

REPORT OF THE

ARCTIC FISHERIES WORKING GROUP

North-East Arctic Cod and Haddock Sub-group

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1 INTRODUCTION

1.1 Participants

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1.2 Introduction

The Joint Norwegian-Russian Fisheries Commission requested ICES to review the stock status for the Northeast Arctic cod before the autumn ACFM meeting. ICES responded to the Commission that the Arctic Fisheries Working Group would hold an extraordinary meeting from May 9-12, 2000 at the Institute of Marine Research in Bergen, Norway to re-assess the status of, and re-consider catch options for, the year 2000 for the cod in Sub-areas I and II. It would also take into account interactions with other species and attempting alternative assessment methods where applicable:

- 1) evaluate the agreed management strategy for cod fixing **F** at a level that maintains **SSB** above 500 000 t (**B_{pa}**), and reducing the fishing mortality to **F**=0.42;

The report from this extraordinary **AFWG** meeting in Northeast Arctic Cod will be dealt with at the ACFM meeting in May 2000.

In addition, the Norwegian Party of the Joint Norwegian-Russian Fisheries Commission requested ICES to undertake a revision of the stock situation for the Northeast Arctic haddock based on the results from the winter and spring research cruises. The Norwegian party also asked ICES to present the assessment in due time before mid-June when there may be held an extraordinary meeting in the Joint Norwegian-Russian Fisheries Commission. Consequently, the results of the stock status evaluation will also be dealt with during the ACFM meeting in May 2000.

1.3 General Comments

The Working Group met as planned and conducted a completely revised assessment on the NEA cod stock the details of which can be found in Sections 2 of the report. Due to the preliminary nature of much of the data and time constraints, the update on stock status of the haddock resource was confined to observations on trends in survey data and summary results of an exploratory VPA. Results and conclusions of the haddock resource evaluation are presented in Section 3 of the report.

Several working documents dealing with alternative assessment procedures and information for future considerations were reviewed. Summaries can be found in Section 4.

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

2.1 Status of the fisheries.

2.1.1 Historical development of the fisheries (Table 2.1)

From a level of about 900 000 t in the mid-1970s, landings declined steadily to around 300 000 t in 1983-1985 (Table 2.1). Landings increased to above 500 000 t in 1987 before dropping to 212 000 t in 1990, the lowest level recorded in the post-war period. The catches increased rapidly from 1991 onwards, stabilised around 750 000 t in 1994-1997 but decreased to about 480 000 t in 1999. The fishery is conducted both with an international trawler fleet and with coastal vessels using traditional fishing gears. Quotas were introduced in 1978 for the trawler fleets and in 1989 for the coastal fleets. In addition to quotas, the fishery is regulated by a minimum catch size, a minimum mesh size in trawls and Danish seines, a maximum by-catch of undersized fish, closure of areas having high densities of juveniles and by seasonal and area restrictions.

2.1.2 Landings prior to 2000 (Tables 2.1-2.3, Figure 2.1A)

Final reported landings for 1998 amount to 592,624 t (Table 2.1), excluding 29,283 t of Norwegian coastal cod. The provisional figures for 1999 are 483,613 t, excluding 23,397 t of Norwegian coastal cod. This is about 3,600 t higher than the estimate of 480 000 t (equal to the TAC) used by the Working Group last year. The catch by area, split into trawl and other gears, is given in Table 2.2 and the nominal catch by country is given in Table 2.3. From 1998 to 1999, catches decreased in Sub-area I and Division IIa, but increased in Division IIb (Table 2.1).

2.1.3 Expected landings in 2000

The mixed Norwegian-Russian fisheries commission agreed on a TAC for North-east Arctic cod and Norwegian coastal cod combined for 2000 of 430 000 t. Of this, 40 000 t is assumed to be Norwegian coastal cod. According to the agreement between Norway and Russia, the total TAC should be divided equally between the two countries. For 2000, 55,200 t was allocated to third countries and 6 000 t transferred from Russia to Norway, giving a Norwegian quota of 193,400 t (coastal cod included) and a Russian quota of 181,400 t. Of the Norwegian quota, 67% was allocated to the fishery with conventional gears and 33% to the trawl fishery.

The Working Group has no information on the size of expected unreported landings in 2000 but believes this problem may continue.

The Working Group assumes that the catch control and reporting of catches is sufficient to make these predictions based on the assumption of a catch constraint (equal to the TAC) for the current year (2000). The Working Group bases this on information from the Norwegian and Russian authorities. There is a comprehensive monitoring program by the Norwegian coast guard that includes counting vessels at sea and checkpoints for catch control and reporting.

2.2 Status of research

2.2.1 Fishing effort and CPUE (Table A1)

CPUE series of the Norwegian, Russian and Spanish trawl fisheries are given in Table A1. The data reflect the total trawl effort, both for Norway and Russia. The Norwegian series has been revised and is given as a total for all areas in the tuning data series (Table 2.12), but the indices by area in Table A1 have not been updated. The Russian CPUE indices in 1998-1999 were about 30-40 % of the levels observed in 1994-1996 in all areas (Table A1).

2.2.2 Survey results (Tables A2-A5, A10-A11, A14-A15)

The overall picture seen in the surveys is summarized as follows; the year-class 1997 seems to be slightly above average, the 1998 to be below average and the 1999 to be weak. Regarding the fishable stock the abundance of age groups 5 and 6 had increased in 2000 compared to 1999, while the abundance of older fish have declined further.

Norwegian Barents Sea winter survey (bottom trawl and acoustics)

The preliminary swept area estimates and acoustic estimates from the Norwegian survey on demersal fish in the Barents Sea in winter 2000 are given in Tables A2 and A2. Compared to 1999 both the swept area estimates and the acoustic

estimates show decreased abundance of ages 1 and 2 and some increase for ages 3-6. The swept area estimates of older fish show a considerable decrease. The development of the fishable stock appears more optimistic in the acoustic estimate than in the swept area estimate.

The indices for 1997 and 1998, when the Russian EEZ was not covered, have been adjusted as reported previously (Mehl, 1999). The number of fish (age group by age group) in the Russian EEZ in 1997 and 1998 were interpolated assuming a linear development in the proportion found in the Russian EEZ from 1996 to 1999. These estimates were then added to the numbers of fish found in the Norwegian EEZ and the Svalbard area in 1997 and 1998.

It should be noted that the survey conducted in 1993 and later years covered a larger area compared to previous years (Jakobsen *et al.* 1997). In 1991 and 1992, the number of young cod (particularly 1-and 2-year old fish) was probably underestimated, as cod of these ages were distributed at the edge of the old survey area. Other changes in the survey methodology through time are described by Jakobsen *et al.* (1997). Note that the change from 35 to 22 mm mesh size in the codend in 1994 is not corrected for in the time series.

Lofoten acoustic survey on spawners

The estimated abundance indices from the Norwegian acoustic survey off Lofoten and Vesterålen (the main spawning area for this stock) in March/April are given in Table A4. A description of the survey, sampling effort and details of the estimation procedure can be found in Korsbrekke (1997). The 2000 estimate of the number of spawners is about 50% of the 1999 estimate and is near the minimum value observed in the 16-year time series. It was a high proportion of first time spawners in the survey, and fish at ages 5, 6 and 7 represents 67 % of the total estimated number of spawners.

