

Selection-at-age (S)

11 12 13
 S-values .0484 .2031 .3821

14 15 16 17 18 19 20 21 22 23
 S-values .8512 1.2388 1.0601 .5211 1.0000 .7901 .7970 1.5219 .7054 1.0000

Table 6.24 Virtual Population Analysis.

SEBASIES MARINUS IN FISHING AREAS I AND IIA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .10

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
11	.007	.002	.007	.013	.004	.000	.000	.005	.010	.002	.007
12	.025	.010	.009	.018	.014	.002	.009	.070	.020	.009	.037
13	.037	.013	.009	.013	.013	.005	.003	.055	.079	.030	.067
14	.095	.052	.037	.029	.030	.011	.012	.093	.215	.046	.144
15	.130	.069	.066	.045	.046	.023	.034	.142	.160	.114	.162
16	.106	.089	.088	.052	.055	.049	.028	.132	.168	.095	.091
17	.038	.037	.031	.025	.032	.020	.018	.051	.087	.045	.079
18	.072	.038	.058	.082	.067	.063	.131	.136	.204	.051	.125
19	.064	.052	.027	.037	.048	.052	.054	.093	.123	.055	.137
20	.045	.050	.036	.033	.043	.052	.101	.070	.080	.077	.114
21	.065	.077	.058	.043	.055	.070	.277	.132	.155	.149	.156
22	.031	.042	.042	.027	.033	.026	.068	.095	.035	.082	.100
23	.073	.090	.078	.047	.030	.026	.090	.053	.043	.143	.139
24+	.073	.090	.078	.047	.030	.026	.090	.053	.043	.143	.139
(15-21)U	.074	.059	.052	.045	.050	.047	.092	.108	.140	.084	.123

Table 6.25 Virtual Population Analysis.

SEBASTES MARINUS IN FISHING AREAS I AND IIA

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
11	86963	97843	80452	70874	43332	24545	15196	14890	15664	11511	43760	0
12	86513	78103	88394	72305	63288	39038	22202	13750	13410	14036	10392	39329
13	80740	76376	69983	79252	64260	56490	35242	19900	11605	11896	12583	9064
14	63093	70406	68239	62781	70805	57371	50877	31792	17047	9705	10448	10653
15	55262	51908	60454	59494	55186	62203	51359	45464	26204	12435	8389	8183
16	61186	43920	43855	51207	51455	47688	54993	44929	35705	20200	10035	6455
17	71593	49777	36364	36355	43972	44053	41072	48405	35620	27309	16629	8789
18	55269	62338	43400	31884	32070	38521	39071	36497	41636	29544	23626	13909
19	46410	46523	54303	37045	26570	27128	32725	31010	28825	30736	25393	18864
20	36674	39410	39970	47839	32308	22926	23297	28067	25558	23054	26319	20043
21	28696	31722	33936	34902	41902	27990	19690	19063	23669	21353	19306	71240
22	13168	24335	26578	28968	30257	35898	23613	13499	15119	18343	16653	14956
23	7368	11552	21107	23060	25514	26497	31661	19964	11105	13209	15293	13631
24	16852	37146	31514	29930	19554	116990	41455	27213	7006	30377	28557	34528
TOTAL NO	709789	721360	698550	665895	600474	627337	482453	594443	308174	273707	267384	
SPS NO	392479	398631	391481	380684	358788	449893	358936	314111	250447	226560	190201	
TOT.BIOM	546277	576504	565034	598314	472557	665016	445737	358347	261175	295488	222730	
SPS BIOM	374787	402126	397756	426476	342837	551950	372129	311825	248712	267253	191328	

Table 6.26

Sebastes varinus SHOT forecast spreadsheet version 3

running recruitment weights

older	.30	S-M =	.00
central	.40	exp(d)	1.00
younger	.30	exp(d/2)	1.00

Year	Land	Recr	W	Y/B	Hang	Act'l	Est'd	Est'd	Act'l	Est'd	Est'd
	-ings	Index	Index	Ratio	-over	Prodn	Prodn	SQC.	Expl	Expl	Land
									Bioa	Bioa	-ings
1973	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	.30	.70	18				70	
1982	16	1	1	.30	.70	4	15	19	53	54	19
1983	15	1	1	.30	.70	26	12	15	63	50	15
1984	29	1	1	.50	.70	49	15	18	73	59	18
1985	29	1	1	.30	.70	31	21	25	97	86	24
1986	30	1	1	.30	.70	32	22	27	100	93	27
1987	24	1	1	.30	.70	10	23	28	30	93	28
1988	24	1	1	.30	.70		22	23		78	23
1989	24	1	1	.30	.70		22	23		76	23
1990		1	1	.30	.70		22	23		75	23

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	1979	1980	1981	1982	1983
Denmark	-	-	-	-	-
Faroe Islands	3	-	8	-	-
France	-	-	-	8	67
German Dem.Rep.	3,488	2,080	1,358	1,153	1,913
Germany, Fed.Rep.	481	303	128	18	130
Norway	2,843	3,157	4,201	3,206	4,883
Poland	106	-	-	-	-
UK (Engl.& Wales)	59	26	9	10	2
UK (Scotland)	-	-	-	-	-
USSR	10,311	7,670	9,276	12,394	15,152
Others	21	48	38	-	-
Total	17,312	13,284	15,018	16,789	22,147

Country	1984	1985	1986	1987	1988 ¹
Denmark	-	-	-	+	-
Faroe Islands	-	-	42	7 ²	24 ²
France	138	239	13	13	109 ²
German Dem.Rep.	2,089	3,807	2,659	1,855	713
Germany, Fed.Rep.	76	193	59	169	27
Norway	4,376	5,464	7,869	7,262	8,925
Poland	-	-	-	-	-
UK (Engl.& Wales)	23	5	10	61	82
UK (Scotland)	-	-	2	20	2
USSR	15,181	10,237	12,200	9,733	9,430
Others	-	-	-	-	-
Total	21,883	19,945	22,854	19,120	19,312

¹ Provisional figures.

² As reported to Norwegian Authorities.

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	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988 ¹
Germany, Fed.Rep.	-	-	19	-	-	-	-	1	2	4
Norway	727	490	641	505	490	593	602	557	984	1,751
UK (Engl.& Wales)	36	12	5	8	1	17	1	5	10	7
UK (Scotland)	-	-	-	-	-	-	-	1	+	-
USSR	182	100	564	200	196	81	122	615	259	420
Others	-	-	1	-	-	-	-	-	-	-
Total	945	602	1,230	713	687	691	725	1,179	1,255	2,182

¹Provisional 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	1979	1980	1981	1982	1983
Faroe Islands	3	-	8	-	-
France	-	-	-	8	67
German Dem.Rep.	787	570	18	73	14
Germany, Fed.Rep.	481	303	109	18	130
Norway	2,051	2,529	3,077	2,487	4,257
Poland	4	-	-	-	-
UK (Engl.& Wales)	11	9	4	2	1
UK (Scotland)	-	-	-	-	-
USSR	6,929	2,014	2,031	2,459	5,031
Others	21	48	37	-	-
Total	10,287	5,473	5,284	5,047	9,500

Country	1984	1985	1986	1987	1988 ¹
Faroe Islands	-	-	6	-	24 ²
France	138	239	13	13	107 ²
German Dem.Rep.	189	82	55	12	130
Germany, Fed.Rep.	76	172	42	63	15
Norway	3,703	4,791	6,367	5,706	7,010
Poland	-	-	-	-	-
UK (Engl.& Wales)	1	2	5	44	56
UK (Scotland)	-	-	1	10	2
USSR	5,459	6,894	5,553	4,739	4,002
Others	-	-	-	-	-
Total	9,566	12,180	12,042	10,587	11,346

¹Provisional figures.

²As reported to Norwegian authorities.

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	1979	1980	1981	1982	1983
Denmark	-	-	-	-	-
Faroe Islands	-	-	-	-	-
France	-	-	-	-	-
German Dem.Rep.	2,701	1,510	1,340	1,080	1,899
Germany, Fed.Rep.	-	-	-	-	-
Norway	65	138	483	214	136
Poland	102	-	-	-	-
UK (Engl.& Wales)	12	5	-	+	+
USSR	3,200	5,556	6,681	9,735	9,925
Total	6,080	7,209	8,504	11,029	11,960

Country	1984	1985	1986	1987	1988 ¹
Denmark	-	-	-	+	-
Faroe Islands	-	-	36	7	-
France	-	-	-	2 ²	-
German Dem.Rep.	1,900	3,725	2,604	1,843	583
Germany, Fed.Rep.	-	21	16	104	8
Norway	80	71	945	572	164
Poland	-	-	-	-	-
UK (Engl.& Wales)	5	2	+	7	19
UK (Scotland)	-	-	-	10	+
USSR	9,641	3,221	6,032	4,735	5,008
Total	11,626	7,040	9,633	7,278	5,784

¹ Provisional figures.

² As reported to Norwegian authorities.

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) Vessel 2-07	Average CPUE		Total effort (in '000 hrs trawling) ⁶	CPUE 7+
	RT ²	PST ³		A ⁴	B ⁵		
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	-	0.37	0.37	-	81	0.36
1974	0.40	-	0.37	0.39	-	97	0.36
1975	0.39	0.51	0.39	0.39	0.45	97	0.37
1976	0.40	0.56	0.34	0.37	0.45	97	0.34
1977	0.27	0.41	0.34	0.31	0.38	93	0.26
1978	0.21	0.32	0.21	0.21	0.27	117	0.17
1979	0.23	0.35	0.26	0.25	0.31	69	0.18
1980	0.24	0.33	0.31	0.28	0.32	48	0.24
1981	0.30	0.36	0.33	0.32	0.35	43	0.27
1982	0.26	0.45	0.39	0.33	0.42	40	0.36
1983	0.26	0.40	0.34	0.30	0.37	60	0.31
1984	0.27	0.41	0.31	0.29	0.36	61	0.29
1985	0.28	0.52	0.37	0.33	0.45	44	0.37
1986	0.23	0.42	0.35	0.29	0.39	59	0.31
1987	0.25	0.50	0.34	0.30	0.42	46	0.33
1988 ¹	0.20	0.30	0.31	0.26	0.31	62	0.26

¹ Provisional.

² Side trawlers, 800-1000 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 (or SRTM trawlers) and Norwegian fresh fish trawlers (vessel 2-07, 250-500 GRT).

⁵ Arithmetic average of CPUE from USSR PST and Norwegian fresh fish trawlers.

⁶ From 1981 onwards based on average CPUE type B.

Table 7.6 GREENLAND HALIBUT in Sub-areas I and II. Norwegian survey indices (numbers in millions) 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
1987	18.5	1.0
1988	39.3	2.5

Table 7.7 Tunfing data.

GREENLAND HALIBUT : USSR & NORWAY EFFORT (hours trawling)
AND TRAWL CATCHES (in numbers at age).

102

NORWEGIAN TRAWL-CPUE

79,88

1,1

3,15

3542,	1,	4,	1,	26,	123,	66,	53,	32,	64,	55,	24,	6,	1
5029,	1,	1,	1,	14,	95,	90,	55,	25,	107,	64,	39,	63,	7
8936,	1,	1,	1,	89,	263,	148,	103,	110,	183,	109,	128,	39,	18
8077,	7,	81,	172,	192,	252,	206,	129,	142,	122,	100,	83,	23,	13
14476,	1,	1,	59,	30,	154,	336,	295,	333,	129,	60,	95,	157,	26
14116,	1,	1,	11,	70,	193,	219,	268,	241,	128,	193,	91,	112,	37
14768,	1,	1,	1,	40,	169,	239,	438,	379,	269,	199,	90,	70,	40
15774,	1,	11,	32,	202,	308,	265,	244,	361,	223,	202,	149,	202,	159
12333,	1,	25,	234,	446,	821,	375,	117,	188,	92,	46,	92,	1,	1
16526,	1,	38,	461,	794,	1123,	715,	295,	73,	25,	54,	1,	26,	8

USSR TRAWL

79,88

1,1

3,15

29460,	1,	423,	1336,	2459,	2145,	870,	266,	168,	63,	17,	1,	1,	1
23242,	1,	63,	484,	911,	1182,	989,	733,	359,	218,	94,	99,	26,	31
25767,	589,	1018,	1684,	1613,	1439,	677,	307,	246,	173,	136,	159,	59,	17
27542,	37,	427,	1029,	1184,	931,	911,	1240,	1015,	651,	365,	219,	78,	27
38445,	1,	246,	828,	1469,	1550,	1905,	1193,	896,	583,	428,	153,	46,	25
37027,	1,	32,	807,	3235,	2801,	1513,	683,	823,	410,	111,	62,	6,	1
19687,	1,	27,	559,	2363,	1868,	828,	382,	474,	242,	68,	27,	3,	1
29048,	1,	455,	1214,	2732,	2116,	968,	592,	424,	160,	95,	39,	2,	1
19466,	1,	249,	797,	2128,	1796,	847,	404,	386,	160,	87,	30,	10,	1
31433,	1,	80,	274,	1516,	1665,	1029,	632,	482,	264,	102,	47,	7,	5

Table 7.8

Module run at 17.34.49 23 SEPTEMBER 1989

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,NORWEGIAN TRAWL-CPUE, has terminal q estimated as the mean

Fleet 2 ,USSR TRAWL, has terminal q estimated as the mean

FLEETS COMBINED BY ** VARIANCE **

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 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

Fishing mortalities

Age,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,
3,	.004,	.002,	.028,	.002,	.009,	.000,	.004,	.019,	.001,	.005,
4,	.048,	.014,	.052,	.028,	.053,	.001,	.016,	.048,	.070,	.005,
5,	.128,	.049,	.117,	.073,	.097,	.049,	.048,	.073,	.073,	.189,
6,	.242,	.085,	.164,	.121,	.134,	.331,	.201,	.169,	.169,	.200,
7,	.309,	.183,	.191,	.149,	.204,	.355,	.378,	.279,	.259,	.251,
8,	.197,	.232,	.141,	.167,	.405,	.322,	.260,	.385,	.276,	.221,
9,	.147,	.216,	.116,	.329,	.301,	.315,	.251,	.289,	.312,	.282,
10,	.133,	.193,	.143,	.463,	.464,	.394,	.541,	.414,	.337,	.650,
11,	.217,	.308,	.289,	.403,	.490,	.410,	.342,	.554,	.244,	.310,
12,	.317,	.302,	.372,	.519,	.409,	.432,	.438,	.407,	.399,	.320,
13,	.270,	.564,	.842,	.590,	.493,	.231,	.353,	.799,	.289,	.460,
14,	.193,	.703,	.785,	.568,	.862,	.504,	.238,	2.404,	.338,	.340,
15,	.226,	.414,	.486,	.509,	.544,	.394,	.382,	.916,	.321,	.416,

Log catchability estimates

Age 5 Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	No data for this fleet at this age									
2,	-12.85,	-13.49,	-12.42,	-13.08,	-13.52,	-13.67,	-13.71,	-13.22,	-12.91,	-13.21

SUMMARY STATISTICS

Fleet,	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
q			F	F		Slope		Intrcpt	
1,	No data for this fleet at this age								
2,	-13.21	.427	.0577	.1884	.000E+00	.000E+00	-13.207	.129	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.188	.427	0.000	.427	0.000				

Age 6

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-14.39,	-15.39,	-13.97,	-13.16,	-15.72,	-14.63,	-15.48,	-14.25,	-13.10,	-12.47
2,	-11.96,	-12.74,	-12.14,	-12.57,	-12.80,	-11.76,	-11.69,	-12.26,	-11.99,	-12.47

SUMMARY STATISTICS

Fleet,	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q			F	F		Slope		Intrcpt
1,	-14.26	1.154	.0106	.0336	.000E+00	.000E+00	-14.256	.348
2,	-12.24	.416	.1523	.2527	.000E+00	.000E+00	-12.238	.125
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	.200	.391	.644	.644	2.708			

Table 7.8 (cont'd)

Age 7

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-12.45,	-13.08,	-12.74,	-12.52,	-13.65,	-13.45,	-13.29,	-13.12,	-12.24,	-12.11
2,	-11.71,	-12.09,	-12.10,	-12.44,	-12.32,	-11.73,	-11.17,	-11.80,	-11.91,	-12.36

SUMMARY STATISTICS

Fleet,	Pred.	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE
q			F	F		Slope		Intrcpt
1	-12.87	.555	.0427	.1179	.000E+00	.000E+00	-12.865	.167
2	-11.96	.402	.2000	.3722	.000E+00	.000E+00	-11.965	.121
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.251	.325	.546	.546	2.814				

Age 8

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-12.72,	-12.69,	-12.90,	-12.56,	-12.40,	-12.87,	-12.82,	-12.37,	-12.25,	-12.28
2,	-12.26,	-11.82,	-12.44,	-12.30,	-11.64,	-11.90,	-11.86,	-11.69,	-11.89,	-12.56

SUMMARY STATISTICS

Fleet,	Pred.	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE
q			F	F		Slope		Intrcpt
1	-12.59	.259	.0565	.1632	.000E+00	.000E+00	-12.585	.078
2	-12.04	.340	.1863	.3735	.000E+00	.000E+00	-12.036	.103
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.221	.206	.399	.399	3.756				

Age 9

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-12.33,	-12.90,	-12.80,	-12.56,	-12.40,	-12.09,	-11.78,	-12.44,	-12.44,	-12.35
2,	-12.83,	-11.84,	-12.76,	-11.52,	-11.98,	-12.12,	-12.21,	-12.16,	-11.66,	-12.23

SUMMARY STATISTICS

Fleet,	Pred.	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE
q			F	F		Slope		Intrcpt
1	-12.41	.336	.0675	.2667	.000E+00	.000E+00	-12.409	.101
2	-12.13	.443	.1693	.3123	.000E+00	.000E+00	-12.132	.134
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.282	.268	.760E-01	.268	.081				

Age 10

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-12.49,	-13.11,	-12.45,	-11.95,	-11.65,	-12.08,	-11.22,	-11.56,	-11.99,	-12.60
2,	-12.95,	-11.98,	-12.70,	-11.21,	-11.64,	-11.82,	-11.29,	-12.01,	-11.73,	-11.35

SUMMARY STATISTICS

Fleet,	Pred.	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE
q			F	F		Slope		Intrcpt
1	-12.11	.588	.0909	1.0560	.000E+00	.000E+00	-12.111	.177
2	-11.87	.607	.2205	.3879	.000E+00	.000E+00	-11.868	.183
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.650	.422	.501	.501	1.405				

Page 7.9

Title : GREENLAND HALIBUT IN FISHING AREAS I AND II
 At 20.32,25 24 SEPTEMBER 1989
 from 78 to 88 on ages 3 to 15
 with Terminal F of .350 on age 8 and Terminal S of 1.000

Initial sum of squared residuals was 199.406 and
 final sum of squared residuals is 100.203 after 60 iterations

Matrix of Residuals

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	WTS	
Ages												
3/ 4	-1.329	.854	-.944	2.536	-1.054	4.131	-4.986	-.316	.621	.545	.001	.001
4/ 5	-1.188	1.331	-.846	1.357	.275	1.373	-2.553	-.063	.670	.479	.000	.010
5/ 6	-.513	1.577	-.107	1.479	.681	-.055	-.442	-.056	.036	.205	.000	.100
6/ 7	-.488	.841	-.375	.924	.069	-.539	.302	.240	-.227	.128	.000	1.000
7/ 8	-.059	.456	.270	.522	-.777	-.490	.215	.211	-.213	.236	.000	1.000
8/ 9	.176	-.104	.591	-.526	-.518	.207	.016	-.101	-.060	-.024	.000	1.000
9/10	.663	.157	.801	-.547	.342	.122	-.185	.008	.006	-.093	.000	1.000
10/11	-.323	-.887	-.493	-.744	.166	.042	-.119	.145	.132	.028	.000	1.000
11/12	.007	-.209	-.044	-.028	.270	.204	-.140	-.047	.221	-.239	.000	1.000
12/13	.016	-.358	-.753	.092	.354	.424	.013	-.336	.014	-.050	.000	1.000
13/14	.777	-.544	.219	1.350	.262	.140	-.237	-.983	.918	-.045	.000	.100
14/15	-.415	-1.212	.176	.668	-.122	.436	-.395	-1.660	2.400	-.691	.000	.010
	.001	.001	.000	.000	.000	.000	.000	.000	.000	.000	4.278	
WTS	.100	.100	.100	.100	.100	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

78
 F-values .4174

79 80 81 82 83 84 85 86 87 88
 F-values .1790 .1871 .1855 .2775 .3495 .3570 .3215 .3756 .3083 .3500

Selection-at-age (S)

3 4 5
 S-values .0071 .0584 .2072

6 7 8 9 10 11 12 13 14 15
 S-values .6165 .9664 1.0000 .9126 1.5986 1.3143 1.4118 1.4150 1.7078 1.0000

Table 7.10 Percentage of mature GREENLAND HALIBUT
by age. Data from the USSR for the years
1983-1987.