Norwegian summer/autumn survey

Tables A5 and A17 give the results of the Norwegian bottom trawl survey in the Barents Sea and Svalbard area in August/September. The values for 1997 and 1998 are adjusted for the lack of coverage of the Russian EEZ in those years by assuming the same area distribution as in 1996 and 1999, respectively. The 1999 results are similar to the 1999 winter survey. Only the coverage in Division IIb (Svalbard) is used in the tuning. There is only 3 years with full coverage of the other areas.

Russian autumn survey

Abundance estimates from the Russian autumn survey (November-December) are given in Table A10 (acoustic estimates) and Table A11 (bottom trawl estimates). The main results here are rather parallel to the Norwegian swept area estimates in winter 2000. Compared to this the Russian survey indicate slightly higher abundance of the 1993 year class and older fish.

International 0-group survey

Abundance indices of 0-group cod from the International 0-group survey are provided in Tables A14 and A15. This shows a decreasing abundance of 0-group cod since 1997 in a pattern similar as observed for age 1 of the same year-classes in the groundfish surveys. The 0-group abundance in the years 1992-1997 is rather outstanding in the time series. Among those year-classes only 1994 and 1995 appear to be above average at age 3 in other surveys.

2.2.3 Age reading

The joint Norwegian-Russian work on cod otolith reading has continued, with regular exchanges of otoliths and age readers. Currently there are no systematic differences in age interpretation. Similar exchanges between Norwegian and Spanish age readers are now being evaluated.

2.2.4 Weight at age (Tables A6-A9, A12-A13)

Length at age and weight at age from the Norwegian survey in the Barents Sea in winter, from the Lofoten survey and from the Russian survey in October-December are given in Tables A6-A9 and A12-A13, respectively.

The data on weight at age from the autumn 1999 Russian survey and the winter 2000 Norwegian survey were in general agreement with each other, with the possible exception of fish at age 4.

The Norwegian winter survey shows similar values for ages 3 – 8 in comparison with 1999, and some increase for ages 1 and 2 (Table A7). The Russian autumn survey shows a small decrease or the same level of the weight of fish at all ages (Table A13). Both surveys show that the weight and length of fish at age in 1999/2000 differ little from the 1998/1999 values. Weight at age remains at a low, but stable level for all ages.

2.2.5 Maturity at age (Table 2.5)

Russian maturity ogives from the autumn survey are available from 1984 until present. For the years 1985-1999 Norwegian maturity at age ogives has been obtained by combining the Barents Sea and Lofoten surveys according to the method described in Marshall *et al.* (1998). The Norwegian maturity ogives tend to give a higher percent mature at age compared to the Russian ogives, which is consistent with the generally higher growth rates observed in cod sampled by the Norwegian surveys. To represent the maturity composition of the stock, the percent mature at age for the Russian and Norwegian surveys have been arithmetically averaged for 1985 and later years. This is consistent with the approach used to estimate the weight at age in the stock (described in Section 2.3.2). Errors, which could not be resolved during the meeting, were discovered in the Norwegian maturity data for 2000. Therefore only the Russian ogives were used for 2000. As in previous assessments, Russian ogives were used for 1984, Norwegian ogives were used for 1982-1983 and knife-edge maturation at age 8 was assumed for the historical period prior to 1982.

2.3 Data used in the assessment

2.3.1 Catch at age (Table 2.8)

For 1998 final total landings for all countries were used to adjust the number at age in the 1998 landings. For 1999, age compositions for all areas were available from Norway (all gears) and Russia (trawl only). From Divisions IIa, age compositions were available for Germany, and from Division IIb, Spain provided age compositions. Age compositions of the total landings were calculated separately in Sub-area I and Division IIa and IIb by using the age compositions that were available and raising the landings from other countries by Norwegian trawl (Sub-area I and Division IIa), and by Spanish trawl (Division IIb).

A SOP check gave a deviation of <1 % for 1998 and 1999. The number at age was adjusted to make the SOP fit exactly to the nominal catch for these years.

2.3.2 Weight at age (Tables 2.4 and 2.9-2.10).

Catch weights

For 1999, the mean weight at age in the catch (Table 2.9) was calculated as a weighted average of the weight at age in the catch for Norway, Russia, Germany and Spain. The weight at age in the catch for these countries is given in Table 2.4. The weight at age in the catch in 1999 was lower than what was assumed by the Working Group last year for all ages.

Stock weights

Stock weights at age a (W_a) at the start of year y for 1983-2000 (Table 2.10) were calculated as follows:

$$W_a = 0.5(W_{rus,a-1} + \left(\frac{N_{nbar,a}W_{nbar,a} + N_{lof,a}W_{lof,a}}{N_{nbar,a} + N_{lof,a}}\right))$$

where

$W_{rus,a-1}$: Weight at age $a-1$ in the Russian survey in year $y-1$ (Table A13)

$N_{nbar,a}$: Abundance at age a in the Norwegian Barents Sea acoustic survey in year y (Table A2)

$W_{nbar,a}$: Weight at age a in the Norwegian Barents Sea acoustic survey in year y (Table A7)

$N_{lof,a}$: Abundance at age a in the Lofoten survey in year y (Table A4)

$W_{lof,a}$: Weight at age a in the Lofoten survey in year y (Table A9)

For age groups 12 and older, the same stock weights were used as for the period 1946-1981. The stock weights at age in 2000 are in good agreement with the prognosis made by ACFM last year.

2.3.3 Natural mortality

A natural mortality of 0.2 was used. In addition, cannibalism was taken into account as described in Section 2.4.3. The proportion of F and M before spawning was set to zero.

2.3.4 Maturity at age (Tables 2.5 and 2.11)

As noted in Section 2.2.5, arithmetic averages of the Russian and Norwegian maturity at age values were used for 1985-1999 and Russian values for 2000.

2.3.5 Tuning data (Table 2.12)

The following surveys and commercial CPUE data were used in the tuning:

Name	Place	Season	Age	Years
Russian bottom trawl	Total area	Autumn	1-8	1981-1999
Norwegian bottom trawl	Svalbard	Autumn	1-8	1983-1999
Norwegian trawl fleet	Total area	All year	9-14	1985-1999
Russian trawl fleet	Total area	All year	9-14	1985-1999
Norwegian bottom trawl	Barents Sea	Winter	1-8	1980-1999
Norwegian acoustic	Barents Sea + Lofoten	Winter	1-11	1984-1999

Surveys that were conducted during winter were allocated to the end of the previous year. This was done so that data from the surveys in 2000 could be included in the assessment. Some of the survey indices have been multiplied by a factor 10 or 100. This was done to keep the dynamics of the surveys even for very low indices, because XSA adds 1.0 to the indices before the logarithm is taken. The Norwegian and Russian trawl fleet series have been updated with the revised catch at age data and some revisions also in the effort data.

2.3.6 Recruitment indices (Table 2.6)

There were five indices of recruitment available for the 1999 year class: the Russian bottom trawl index in Sub-area I and the index in Division IIb, the Norwegian Barents Sea trawl and acoustic survey indices as well as an index of recruitment from the International 0-group survey. All surveys indicate that the 1999 year-class is less abundant than any other year-class during the 1990s.

2.3.7 Predation and cannibalism

The consumption by cod of various prey species was calculated in the same way as last year. These data were used to assess the impact of predation by cod on the cod and haddock stocks, and to study the relationship between food consumption and individual growth of cod. Bogstad and Mehl (1997) describe the method used for calculation of the consumption.

The cod stomach content data were taken from the joint PINRO-IMR stomach content database (methods described in Mehl and Yaragina 1992). About 7,500 cod stomachs from the Barents Sea are analysed annually. The stomachs are sampled throughout the year, although sampling is less frequent in the second quarter of the year. In the current assessment, data from 1999 have been added. The 1998 data have been slightly revised, leading to minor changes in the results.

The Barents Sea was divided into three areas (west, east and north) and the consumption by cod was calculated from the average stomach content of each prey group by area, half-year and cod age group.

The number of cod predators at age was taken from the VPA, and thus an iterative procedure has to be applied (Section 2.4.3). It was assumed that the mature part of the cod stock is found outside the Barents Sea for three months during the first half of the year. There were very few samples of the stomach contents of cod in the spawning areas. Thus, consumption by cod in the spawning period was omitted from the calculations. It is believed that the cod generally eats very little during spawning, although some predation by cod on herring has been observed close to the spawning areas. The geographical distribution of the cod stock by season is based on Norwegian survey data.

The total number of cod ages 0–6 (million) consumed is given in the text table below:

Year	Age cons.	0	Age 1 cons.	Age 2 cons.	Age 3 cons.	Age 4 cons.	Age 5 cons.	Age 6 cons.
1984		0	424	21	+	0	0	0
1985		1519	379	67	+	0	0	0
1986		53	420	394	99	0	0	0
1987		654	181	279	14	0	0	0
1988		29	405	22	2	0	0	0
1989		939	145	+	0	0	0	0
1990		0	62	28	0	0	0	0
1991		123	153	212	2	0	0	0
1992		4312	1029	155	4	0	0	0
1993		3881	20246	509	53	1	+	0
1994		8922	7192	673	134	54	9	+
1995		8330	15498	740	248	85	3	+
1996		10450	22354	1511	142	55	20	1
1997		3050	17476	1991	180	17	1	+
1998		80	5332	649	262	37	3	1
1999		0	1836	530	101	6	+	0

The consumption by cod of various prey species is shown in Table A16. The consumption of capelin increased from 1996 to 1999. This is consistent with the increase in capelin biomass from 1996 to 1999 (ICES C.M. 1999/Assess:18). The consumption of cod by cod has decreased, and is now at a fairly low level.

2.3.8 Prediction data (Table 2.22, Figure 2.4)

The input data to the short-term prediction with management option table (1999-2001) are given in Table 2.22. The data for 1999 were taken from the XSA input, and a ‘pseudo-prediction’ through 1999 was done in order to produce a catch option table for 2000.

The weight at age in the stock in 2001 and later years was set equal to the 1998-2000 average, while the weight at age in the catch in 2000 and later years was set equal to the 1997-1999 average. For older age groups (12-15), weight at age in the stock and the catch was set equal to the values used for the period 1946-1981. The average maturity ogive for the years 1998-2000 was used for 2001 onwards.

The stock number at age in 2000 was taken from the final VPA (Table 2.18) for ages 4 and older. The number at age 3 was taken from the XSA (Table 2.14).

The fishing pattern for 2000 and later years was set equal to the average fishing pattern in the period 1997-1999. The natural mortality due to cannibalism, $M_2(a,y)$ was predicted by the following model:

$$M_2(a, y) = \frac{\alpha e^{-\beta l(a,y)^{\gamma}} (B(2a+, y))^{\kappa}}{C(y)^{\delta}}$$

Where $M_2(a,y)$ is the mortality of fish in year y of age a . $l(a,y)$ is the mean length of fish of age a in year y . $C(y)$ is the capelin biomass at year y and $B(2a+,y)$ is the biomass of cod of age $2a$ and older (which we assume is able to prey on cod of age a , Bogstad *et al.* 1994) in year y . This model was fitted to the calculated predation mortalities at ages 2 and 3 in the XSA by minimizing

$$\sum_{y,a} \frac{(M_{2,XSA}(y, a) - M_{2,mod}(y, a))^2}{M_{2,mod}(y, a)}$$

The following parameter values were obtained: $\alpha=0.010$, $\beta=0.000011$, $\delta=0.18$, $\gamma=3.30$, $\kappa=0.50$. These values were used to predict the natural mortality at age 2 and 3 due to cannibalism in 2000. The biomass of cod by age was taken from the prediction, while the length at age in 2001 was set equal to the value for 2000. The natural mortality at age 4-6 due to cannibalism was set to zero, as the values for these age groups were zero or close to zero in 1999. The natural mortality due to cannibalism in 2001 and later years is set equal to the 2000 values.

Fig. 2.2 shows the development in natural mortality due to cannibalism (XSA and predicted by the model above) for cod (prey) age groups 2 and 3 and the abundance of capelin in the period 1984-1999, as well as the predicted values for 2000.

The recruitment at age 3 in year 2001 was calculated by applying the predicted natural mortality at age 2 in 2000 to the XSA estimate of age 2 fish in the beginning of 2000. The abundance of the 1999 year class at age 3 (in 2002) was estimated to 165 million (see Section 2.5.2).

2.4 Methods used in the assessment

2.4.1 VPA and tuning

Tuning of the VPA was carried out using Extended Survivors Analysis (XSA), using the same settings as last year, i.e., the default settings for the XSA were used with the following exceptions: (1) The SE of the mean to which the estimates are shrunk, was set to 1.0; (2) catchability was set to be stock size dependent for ages younger than 6, and age independent for ages 13 and older.

2.4.2 Recruitment (Table 2.7)

The only year class which needs to be estimated by the RCT3 program is the 1999 year class, see section 2.5.2.

2.4.3 Including cannibalism in the VPA (Tables 2.13-2.16)

Cannibalism was included in the VPA in the same way as last year. The VPA for this assessment is run on ages 1-15. Consumption of cod by cod was calculated by age group using the method described by Bogstad and Mehl (1997) and treated as an additional catch in the XSA, which was run iteratively until convergence. The procedure converges quickly, as verified by the Comprehensive Fisheries Evaluation Working Group (ICES C.M. 1997/Assess:15).

The tuning diagnostics from VPA with cannibalism are given in Table 2.13 and the total fishing mortalities (true fishing mortality plus mortality from cannibalism) and population numbers in Tables 2.14 and 2.15. The fit between the survey for ages 1 and 2 and the VPA that incorporated cannibalism is considerably better than the fit with the VPA without cannibalism, as discussed in last year's report.

Mortalities induced by cannibalism on age 1 in 1993-1999 (1.0-2.5) are higher than in the period 1984-1992. A similar pattern was observed for 2-year olds. However, the mortalities induced by cannibalism in 1998 and 1999 are lower than in 1993-1997. The mortalities induced by cannibalism in 1999 are slightly lower than those predicted in last year's assessment.