Age years	1983	1984	1985	1986	1987	Average 1983-1987
4	-	-	-	0.04	0.06	0.05
5	0.15	0.57	0.18	0.23	0.20	0.27
6	0.29	0.69	0.43	0.49	0.46	0.47
7	0.56	0.62	0.63	0.52	0.70	0.61
8	0.85	0.61	0.77	0.62	0.74	0.72
9	0.94	0.61	0.92	0.80	0.91	0.84
10	0.96	0.74	0.97	0.88	0.96	0.90
11	0.99	0.92	0.97	1.00	1.00	0.98
12	1.00	0.92	1.00	1.00	1.00	0.98
13	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	-	1.00
15	1.00	1.00	-	-	-	1.00
16	1.00	-	-	1.00	-	1.00

Table 7.11 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	3521	1117	2519	2337	2982	3255	3589	3155	1138	1917
7	10464	12712	9605	3923	6204	6520	5824	4200	4118	2727	1665	1919
8	18562	12283	6438	3515	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	30	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	1987	1988					
3	48	314	0	88	141	50	5					
4	551	1212	36	461	985	435	230					
5	1304	1543	915	1219	1672	1212	894					
6	1494	1864	3698	2874	3335	2972	2505					
7	1276	1851	3350	2561	2712	3572	3098					
8	1208	2287	1938	1548	1531	1745	2063					
9	1493	1491	1064	972	1128	752	1166					
10	1258	1228	1191	1037	997	828	848					
11	838	713	602	614	530	362	474					
12	502	488	340	363	434	202	309					
13	324	247	171	161	314	186	131					
14	108	201	132	120	305	63	138					
15	43	51	41	55	232	7	46					
16+	3	13	30	8	7	0	0					
TOTAL	10450	13503	13508	12081	14323	12387	11907					

Table 7.12 Virtual Population Analysis.

GREENLAND HALIBUT IN FISHING AREAS I AND II

MEAN WEIGHT AT AGE OF THE STOCK 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	1.848	1.848	1.848	1.848	1.848	1.848	1.848	1.848	1.848	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	1987	1988					
3	.270	.310	.300	.300	.340	.307	.414					
4	.620	.450	.480	.380	.470	.574	.554					
5	.690	.750	.630	.600	.620	.709	.740					
6	.840	1.040	.960	.890	.920	1.003	.962					
7	1.030	1.340	1.180	1.200	1.280	1.266	1.249					
8	1.310	1.570	1.530	1.850	1.900	1.683	1.626					
9	1.740	1.970	2.310	2.590	2.480	2.482	2.164					
10	2.240	2.730	2.870	3.180	3.110	2.982	2.897					
11	2.770	3.290	3.460	3.620	3.350	3.547	3.406					
12	3.370	4.220	3.770	3.950	3.720	3.800	3.661					
13	4.320	4.710	3.990	4.480	4.000	4.560	4.247					
14	5.350	6.080	4.350	4.250	4.180	5.002	4.187					
15	5.780	6.000	4.470	4.800	4.500	5.953	4.463					
16+	6.600	6.600	4.600	5.000	5.400	5.953	4.463					

Table 7.13 Virtual Population Analysis.

GRFENLAND HALIBUT IN FISHING AREAS I AND II

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .15

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	.004	.004	.003	.027	.002	.011	.000	.004	.007	.003	.002
4	.026	.048	.015	.055	.026	.056	.001	.020	.050	.027	.019
5	.105	.134	.048	.126	.078	.091	.052	.058	.087	.076	.068
6	.258	.241	.089	.164	.132	.145	.309	.218	.211	.207	.210
7	.421	.300	.183	.202	.148	.226	.392	.344	.309	.346	.325
8	.443	.202	.224	.140	.178	.403	.368	.299	.335	.316	.325
9	.391	.146	.221	.111	.327	.328	.313	.300	.349	.258	.341
10	.388	.125	.192	.147	.436	.460	.446	.535	.537	.439	.486
11	.518	.190	.285	.289	.421	.447	.405	.410	.545	.358	.457
12	.515	.230	.255	.335	.517	.436	.374	.430	.538	.388	.554
13	.644	.205	.356	.633	.499	.489	.253	.288	.771	.439	.441
14	.649	.147	.462	.368	.342	.628	.497	.267	1.292	.318	.641
15	.416	.245	.291	.251	.161	.254	.233	.374	1.139	.074	.382
16+	.416	.245	.291	.251	.161	.254	.233	.374	1.139	.074	.382
(5-10)U	.334	.191	.160	.148	.217	.275	.313	.292	.305	.274	.293
(7-11)U	.432	.193	.221	.178	.302	.373	.385	.378	.415	.343	.387

Table 7.14: 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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	23629	23627	26700	27069	27653	31633	29811	25325	20339	15504	2167	0
4	22701	20265	20255	22922	22683	23757	26936	25659	21716	17375	13298	1860
5	20431	19046	16621	17179	18667	19013	19325	23151	21658	17779	14552	11233
6	16953	15829	14341	13629	13031	14860	14936	15786	18797	17093	14180	11697
7	12840	11276	10708	11290	9957	9834	11065	9441	10930	13096	11964	9889
8	7073	7255	7187	7677	7943	7390	6753	6434	5762	6904	7975	7438
9	5002	3908	5103	4947	5745	5719	4251	4024	4108	3547	4330	4960
10	3153	2914	2906	3520	3810	3566	3546	2677	2566	2495	2358	2651
11	2472	1841	2213	2064	2615	2119	1938	1955	1349	1291	1384	1248
12	1164	1268	1311	1432	1331	1478	1167	1113	1116	673	777	755
13	785	598	867	874	882	683	822	691	623	561	393	384
14	329	355	420	523	399	461	361	550	446	248	311	218
15	261	148	264	227	311	244	212	189	362	105	155	141
16+	91	104	68	73	22	62	155	27	11	0	0	91
TOTAL NO	116886	108434	108963	113424	115050	120820	121279	117021	109784	105471	104895	
SPS NO	39614	35854	35921	37050	37828	37614	36551	35597	36203	34726	33446	
TOT. BIOM	97156	117261	94187	102677	104168	117098	109387	105400	105668	103229	101953	
SPS BIOM	57207	63396	54389	60875	58536	67107	60877	60454	58965	55949	53468	

Ignored

Average recruitment (age 3) 1978-1987: 25,000.

Table 7.15

List of input variables for the ICES prediction program.

GREENLAND HALIBUT

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
1989	25000.0
1990	25000.0
1991	25000.0

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	25000.0	.0025	.15	.00	.360	.360
4	22066.0	.020	.15	.05	.564	.564
5	17656.0	.073	.15	.27	.724	.724
6	11697.0	.21	.15	.47	.983	.983
7	9889.0	.32	.15	.61	1.258	1.258
8	7438.0	.32	.15	.72	1.655	1.655
9	4960.0	.34	.15	.84	2.323	2.323
10	2651.0	.49	.15	.90	2.939	2.939
11	1248.0	.46	.15	.98	3.477	3.477
12	755.0	.55	.15	.98	3.731	3.731
13	384.0	.44	.15	1.00	4.403	4.403
14	218.0	.64	.15	1.00	4.594	4.594
15	141.0	.38	.15	1.00	5.208	5.208
16+	91.0	.38	.15	1.00	5.208	5.208

Table 7.16

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

GREENLAND HALIBUT

Year 1989					Year 1990					Year 1991		
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	
.7	.27	101	54	14	.3	.13	106	58	8	119	68	
					.6	.25	F _{max}		14	111	62	
					.7	.27	F _{med} =F ₈₉		15	110	61	
					1.0	.38	F _{high}		20	104	56	
					1.0	.39	F ₈₈		21	103	55	

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

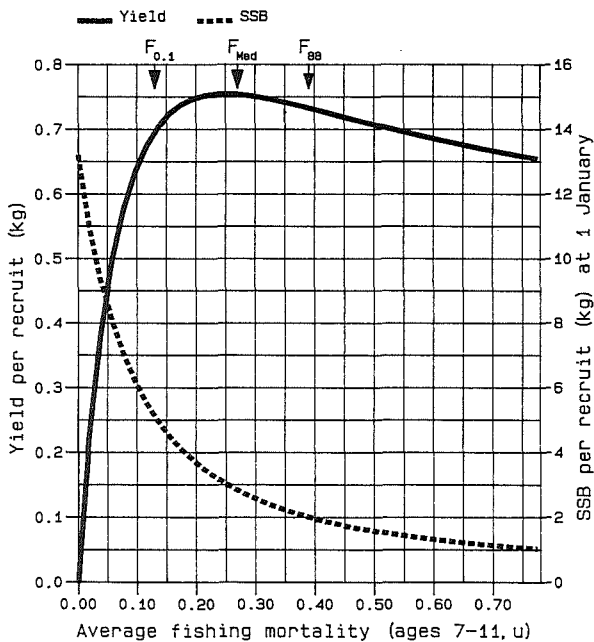
Figure 7.2 (cont'd)