In order to build a matrix of natural mortality which includes predation, the fishing mortality estimated in the final XSA analyses was split into the mortality caused by the fishing fleet (true F) and the mortality caused by cod cannibalism (M2 in MSVPA terminology) by using the number caught by fishing and by cannibalism. The new natural mortality data matrix was prepared by adding 0.2 (M1) to the predation mortality (M2). This new M matrix (Table 2.16) was used together with the new true Fs to run the final VPA on ages 3-15+. M2 and F values for ages 1-6 in 1984-1999 are given in the text tables below.

Cannibalism on cod age 3 and older may of course also have occurred before 1984, and thus there will be an inconsistency in the recruitment time series.

Year	M2 age 1	M2 age 2	M2 age 3	M2 age 4	M2 age 5	M2 age 6
1984	0.2485	0.0358	0.0006	0.0000	0.0000	0.0000
1985	0.3609	0.0560	0.0004	0.0000	0.0000	0.0000
1986	0.5172	0.8028	0.1122	0.0000	0.0000	0.0000
1987	0.5235	0.7971	0.0583	0.0000	0.0000	0.0000
1988	0.7963	0.1084	0.0087	0.0000	0.0000	0.0000
1989	0.2169	0.0011	0.0000	0.0000	0.0000	0.0000
1990	0.0486	0.0593	0.0000	0.0000	0.0000	0.0000
1991	0.1024	0.2336	0.0050	0.0000	0.0000	0.0000
1992	0.4643	0.1430	0.0068	0.0000	0.0000	0.0000
1993	2.5428	0.4415	0.0666	0.0030	0.0026	0.0000
1994	1.7532	0.6455	0.1980	0.0959	0.0265	0.0048
1995	1.8584	0.9167	0.5281	0.1977	0.0048	0.0001
1996	1.9393	1.0356	0.4387	0.2240	0.0784	0.0059
1997	2.4095	1.0433	0.3114	0.0955	0.0098	0.0018
1998	1.4621	0.6161	0.3585	0.1109	0.0278	0.0164
1999	1.0387	0.5154	0.1771	0.0133	0.0000	0.0000

Year	F age 1	F age 2	F age 3	F age 4	F age 5	F age 6
1984	0.0000	0.0017	0.0193	0.1239	0.3072	0.6241
1985	0.0001	0.0015	0.0529	0.1706	0.3779	0.6043
1986	0.0001	0.0017	0.0327	0.2123	0.4952	0.7105
1987	0.0000	0.0011	0.0552	0.2274	0.5101	0.9441
1988	0.0000	0.0009	0.0542	0.1267	0.3681	0.5978
1989	0.0000	0.0009	0.0327	0.1283	0.2654	0.3979
1990	0.0000	0.0004	0.0086	0.0622	0.1342	0.2303
1991	0.0000	0.0007	0.0133	0.0624	0.1872	0.3209
1992	0.0004	0.0011	0.0337	0.1266	0.2205	0.4419
1993	0.0000	0.0006	0.0128	0.0933	0.3442	0.4597
1994	0.0000	0.0003	0.0096	0.1055	0.3134	0.6417
1995	0.0000	0.0003	0.0104	0.0986	0.3258	0.5759
1996	0.0000	0.0006	0.0237	0.1171	0.3224	0.5323
1997	0.0000	0.0006	0.0222	0.2027	0.5346	0.6905
1998	0.0000	0.0015	0.0437	0.2673	0.4977	0.7100
1999	0.0000	0.0003	0.0132	0.1733	0.5301	0.7081

2.5 Results of the assessment

2.5.1 Fishing mortalities and VPA (Tables 2.17-2.21, Figures 2.1A-B, 2.3)

The average age 5-10 fishing mortalities for the years 1981-1989 were in the range 0.68 to 0.94 (Table 2.21). The lowest value occurred during 1989 and the highest in 1987. In 1990, fishing mortality dropped to 0.29 mainly as a result of management measures brought into effect to control the amount of fishing effort. F_{5-10} then increased, reaching 1.03 in 1997 before dropping to about 0.90 in 1998-1999. The assumed fishing mortality in 1999 is higher than predicted last year (0.91 vs. 0.73), and the spawning stock biomass in 1999 is estimated to be 278 000 t, compared to 298 000 t in last year's ACFM assessment. The fishing pattern in 1999 indicates a lower exploitation rate of ages 3 and 4 than predicted.

Fig 2.3 shows the results of a retrospective analysis when cannibalism is taken into account. The number of cod consumed by cod was not recalculated year by year in the retrospective analysis, however. The fishing mortalities and stock numbers are given in Tables 2.17-2.18, while the stock biomass at age and the spawning stock biomass at age are given in Tables 2.19-2.20. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1946 is given in Table 2.21 and Figures 2.1A and 2.1B.

Due to the large SOP discrepancies, the SOP corrected values are given. Reconstruction of the time series on weight at age in the catch and in the stock and the maturation ogive for the period 1946-1981 is continuing. This might address the problem of SOP discrepancies, but has turned out to be a more complicated task than expected. Revised maturity ogives for the period 1946-1981 are expected to be ready for the AFWG meeting in August 2000, while revised catch and stock weights at age are expected to be ready for the 2001 meeting.

2.5.2 Recruitment (Table 2.7A-B)

Table 2.7A shows the results of the RCT3 analysis predicting the 1999 year-class at age 3 on the basis of survey data on 0-group and 1-group since 1966 (input given in Table 2.6). All surveys appear poorly related to the VPA estimates and the predicted value is mainly driven by the average VPA value.

In an attempt to estimate the 1999 year-class more precisely another RCT3-analysis was made. Since the sampling gear in the 0-group survey was modified in 1985 and in the Norwegian winter acoustic and bottom trawl survey was modified in 1994, those older survey data was left out. To take better account of the mortality between survey observation (age 1) and time of recruitment, this analysis was related to the XSA estimate at age 1 (Table 2.15). The input and result are shown in Table 2.7B. Here the result is driven by the Norwegian bottom trawl winter survey. This reduced survey series is short (3 high values and one moderate), and the prediction of the 1999 value is not regarded accurate since it extrapolates well outside the range of the data.

All surveys indicate that the 1999 year-class is poor. On this basis it was decided to set the 1999 year-class equal to 165 million, which is the average of the 10 lowest VPA values in the stock history.

2.6 Reference points and safe biological limits

2.6.1 Biomass reference points (Figure 2.4)

Jakobsen (1993) discusses past, present and future management of North-east Arctic cod. He suggested that to reduce the likelihood of poor year classes, the spawning stock biomass should be kept well above a level of 500 000 t (MBAL). This can also be seen from the stock/recruitment plot given in Figure 2.4. It was proposed at the ACFM meeting in 1998 to use 500 000 t as B_{pa} and 112 000 t as B_{lim} . The Working Group will postpone a revision of the values until the historical time series on weight and maturity at age has been revised (Section 2.5.1).

2.6.2 Fishing mortality reference points

At the 1998 WG meeting, the following values were estimated for the fishing mortality reference points $F_{0.1} = 0.13$, $F_{max} = 0.24$, $F_{low} = 0.27$, $F_{med} = 0.46$ and $F_{high} = 0.91$ (median values). This was done using the PASoft program package (MRAG 1997). Data input and analysis performed were described by Motos (WD 1998). The present exploitation level is $F_{99} = 0.91$ (*status quo*) which is equal to F_{high} .

The SGPAFM (ICES 1998/ACFM:10) suggested the limit reference point $F_{lim} = F_{med}$ for Northeast Arctic cod, haddock and saithe. A precautionary fishing mortality (F_{pa}) is then defined as $F_{pa} = F_{lim} e^{-1.645\sigma}$ ($\sigma = 0.2-0.3$). The 1998 WG, however, found that setting $F_{lim} = F_{med}$ did not correspond very well with the exploitation history for cod. The median value for F_{loss} was estimated at 0.70, and the 5th percentile of this value was adopted as a precautionary reference fishing mortality ($F_{pa} = 0.42$) by the WG in 1998.

2.7 Catch options (Table 2.23)

The management option table (Table 2.23) shows that if the agreed TAC of 390 000 t is taken, F_{5-10} will decrease from 0.91 in 1999 ($F_{status quo}$) to 0.56 in 2000, which is above F_{pa} (0.42).

In Figure 2.1D the catch level in 2000 and spawning stock biomass level in 2001 are plotted against the fishing mortality in 2000.

2.8 Medium-term forecasts and management scenarios

2.8.1 Input data (Table 2.22)

The input data were the same as used for the short-term predictions, using the same data for the years after 2001 as for 2001 (Table 2.22).

2.8.2 Methods

It was decided to limit the risk analysis for North-east Arctic cod to a single-species analysis, where only uncertainty in the initial stock estimate and the recruitment is taken into account. The simulation period was 1999-2003, and the variable of interest was the probability that the SSB is below B_{pa} by the end of the period.

The uncertainty of the stock estimate in 2000 and later years was modeled using a lognormal distribution with a standard error on log scale of 0.3 for all ages. This value is somewhat above the external standard error from the XSA, in recognition of the risk of bias in the assessment, which has been observed in previous years. The errors in numbers at age are assumed not to be correlated. No uncertainty was put on the natural mortality, but the uncertainty in number at age for the younger year classes should also be viewed as an error accounting for the uncertainty in cannibalism-induced M.

A modified version of the general-purpose simulation spreadsheet used for studying harvest control rules for Norwegian Spring-spawning herring by WGNPBW meeting was used in the simulations. 1000 simulations were performed for each harvest control rule.

2.8.3 Results

The text table below shows the results of the risk analysis.

F	Basis	Landings 2000	SSB 2001	P (SSB < B_{pa}) in 2003
0.26	Assumed catch by the end of June 2000	200	414	< 5%
0.42	F_{pa}	305	363	< 5%
0.44	5 % probability of SSB < B_{pa} in 2003	318	356	5 %
0.56	TAC 2000	390	322	26 %
0.90	F_{99}	570	243	92 %

2.8.4 Management considerations

The spawning stock in 2000 is well below B_{pa} , and not far from historical low levels. The F in 2000 induced by the agreed TAC indicates a large reduction in F from 1999 to 2000, but the resulting SSB in 2001 will remain well below B_{pa} . The fishing mortality has been above F_{lim} of 0.70 for the last 3 years. A reduction of the fishing mortality at all ages and rebuilding of the SSB is required. Given that the incoming year classes are expected to be weak, a rapid rebuilding of the spawning stock is strongly recommended.

At its last meeting, ACFM estimated that a fishing mortality of 0.13 would imply rebuilding the stock to above B_{pa} already in 2001, while a fishing mortality of 0.32 would imply a low risk of SSB < B_{pa} by 2003. This years estimates suggest that a fishing mortality of 0.42 would imply a low risk of SSB < B_{pa} by 2003. It is noted, however, that this risk increases very rapidly with increasing F when the 5% risk is exceeded. It is also important to remember that the actual F has generally been higher than that estimated in the assessment year, and this should be taken into consideration. Even if there are some indications that the stock estimate is more consistent now than previously, the experience that the realized fishing mortality has tended to be well above the level which is assumed when TACs are decided implies that one should not attempt to apply the highest fishing mortality that appears to be associated with a low risk, but rather apply an ample safety margin.

The agreed TAC for 2000 is 390 000 tonnes, corresponding to a fishing mortality of 0.56. This implies a substantial risk (26 %) that the SSB will remain below B_{pa} in 2003, and it is well above F_{pa} .

2.9 Comments to the assessment

Given that this was an intersessional meeting of the group and the short time available, the WG this time decided to concentrate on updating the previous assessment by including new data, rather than exploring methodological problems. Such problems are known to exist, as discussed in previous working group reports. For cod, the survey design and the area coverage has changed over the years that are included in the catchability estimates. It has been attempted to correct the indices for the effect of some of these changes, but there is still the possibility of hidden trends in the catchabilities.

Based on past experience, it is likely that the present assessment has overestimated stock size and underestimated F. However, when comparing the present assessment with last year's assessment, the changes in stock number estimates and mortality estimates in the most recent years are minor, and the catchability estimates and the residual patterns are largely the same.

Table 2.1 North-East Arctic COD. Total catch (t) by fishing areas and unreported catch. (Data provided by Working Group members.)

Year	Sub-area I	Division IIa	Division IIb	Unreported catches	Total catch
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	166,649	209,930	58,360		434,939
1989	164,512	149,360	18,609		332,481
1990	62,272	99,465	25,263	25,000	212,000
1991	70,970	156,966	41,222	50,000	319,158
1992	124,219	172,532	86,483	130,000	513,234
1993	195,771	269,383	66,457	50,000	581,611
1994	353,425	306,417	86,244	25,000	771,086
1995	251,448	317,585	170,966		739,999
1996	278,364	297,237	156,627		732,228
1997	273,376	326,689	162,338		762,403
1998	250,815	257,398	84,411		592,624
1999 ¹	158,501	218,393	106,719		483,613

¹ Provisional figures.

Table 2.2 North-East Arctic COD. Total nominal catch (000 t) by trawl and other gear for each area, data provided by Working Group members.

Year	Sub-area I		Division IIa		Division IIb	
	Trawl	Others	Trawl	Others	Trawl	Others
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	149.1	17.6	122.0	88.0	58.2	0.2
1989	144.4	19.5	68.9	81.2	19.1	0.1
1990	51.4	10.9	47.4	52.1	24.5	0.8
1991	58.9	12.1	73.0	84.0	40.0	1.2
1992	103.7	20.5	79.7	92.8	85.6	0.9
1993	165.1	30.7	155.5	113.9	66.3	0.2
1994	312.1	41.3	165.8	140.6	84.3	1.9
1995	218.1	33.3	174.3	143.3	160.3	10.7
1996	248.9	32.7	137.1	159.0	147.7	6.8
1997	235.6	37.7	150.5	176.2	154.7	7.6
1998	219.8	31.0	127.0	130.4	82.7	1.7
1999 ¹	132.8	25.7	103.4	115.0	104.9	1.8

¹ Provisional figures.

Table 2.3 North-East Arctic COD. Nominal catch (t) by countries (Sub-area I and Divisions IIa and IIb combined) (Data provided by Working Group members.)