FISH STOCK SUMMARY

STOCK: Greenland Halibut in Sub-areas I and II

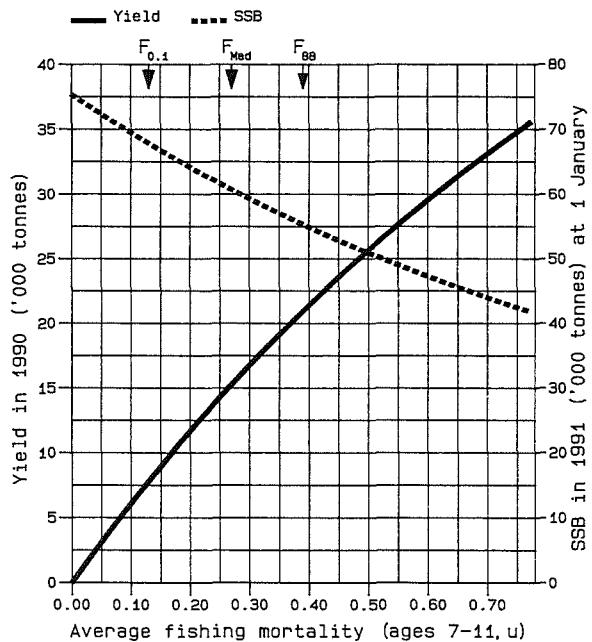
23-10-1989

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Fischeriönchiora
Bibliotek

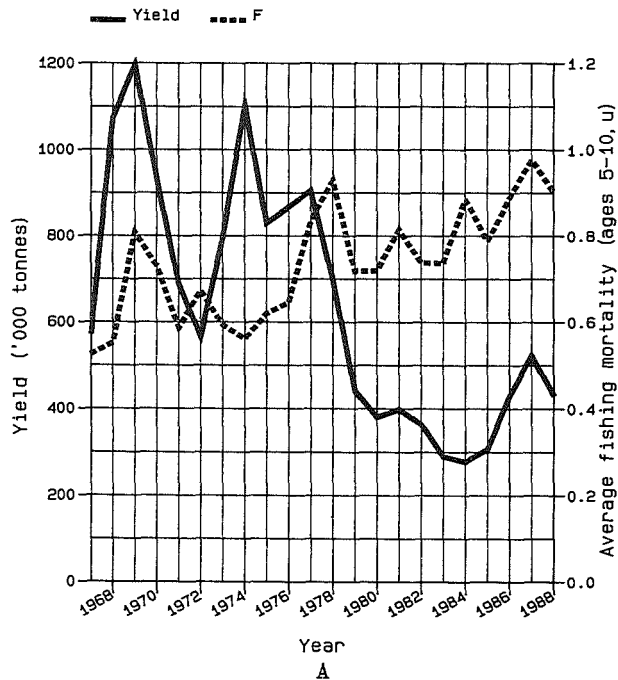
Figure 3.1

FISH STOCK SUMMARY

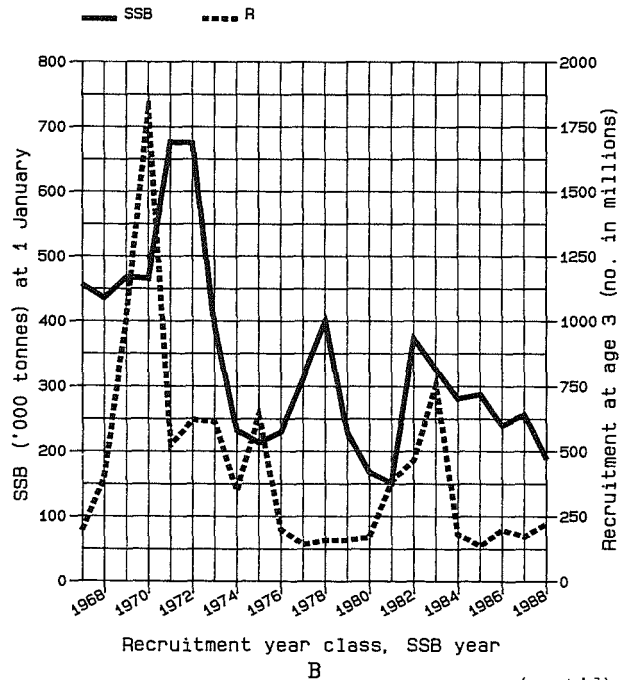
STOCK: North-East Arctic Cod

23-10-1989

Trends in yield and fishing mortality (F)



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



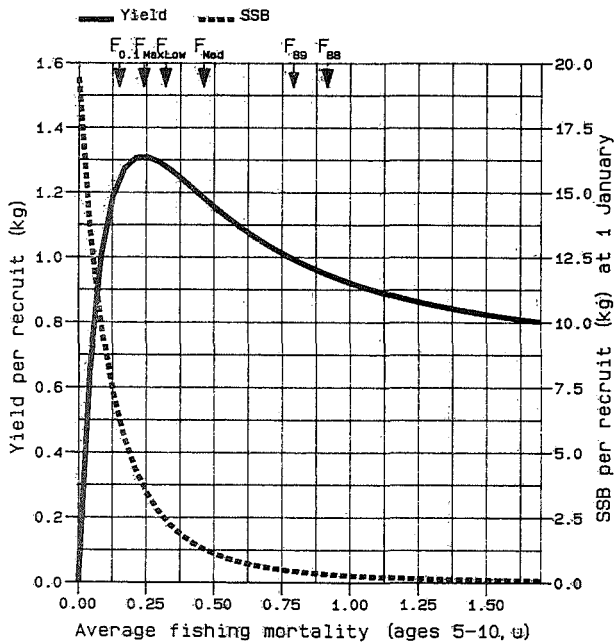
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Figure 3.1 (cont'd)

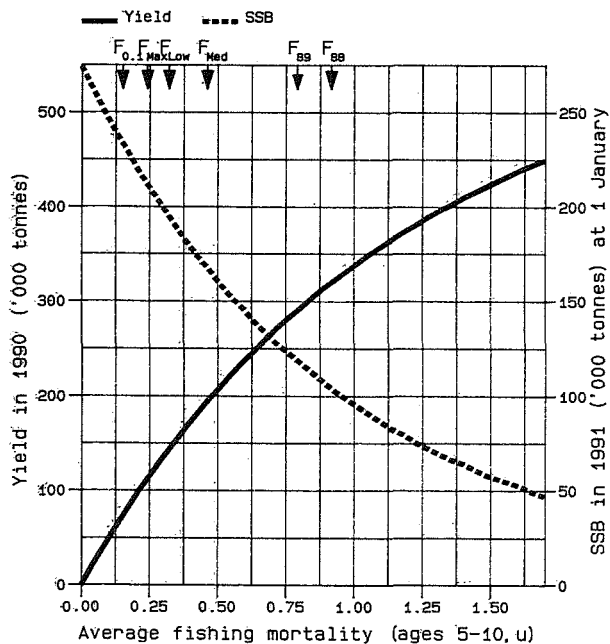
FISH STOCK SUMMARY
 STOCK: North-East Arctic Cod
 23-10-1989

Long-term yield and spawning stock biomass

Short-term yield and spawning stock biomass



C

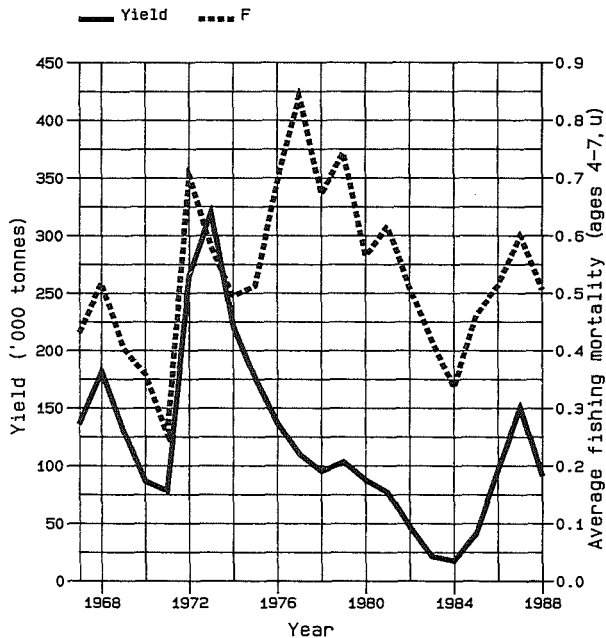


D

Figure 4.1

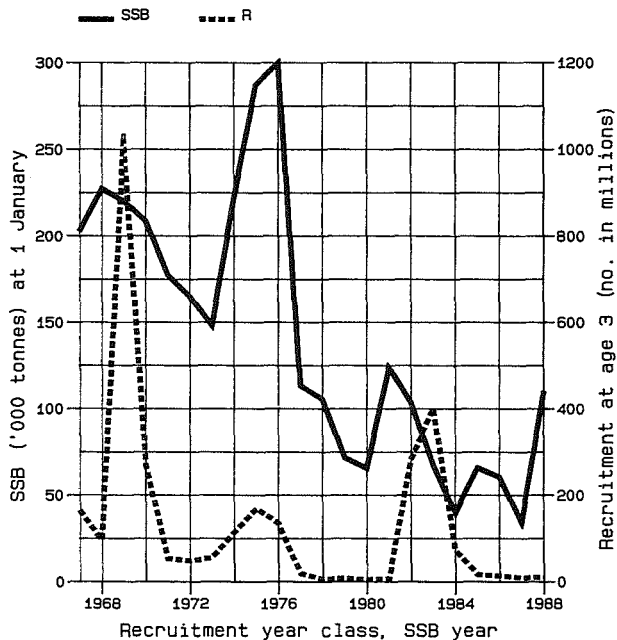
FISH STOCK SUMMARY
 STOCK: North-East Arctic Haddock
 23-10-1989

Trends in yield and fishing mortality (F)



A

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



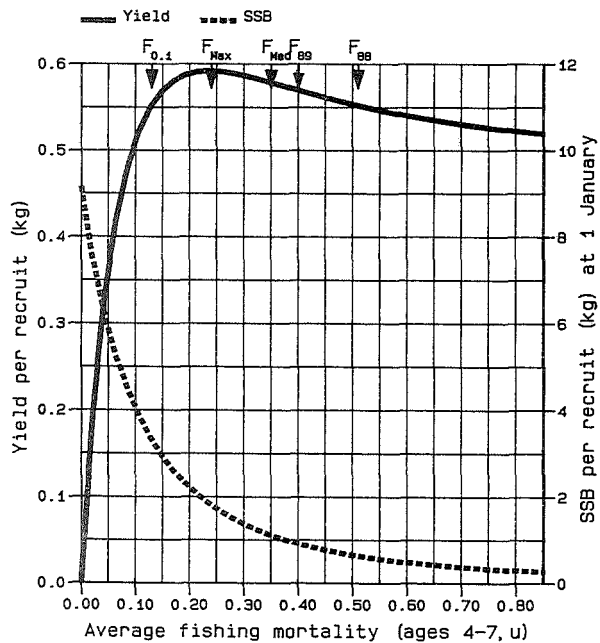
B

(cont'd)

Figure 4.1 (cont'd)

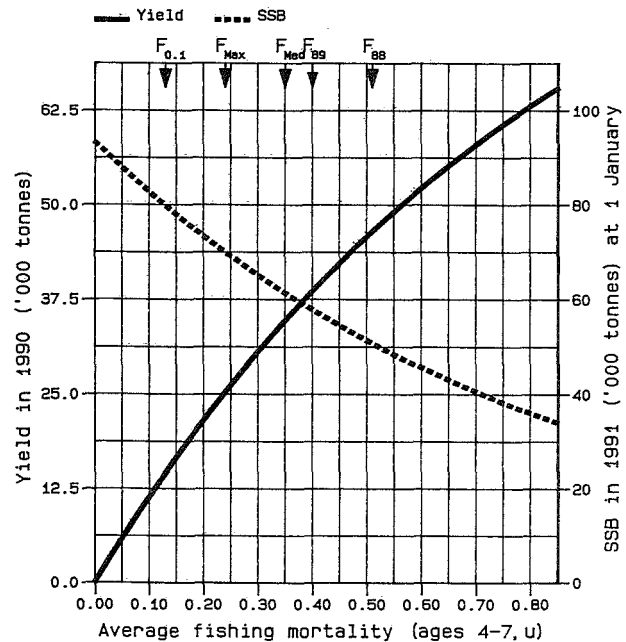
FISH STOCK SUMMARY
 STOCK: North-East Arctic Haddock
 23-10-1989

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 5.1 Landings by gear categories 1977-1988.

North-East Arctic Saithe

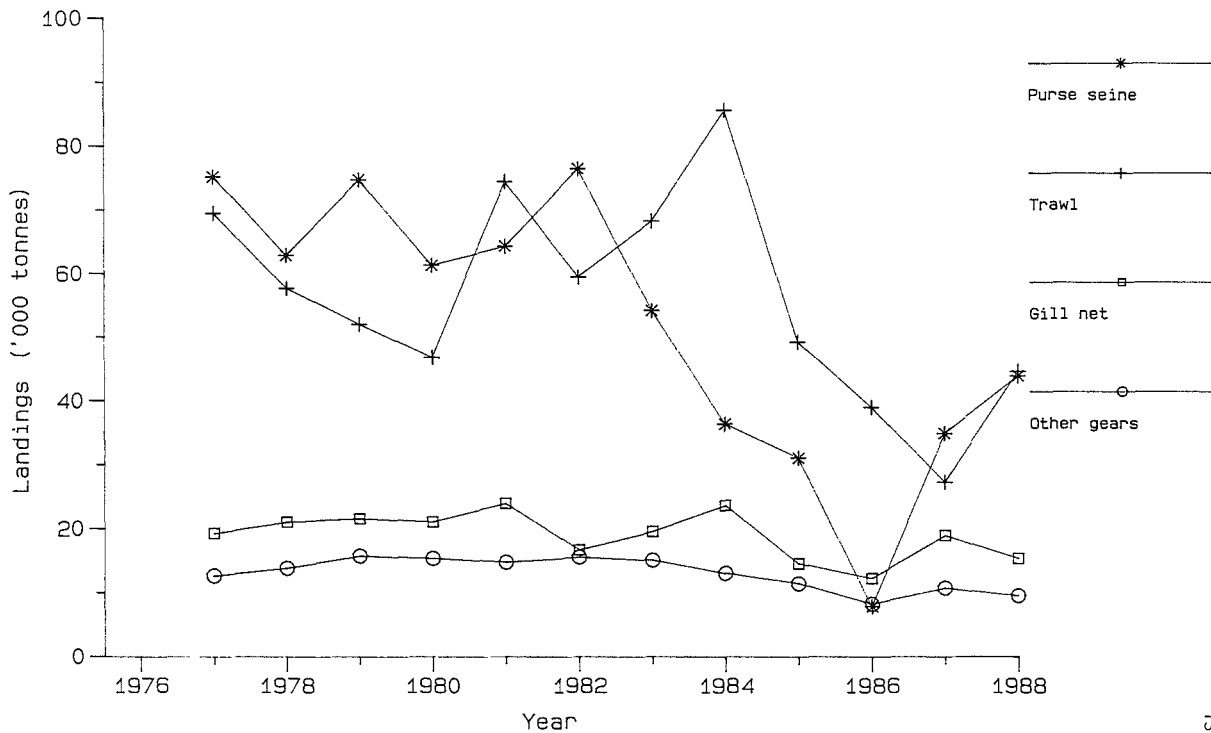


Figure 5.2 Stock and recruitment.

North-East Arctic Saithe

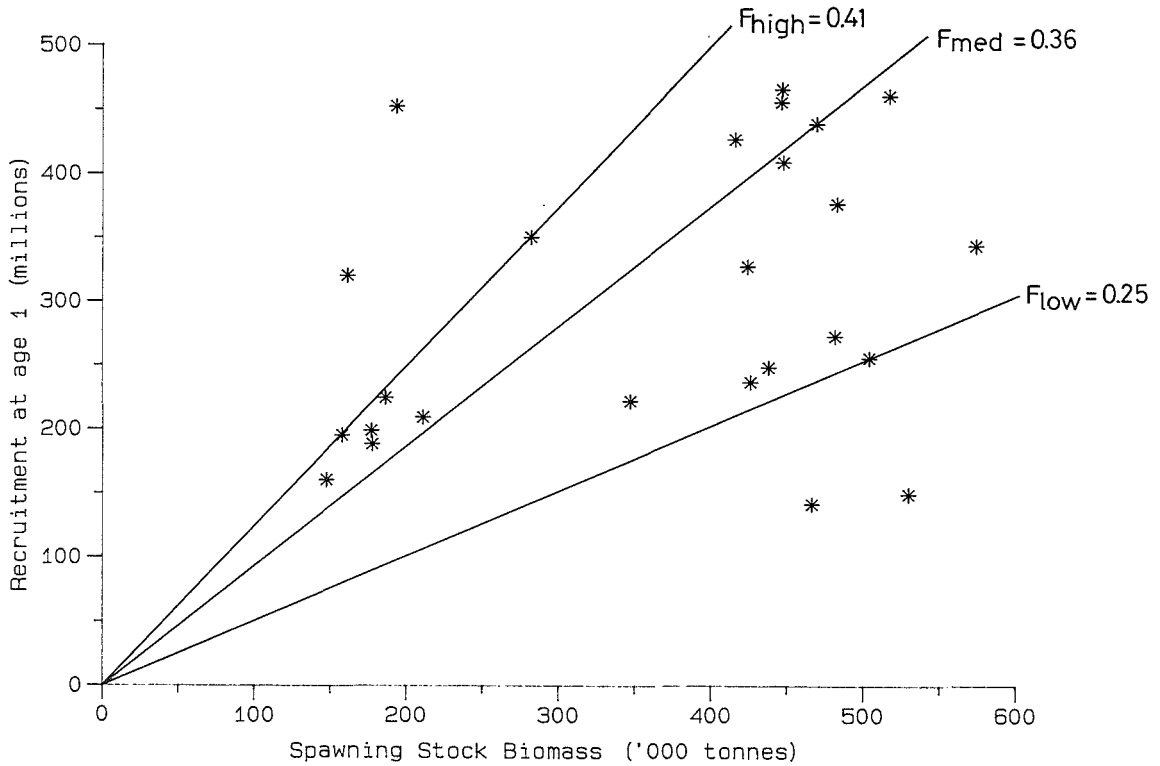
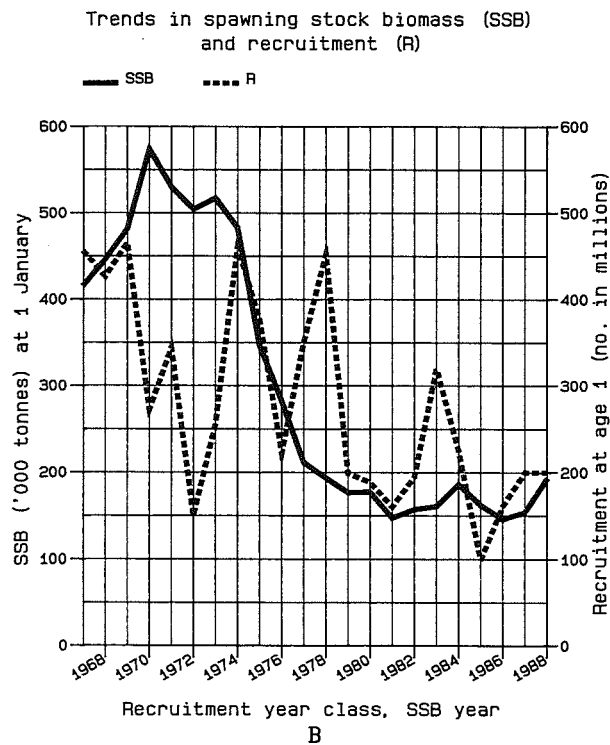
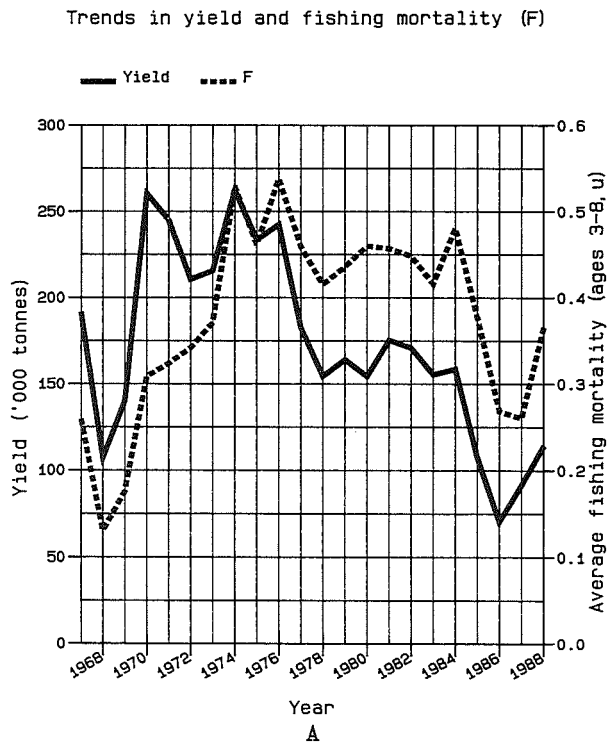


Table 5.3

FISH STOCK SUMMARY

STOCK: North-East Arctic Saithe

23-10-1989

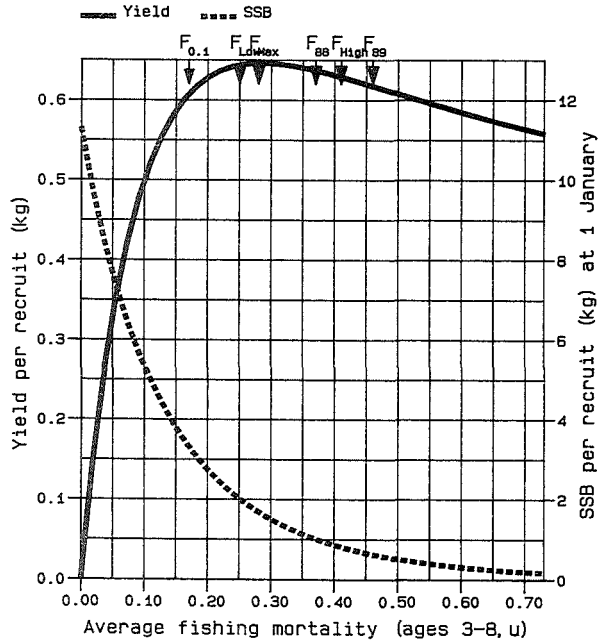


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Figure 5.3 (cont'd)

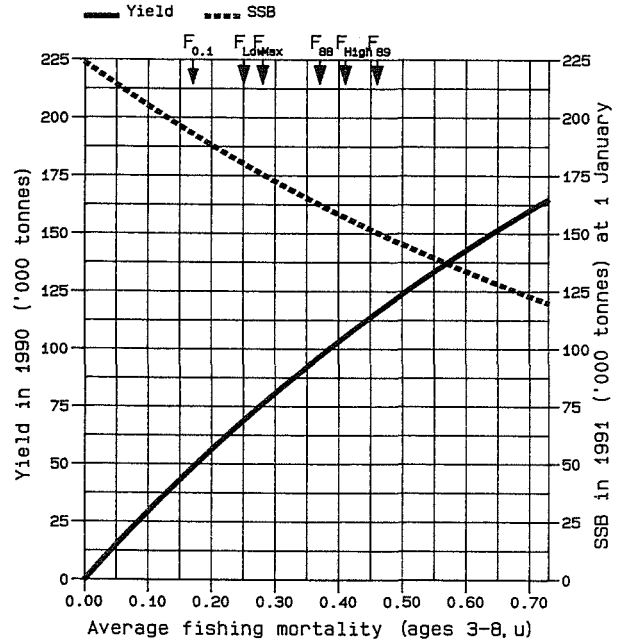
FISH STOCK SUMMARY
 STOCK: North-East Arctic Saithe
 23-10-1989

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 6.1A *Sebastes mentella*.
Length distribution (%) of the landings in 1988
from the USSR and the Federal Republic of Germany.