Year	Faroe Islands	France	German Dem. Rep.	Fed. Rep. Germany	Norway	Poland	United Kingdom	Russia ²	Others	Total all countries
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
					Spain					
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	15,329	2,551	605	2,803	223,412	10,905	8,107	169,365	1,862	434,939
1989	15,625	3,231	326	3,291	158,684	7,802	7,056	134,593	1,273	332,481
1990	9,584	592	169	1,437	88,737	7,950	3,412	74,609	510	187,000
1991	8,981	975	Greenland	2,613	126,226	3,677	3,981	119,427 ³	3,278	269,158
1992	11,663	2	3,337	3,911	168,460	6,217	6,120	182,315	Iceland 1,209	383,234
1993	17,435	3,572	5,389	5,887	221,051	8,800	11,336	244,860	9,374 3,907	531,611
1994	22,826	1,962	6,882	8,283	318,395	14,929	15,579	291,925	36,737 28,568	746,086
1995	22,262	4,912	7,462	7,428	319,987	15,505	16,329	296,158	34,214 15,742	739,999
1996	17,758	5,352	6,529	8,326	319,158	15,871	16,061	305,317	23,005 14,851	732,228
1997	20,076	5,353	6,426	6,680	357,825	17,130	18,066	313,344	4,200 13,303	762,403
1998	14,290	1,197	6,388	3,841	284,647	14,212	14,294	244,115	1,423 8,217	592,624
1999 ¹	13,700	2,137	4,300	3,019	223,390	10,034	8,819	210,374	1,942 5,898	483,613

¹ Provisional figures.

² USSR prior to 1991.

³ Includes Baltic countries.

Table 2.4 North-east Arctic COD. Weights at age (kg) in landings from various countries

Norway														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1983	0.41	0.82	1.32	2.05	2.82	3.94	5.53	7.70	9.17	11.46	16.59	16.42	16.96	24.46
1984	1.16	1.47	1.97	2.53	3.13	3.82	4.81	5.95	7.19	7.86	8.46	7.99	9.78	10.64
1985	0.34	0.99	1.43	2.14	3.27	4.68	6.05	7.73	9.86	11.87	14.16	14.17	13.52	15.33
1986	0.30	0.67	1.34	2.04	3.14	4.60	5.78	6.70	7.52	9.74	10.68	12.86	9.59	16.31
1987	0.24	0.48	0.88	1.66	2.72	4.35	6.21	8.78	9.78	12.50	13.75	15.12	10.43	19.95
1988	0.36	0.56	0.83	1.31	2.34	3.84	6.50	8.76	9.97	11.06	14.43	19.02	12.89	10.16
1989	0.53	0.75	0.90	1.17	1.95	3.20	4.88	7.82	9.40	11.52	11.47		19.47	14.68
1990	0.40	0.81	1.22	1.59	2.14	3.29	4.99	7.83	10.54	14.21	17.63	7.97	14.64	
1991	0.63	1.37	1.77	2.31	3.01	3.68	4.63	6.06	8.98	12.89	17.00		14.17	16.63
1992	0.41	1.10	1.79	2.45	3.22	4.33	5.27	6.21	8.10	10.51	11.59		15.81	6.52
1993	0.30	0.83	1.70	2.41	3.35	4.27	5.45	6.28	7.10	7.82	10.10	16.03	19.51	17.68
1994	0.30	0.82	1.37	2.23	3.35	4.27	5.56	6.86	7.45	7.98	9.53	12.16	11.45	19.79
1995	0.44	0.78	1.26	1.87	2.80	4.12	5.15	5.96	7.90	8.67	9.20	11.53	17.77	21.11
1996	0.29	0.90	1.15	1.67	2.58	4.08	6.04	6.62	7.96	9.36	10.55	11.41	9.51	24.24
1997	0.35	0.78	1.14	1.56	2.25	3.48	5.35	7.38	7.55	8.30	11.15	8.64	12.80	
1998	0.38	0.68	1.03	1.64	2.23	3.24	4.85	6.88	9.18	9.84	15.78	14.37	13.77	15.58
1999	0.46	0.88	1.16	1.65	2.40	3.12	4.26	6.00	6.52	10.64	14.05	12.67	9.20	17.22
Russia (trawl only)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1983	0.65	1.05	1.58	2.31	3.39	4.87	6.86	8.72	10.40	12.07	14.43			
1984	0.53	0.88	1.45	2.22	3.21	4.73	6.05	8.43	10.34	12.61	14.95			
1985	0.33	0.77	1.31	1.84	2.96	4.17	5.94	6.38	8.58	10.28				
1986	0.29	0.61	1.14	1.75	2.45	4.17	6.18	8.04	9.48	11.33	12.35	14.13		
1987	0.24	0.52	0.88	1.42	2.07	2.96	5.07	7.56	8.93	10.80	13.05	18.16		
1988	0.27	0.49	0.88	1.32	2.06	3.02	4.40	6.91	9.15	11.65	12.53	14.68		
1989	0.50	0.73	1.00	1.39	1.88	2.67	4.06	6.09	7.76	9.88				
1990	0.45	0.83	1.21	1.70	2.27	3.16	4.35	6.25	8.73	10.85	13.52			
1991	0.36	0.64	1.05	2.03	2.85	3.77	4.92	6.13	8.36	10.44	15.84	19.33		
1992	0.55	1.20	1.44	2.07	3.04	4.24	5.14	5.97	7.25	9.28	11.36			
1993	0.48	0.78	1.39	2.06	2.62	4.07	5.72	6.79	7.59	11.26	14.79	17.71		
1994	0.41	0.81	1.24	1.80	2.55	2.88	4.96	6.91	8.12	10.28	12.42	16.93		
1995	0.37	0.77	1.21	1.74	2.37	3.40	4.71	6.73	8.47	9.58	12.03	16.99		
1996	0.30	0.64	1.09	1.60	2.37	3.42	5.30	7.86	8.86	10.87	11.80			
1997	0.30	0.57	1.00	1.52	2.18	3.30	4.94	7.15	10.08	11.87	13.54			
1998	0.33	0.68	1.06	1.60	2.34	3.39	5.03	6.89	10.76	12.39	13.61	14.72		
1999	0.24	0.58	0.98	1.41	2.17	3.26	4.42	5.70	7.27	10.24	14.12			
Germany (Division IIa and IIb)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994		0.68	1.04	2.24	3.49	4.51	5.79	6.93	8.16	8.46	8.74	9.48	15.25	
1995		0.44	0.84	1.50	2.72	3.81	4.46	4.81	7.37	7.69	8.25	9.47		
1996			0.84	1.15	1.64	2.53	3.58	4.13	3.90	4.68	6.98	6.43	11.32	
1997			0.43	0.92	1.42	2.01	3.15	4.04	5.16	4.82	3.96	7.04	8.80	
1998	0.23		0.73	1.17	1.89	2.72	3.25	4.13	5.63	6.50	8.57	8.42	11.45	8.79
1999 ¹		0.85	1.45	2.00	2.65	3.47	4.16	5.45	6.82	5.90		8.01		
¹ Division IIa only														
Spain (Division IIb)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994	0.43	1.08	1.38	2.32	2.47	2.68	3.46	5.20	7.04	6.79	7.20	8.04	10.46	15.35
1995	0.42	0.51	0.98	1.99	3.41	4.95	5.52	8.62	9.21	11.42	9.78	8.08		
1996		0.66	1.12	1.57	2.43	3.17	3.59	4.44	5.48	6.79	8.10			
1997 ¹	0.51	0.65	1.22	1.68	2.60	3.39	4.27	6.67	7.88	11.34	13.33	10.03	8.69	
1998	0.47	0.74	1.15	1.82	2.44	3.32	3.71	5.00	7.26					
1999		0.77	1.12	1.73	2.45	3.10	4.45	5.64	6.76	7.04	7.08			
¹ IIa and IIb combined														
Iceland (Sub-area I)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994		0.42	0.85	1.44	2.77	3.54	4.08	5.84	6.37	7.02	7.48	7.37		
1995			1.17	0.91	1.60	2.28	3.61	4.73	6.27			6.26		
1996			0.36	0.99	1.55	2.83	3.79	4.81	5.34	7.25	7.68	9.08	8.98	10.52
1997	0.42	0.43	0.76	1.60	2.40	3.45	4.40	5.74	6.15		8.28	10.52	9.89	
UK (England & Wales)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1995 ¹			1.47	2.11	3.47	5.57	6.43	7.17	8.12	8.05	10.2	10.1		
1996 ²			1.55	1.81	2.42	3.61	6.3	6.47	7.83	7.91	8.93	9.36	10.9	
1997 ²			1.93	2.17	3.07	4.17	4.89	6.46		12.3	8.44			