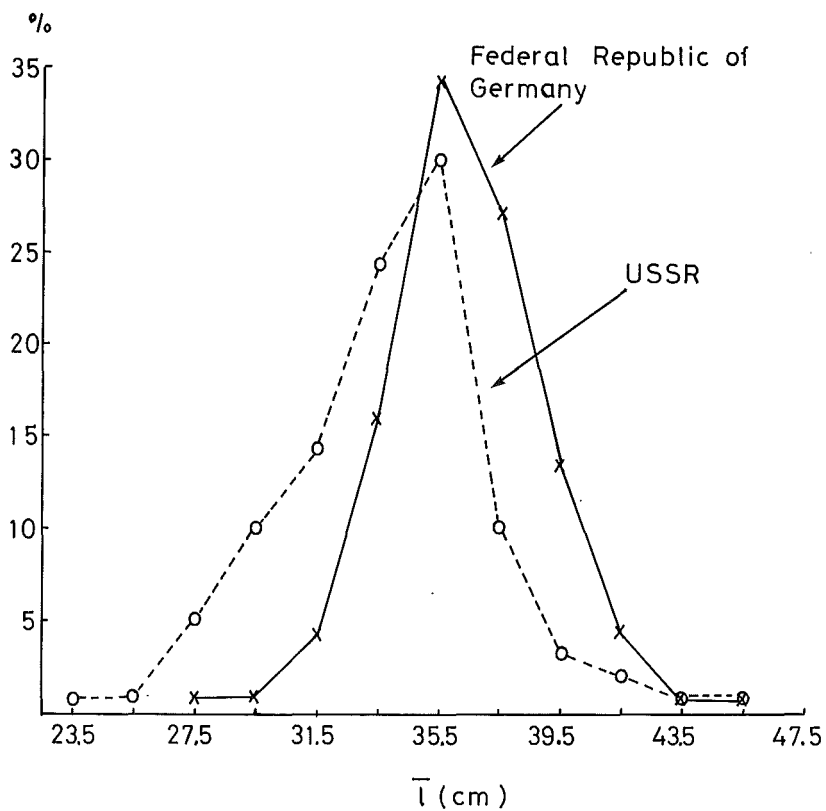


Figure 6.1B *Sebastes mentella*.
Corresponding age distributions (%) of the landings in
1988 from the USSR and the Federal Republic of Germany.

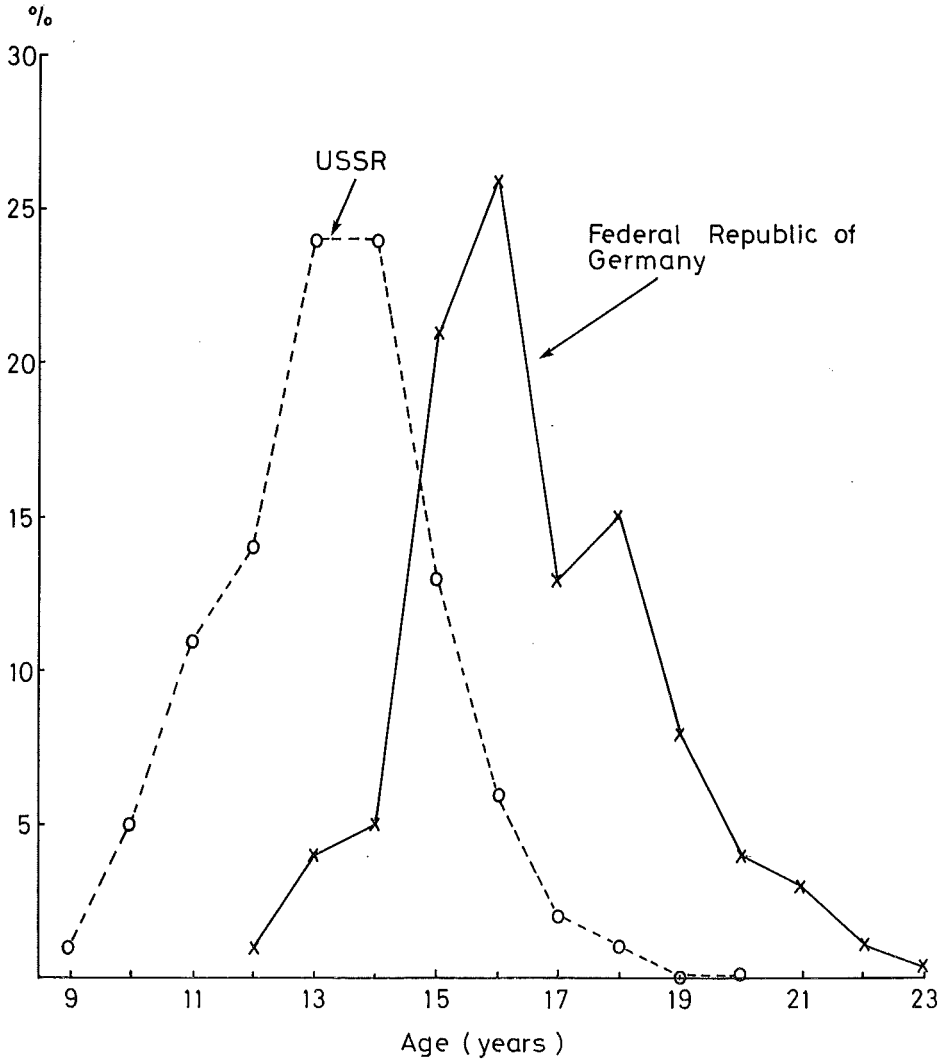


Figure 6.2 *Sebastes mentella*.
Age-length relationship for the USSR and the
Federal Republic of Germany landings presented
to the Arctic Fisheries Working Group in 1988.

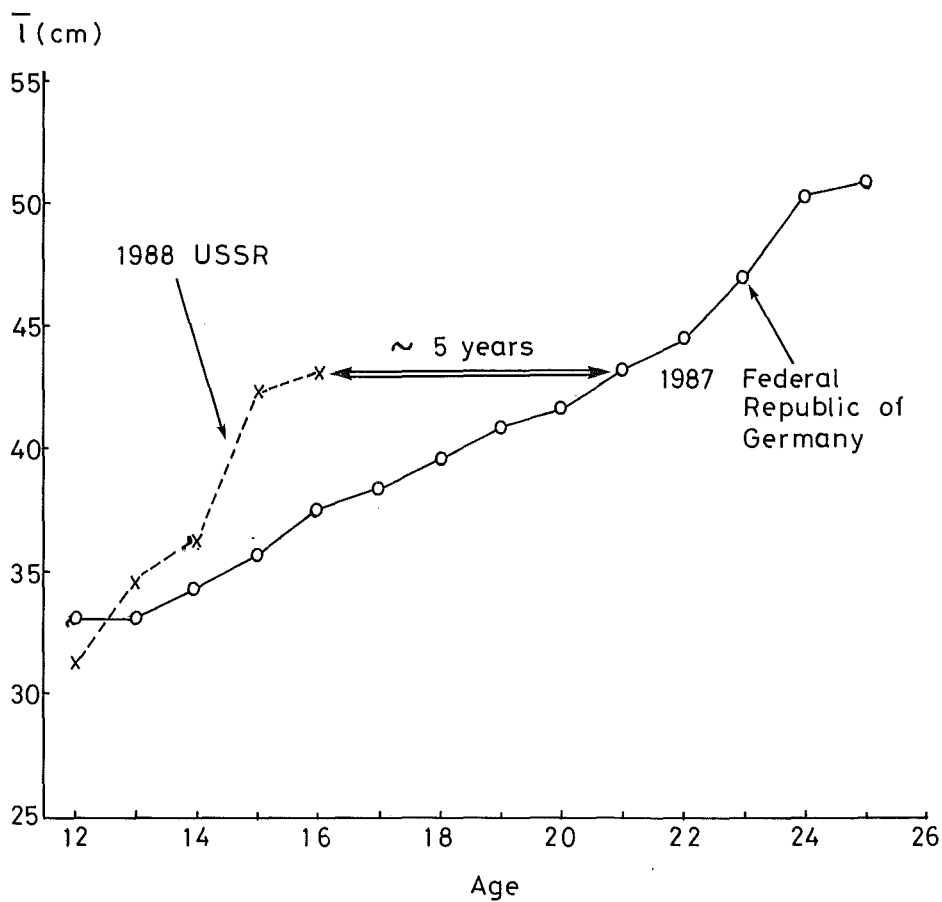


Figure 6.3 *Sebastes mentella* in Divisions IIa and IIb.
Fishing mortality vs. total effort.