¹ Division IIa and IIb

² Division IIa

Table 2.5 North-East Arctic COD. Basis for maturity ogives (percent) used in the assessment. Norwegian and Russian data.

Norway								
Year	Percentage mature							
	3	4	5	6	7	8	9	10
1982	-	5	10	34	65	82	92	100
1983	5	8	10	30	73	88	97	100

Russia								
Year	Percentage mature							
	3	4	5	6	7	8	9	10
1984	-	5	18	31	56	90	99	100
1985	-	1	10	33	59	85	92	100
1986	-	2	9	19	56	76	89	100
1987	-	1	9	23	27	61	81	80
1988	-	1	3	25	53	79	100	100
1989	-	-	2	15	39	59	83	100
1990	-	2	6	20	47	62	81	95
1991	-	3	1	23	66	82	96	100
1992	-	1	8	31	73	92	95	100
1993	-	3	7	21	56	89	95	99
1994	-	1	8	30	55	84	95	98
1995	-	-	4	23	61	75	94	97
1996	-	-	1	22	56	82	95	100
1997	-	-	1	10	48	73	90	100
1998	-	-	2	15	47	87	97	96
1999	-	-	1	10	38	75	94	100
2000	-	-	7	20	54	85	95	100

Norway								
Year	Percentage mature							
	3	4	5	6	7	8	9	10
1985	-	1	9	38	51	85	100	79
1986	3	7	8	19	50	67	36	80
1987	-	0	4	12	16	31	19	-
1988	-	2	6	41	54	45	100	100
1989	-	1	8	21	43	79	87	100
1990	-	1	4	22	68	93	91	100
1991	-	5	12	34	65	84	99	100
1992	-	1	16	55	77	94	100	100
1993	-	3	12	40	63	94	98	99
1994	-	1	14	36	64	79	98	100
1995	-	1	9	43	63	73	96	98
1996	-	-	2	30	70	84	100	100
1997	-	-	2	17	64	92	100	89
1998	-	1	6	23	40	77	90	100
1999	-	-	-	11	53	83	83	100

Table 2.6

NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,,
 5,34,2 (No. of surveys, No. of years, VPA Column No.),,

1966	, 113,	-11,	-11,	2,	-11,	-11
1967	, 199,	-11,	-11,	4,	-11,	-11
1968	, 409,	-11,	-11,	2,	-11,	-11
1969	,1027,	-11,	-11,	25,	-11,	-11
1970	,1837,	23,	64,	251,	-11,	-11
1971	, 530,	7,	9,	77,	-11,	-11
1972	, 629,	5,	4,	52,	-11,	-11
1973	, 621,	16,	5,	148,	-11,	-11
1974	, 351,	1,	1,	29,	-11,	-11
1975	, 646,	60,	1,	90,	-11,	-11
1976	, 201,	1,	1,	13,	-11,	-11
1977	, 138,	1,	1,	49,	-11,	-11
1978	, 151,	1,	2,	22,	-11,	-11
1979	, 152,	1,	1,	40,	-11,	-11
1980	, 166,	1,	1,	13,	4.6,	8
1981	, 397,	1,	1,	10,	0.8,	4
1982	, 523,	1,	8,	59,	152.9,	60.5
1983	,1043,	4,	9,	169,	2755.0,	745.4
1984	, 287,	1,	1,	155,	149.5,	69.1
1985	, 205,	3,	10,	246,	665.8,	353.6
1986	, 173,	1,	2,	137,	22.0,	1.6
1987	, 243,	1,	1,	17,	3.2,	2.0
1988	, 412,	1,	1,	33,	8.2,	7.5
1989	, 721,	1,	1,	38,	207.2,	81.1
1990	, 899,	6,	1,	123,	460.5,	181.0
1991	, 820,	3,	6,	230,	126.6,	241.4
1992	, 663,	10,	60,	294,	534.5,	1074.0
1993	, 441,	2,	5,	209,	1035.9,	858.3
1994	, 745,	16,	3,	227,	5253.1,	2619.2
1995	, -11,	25,	36,	240,	5768.5,	2396.0
1996	, -11,	10,	-11,	287,	4815.5,	1623.5
1997	, -11,	-11,	16,	160,	2418.5,	3401.3
1998	, -11,	1,	2,	68,	484.6,	358.3
1999	, -11,	1,	2,	21,	128.8,	154.1

R-1-1 Russian Bottom trawl survey, area I, age 1

R-2B-1 Russian IIB, age 1

INT0GP International 0-group survey

N-BST1 Norwegian Barents Sea, Bottom trawl survey, age 1

N-BSA1 Norwegian Barents Sea Acoustic survey age 1

Table 2.7A

Analysis by RCT3 ver3.1 of data from file :

tab-3-6.rct

NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,

Data for 5 surveys over 34 years : 1966 - 1999

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1996

	I-----Regression-----I					I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	.26	5.08	1.17	.230	25	10.00	7.70	1.434	.092
R-2B-1									
INT0GP	1.83	-2.36	1.89	.103	29	5.66	8.03	2.272	.037
N-BST1	.46	3.80	.93	.310	15	8.48	7.70	1.172	.138
N-BSA1	.40	4.29	.77	.398	15	7.39	7.24	.937	.216
						VPA Mean =	6.16	.605	.517

Yearclass = 1997

	I-----Regression-----I					I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1									
R-2B-1	2.61	2.14	2.93	.044	25	2.83	9.54	3.665	.015
INT0GP	1.92	-2.83	1.96	.092	29	5.08	6.93	2.311	.038
N-BST1	.46	3.76	.93	.305	15	7.79	7.38	1.160	.151
N-BSA1	.39	4.29	.76	.395	15	8.13	7.50	.983	.211
						VPA Mean =	6.19	.590	.585