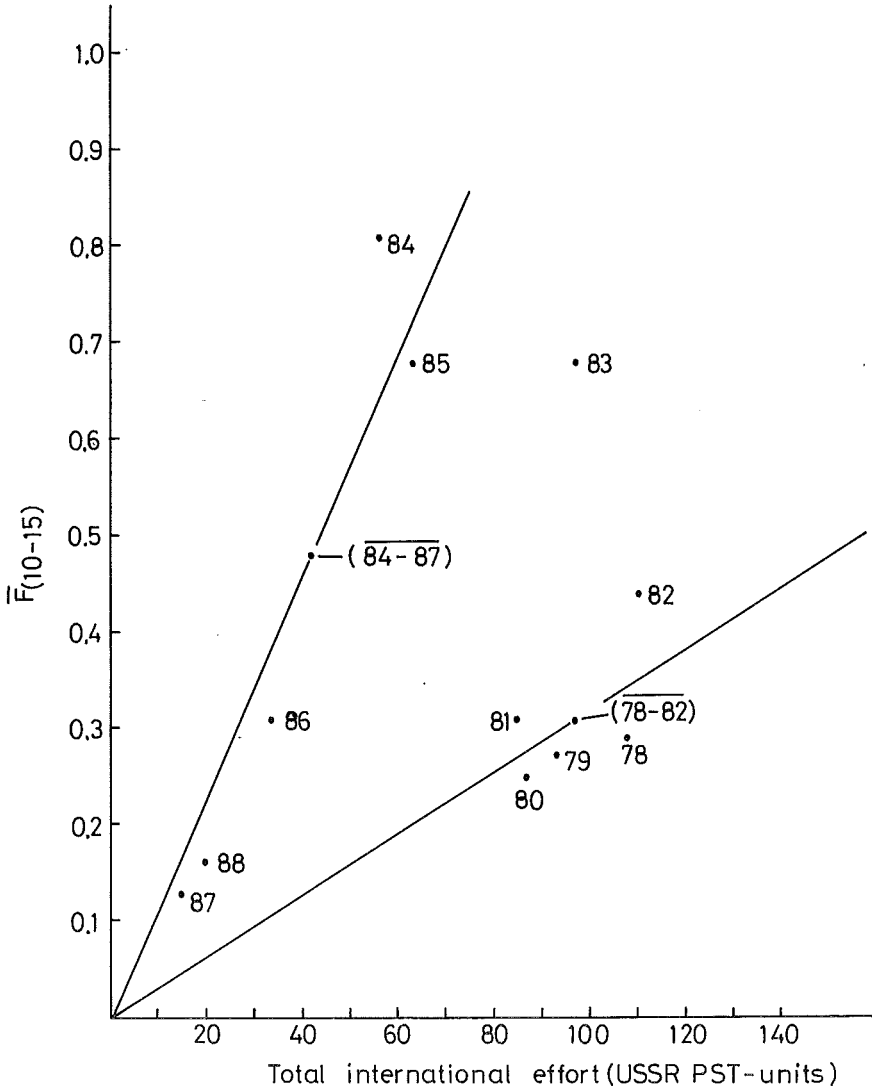


Figure 6.4 Stock-recruitment plot for Sebastes mentella.

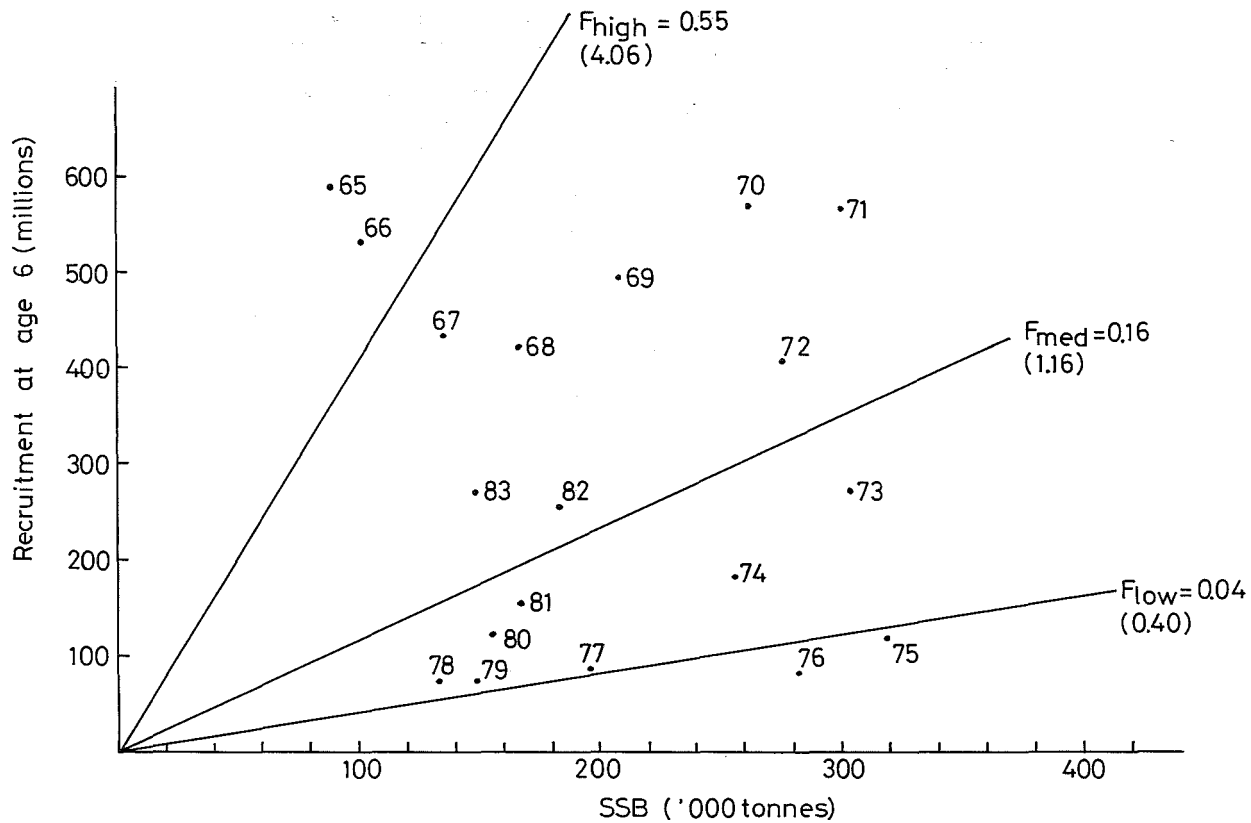


Figure 6.5

FISH STOCK SUMMARY

STOCK: *Sebastes Mentella* in areas IIA and IIB

23-10-1989

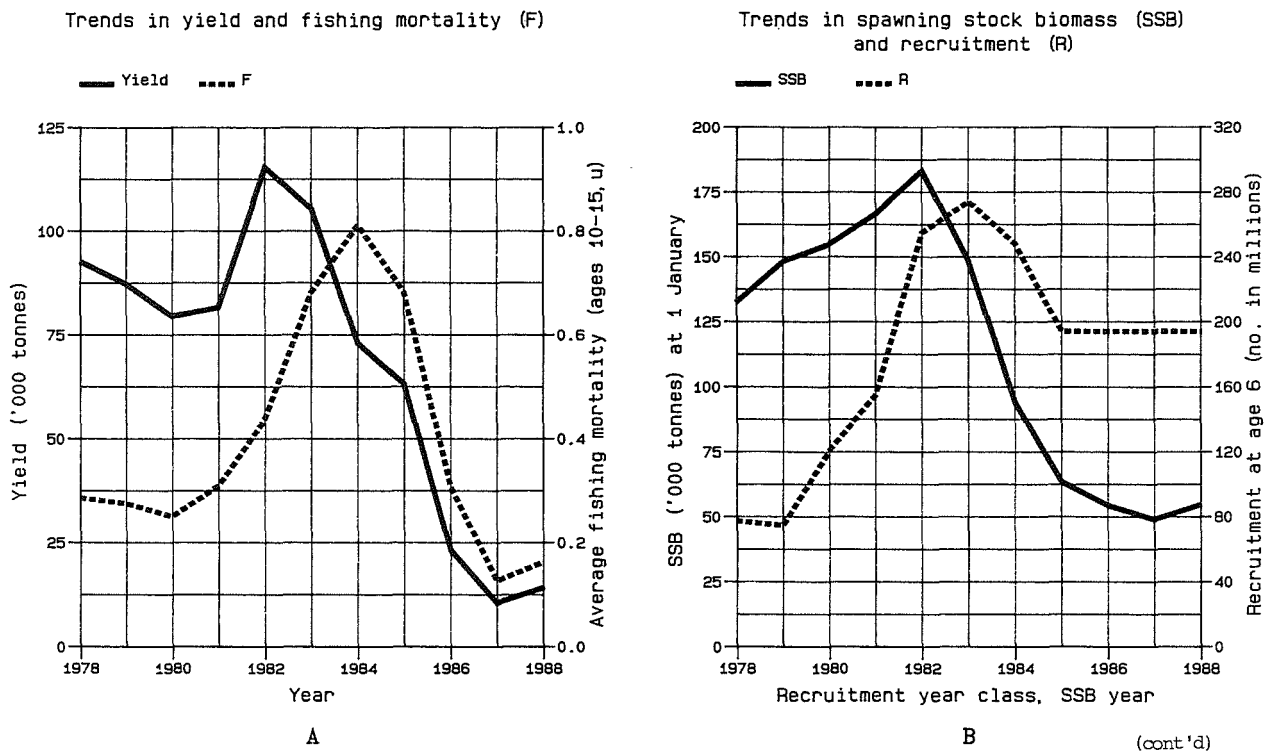


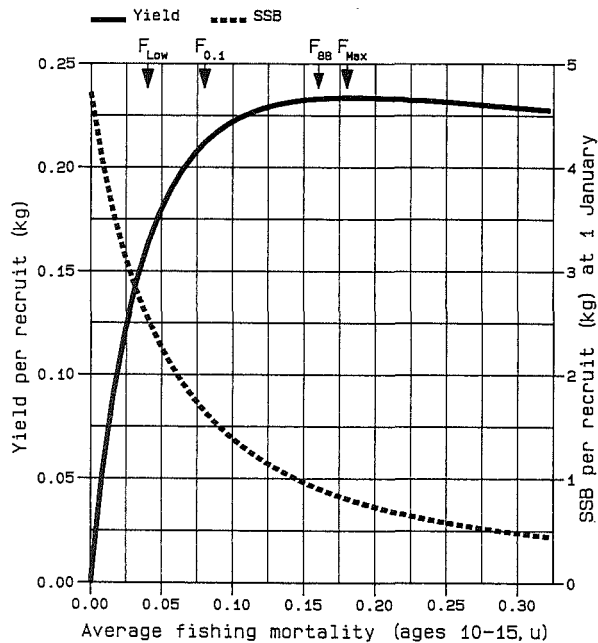
Figure 6.5 (cont'd)

FISH STOCK SUMMARY

STOCK: *Sebastes Mentella* in areas IIA and IIB

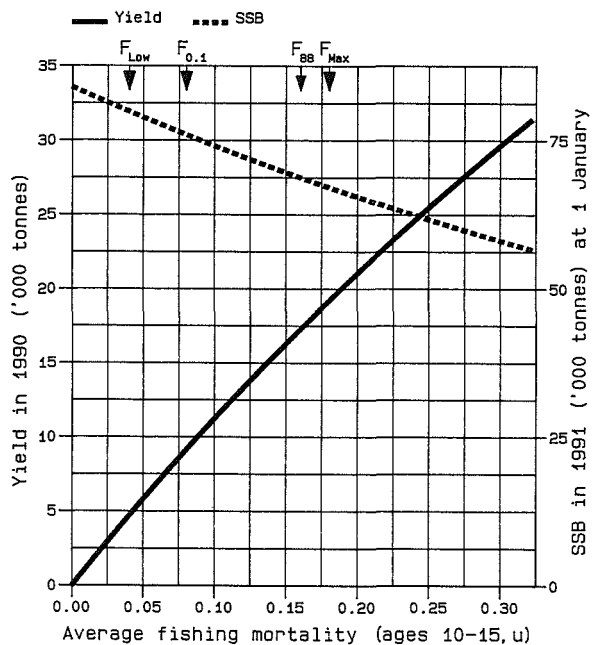
23-10-1989

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 6.6 *Sebastes marinus* in Sub-areas I and II.
Fishing mortality vs. total effort.

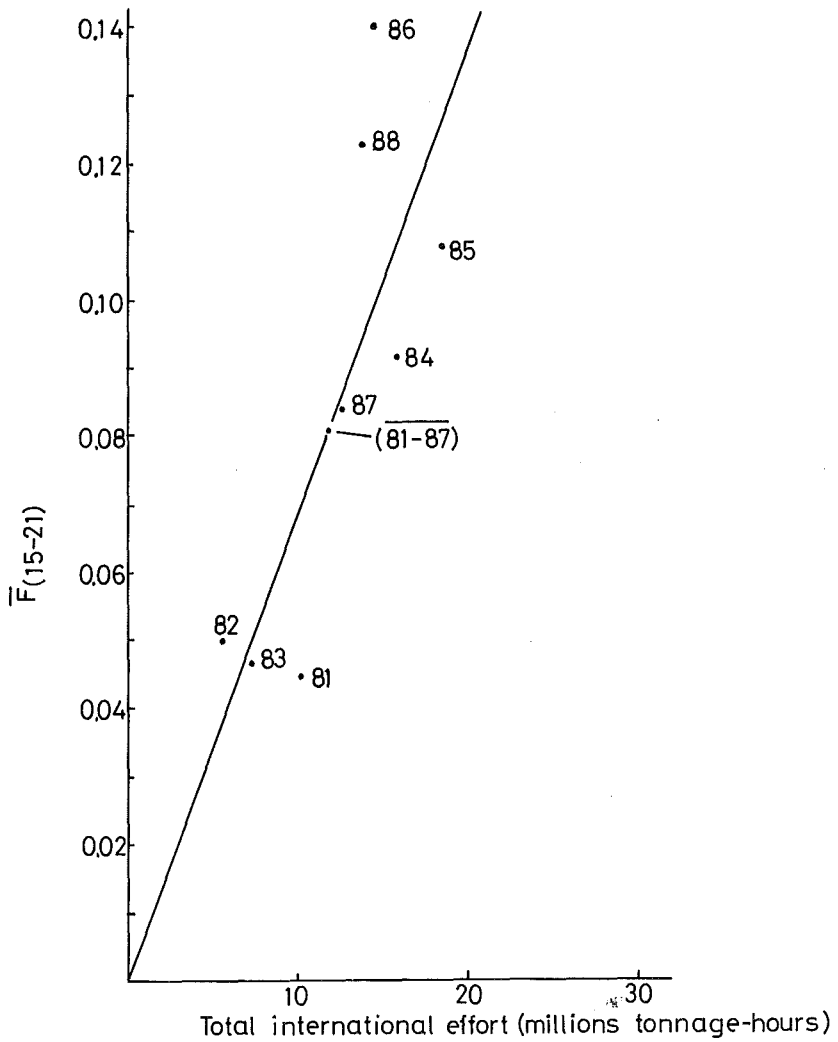


Figure 7.1 Stock-recruitment plot for Greenland Halibut in Sub-areas I and II.

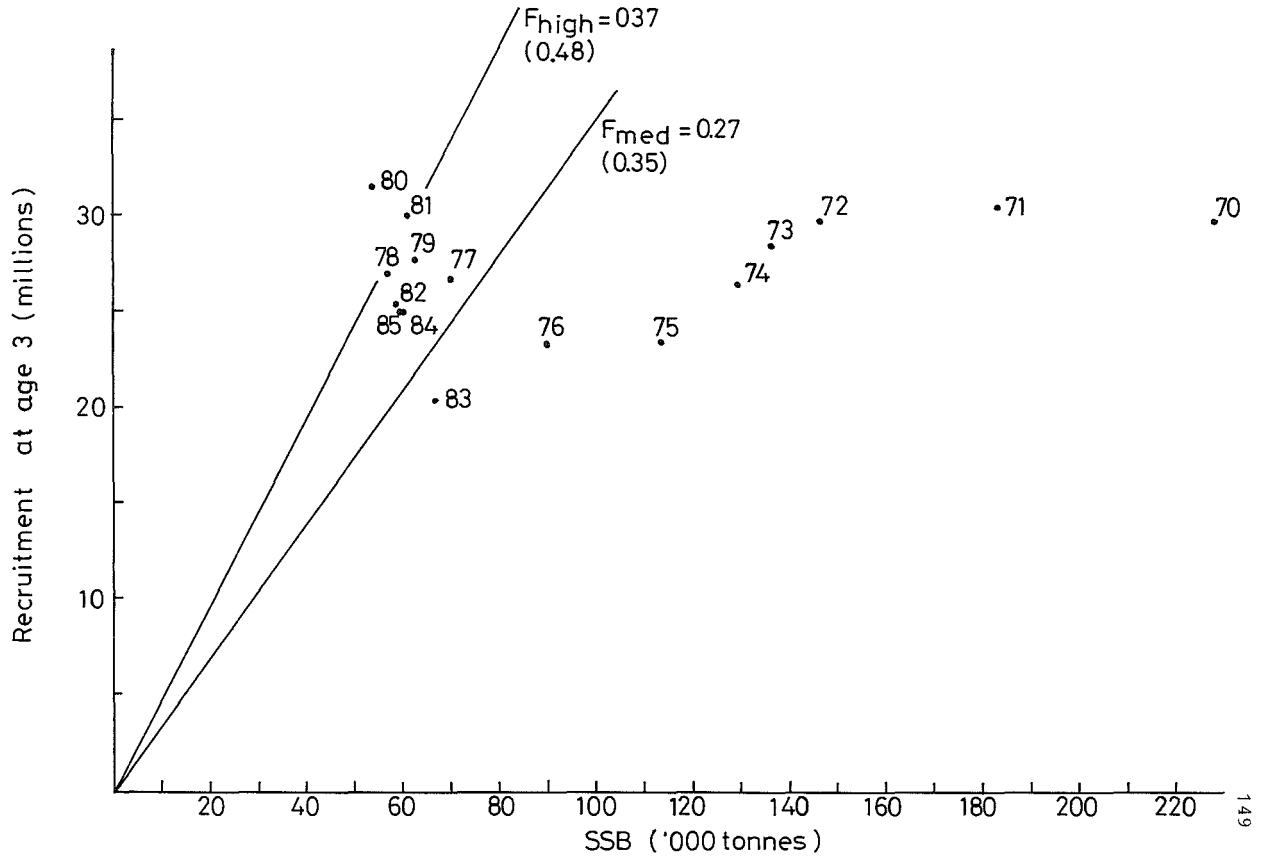
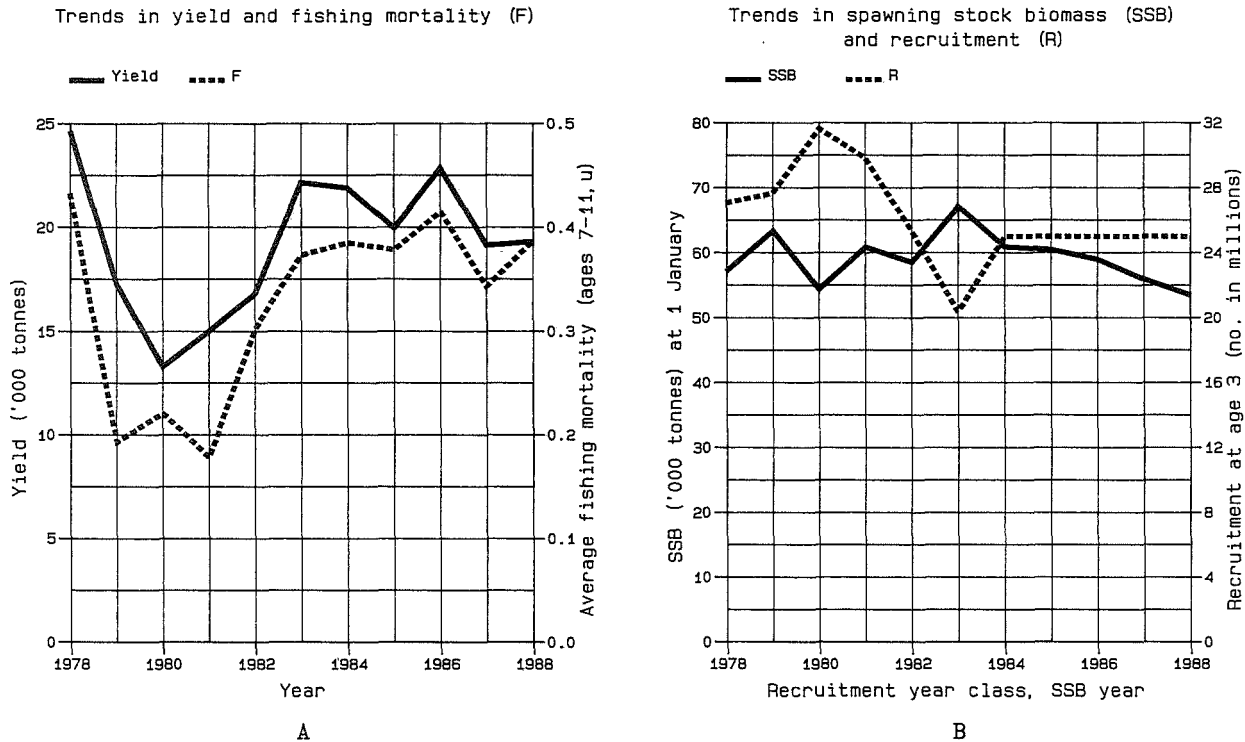


Figure 7.2

FISH STOCK SUMMARY
STOCK: Greenland Halibut in Sub-areas I and II
23-10-1989



(cont'd)