Yearclass = 1998

	I-----Regression-----I					I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	.23	5.15	1.14	.225	25	1.00	5.38	1.396	.089
R-2B-1	2.75	1.90	3.19	.036	25	1.10	4.92	3.848	.012
INT0GP	1.97	-3.14	1.99	.087	29	4.23	5.21	2.411	.030
N-BST1	.47	3.74	.94	.299	15	6.19	6.62	1.127	.137
N-BSA1	.39	4.30	.76	.390	15	5.88	6.60	.920	.205
						VPA Mean =	6.22	.574	.527

Table 2.7a (Continued)

Yearclass = 1999

I-----Regression-----I					I-----Prediction-----I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	.22	5.18	1.13	.223	25	1.00	5.40	1.422	.086
R-2B-1	2.87	1.67	3.46	.030	25	1.10	4.82	4.280	.009
INT0GP	1.96	-3.14	1.96	.087	29	3.09	2.92	2.818	.022
N-BST1	.46	3.72	.94	.292	15	4.87	5.98	1.153	.130
N-BSA1	.38	4.31	.76	.384	15	5.04	6.25	.934	.199
VPA Mean =							6.25	.559	.554
Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA		
1996	910	6.81	.44	.35	.66				
1997	832	6.72	.45	.35	.59				
1998	508	6.23	.42	.18	.19				
1999	426	6.06	.42	.24	.34				

Table 2.7b Input and results of alternative RCT prediction of 1999 year class.

```

NORTHEAST ARCTIC COD : recruits as 1 year-olds (inc. data for ages 0,1),,,,
5,15,2
      (No. of surveys, No. of years, VPA Column No.),,
1985, 1149, 3, 10, 246, -11, -11
1986, 491, 1, 2, 137, -11, -11
1987, 815, 1, 1, 17, -11, -11
1988, 819, 1, 1, 33, -11, -11
1989, 1445, 1, 1, 38, -11, -11
1990, 1736, 6, 1, 123, -11, -11
1991, 3063, 3, 6, 230, -11, -11
1992, 24285, 10, 60, 294, -11, -11
1993, 9614, 2, 5, 209,1035.9, 858.3
1994, 20292, 16, 3, 227,5253.1, 2619.2
1995, 28855, 25, 36, 240,5768.5, 2396.0
1996, 21220, 10, -11, 287,4815.5, 1623.5
1997, -11, -11, 16, 160,2418.5, 3401.3
1998, -11, 1, 2, 68, 484.6, 358.3
1999, -11, 1, 2, 21, 128.8, 154.1
R-1-1 Russian Bottom trawl survey, area I, age 1
R-2B-1 Russian IIb, age 1
INT0GP International 0-group survey
N-BST1 Norwegian Barents Sea, Bottom trawl survey, age 1
N-BSA1 Norwegian Barents Sea Acoustic survey age 1

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Analysis by RCT3 ver3.1 of data from file :

tab-3-61.rct

NORTHEAST ARCTIC COD : recruits as 1 year-olds (inc. data for ages 0,1),,,,

Data for 5 surveys over 15 years : 1985 - 1999

Table 2.7b (Continued)

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1995

I-----Regression-----I						I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	2.24	4.78	1.15	.633	10	3.26	12.08	1.720	.280
R-2B-1	1.96	4.88	1.77	.421	10	3.61	11.96	2.459	.137
INT0GP	2.22	-2.58	1.80	.411	10	5.48	9.60	2.209	.169
N-BST1									
N-BSA1									
						VPA Mean =	7.94	1.413	.414

Yearclass = 1996

I-----Regression-----I						I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	1.90	5.16	1.03	.713	11	2.40	9.70	1.245	.077
R-2B-1									
INT0GP	2.36	-3.16	1.78	.450	11	5.66	10.19	2.174	.025
N-BST1	.60	4.92	.22	.928	3	8.48	10.04	.457	.571
N-BSA1	.98	2.47	.33	.855	3	7.39	9.71	.658	.275
						VPA Mean =	8.21	1.522	.051

Yearclass = 1997

I-----Regression-----I						I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1									
R-2B-1	1.65	5.31	1.47	.550	11	2.83	9.97	1.799	.016
INT0GP	2.30	-2.90	1.61	.503	12	5.08	8.80	1.877	.015
N-BST1	.59	4.98	.16	.927	4	7.79	9.61	.262	.778
N-BSA1	1.03	2.13	.29	.793	4	8.13	10.53	.563	.168
						VPA Mean =	8.42	1.536	.023

Table 2.7b (Continued)

Yearclass = 1998

Survey/ Series	I-----Regression-----I					I-----Prediction-----I			
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	1.91	5.17	1.01	.723	12	.69	6.49	1.250	.073
R-2B-1	1.62	5.38	1.46	.555	11	1.10	7.16	1.780	.036
INT0GP	2.28	-2.79	1.56	.520	12	4.23	6.88	1.882	.032
N-BST1	.59	4.97	.16	.926	4	6.19	8.65	.414	.665
N-BSA1	1.03	2.13	.29	.792	4	5.88	8.21	.884	.146
VPA Mean =							8.49	1.532	.048

Yearclass = 1999

Survey/ Series	I-----Regression-----I					I-----Prediction-----I			
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	1.89	5.20	1.02	.718	12	.69	6.51	1.288	.124
R-2B-1	1.60	5.45	1.46	.560	11	1.10	7.20	1.806	.063
INT0GP	2.26	-2.68	1.50	.539	12	3.09	4.31	2.146	.045
N-BST1	.60	4.97	.16	.926	4	4.87	7.87	.612	.551
N-BSA1	1.04	2.12	.30	.790	4	5.04	7.34	1.272	.128
VPA Mean =							8.57	1.524	.089

Year	Weighted	Log	Int	Ext	Var	VPA	Log
Class	Average Prediction	WAP	Std Error	Std Error	Ratio		VPA
1995	20538	9.93	.91	1.08	1.41	28855	10.27
1996	18657	9.83	.35	.21	.35	21221	9.96
1997	16844	9.73	.23	.21	.81		
1998	4076	8.31	.34	.30	.77		
1999	1793	7.49	.45	.39	.74		

1

Table 2.8

Run title : Arctic Cod (run: SVPBJA06/V06)
 At 9/05/2000 18:38

Table 1	Catch numbers at age				Numbers*10**-3
YEAR,	1946,	1947,	1948,	1949,	
AGE					
3,	4008,	710,	140,	991,	
4,	10387,	13192,	3872,	6808,	
5,	18906,	43890,	31054,	35214,	
6,	16596,	52017,	55983,	100497,	
7,	13843,	45501,	77375,	83283,	
8,	15370,	13075,	21482,	29727,	
9,	59845,	19718,	15237,	13207,	
10,	22618,	47678,	9815,	5606,	
11,	10093,	31392,	30041,	8617,	
12,	9573,	9348,	7945,	13154,	
13,	5460,	9330,	4491,	3657,	
14,	1927,	4622,	3899,	1895,	
+gp,	750,	4103,	4205,	2167,	
0 TOTALNUM,	189376,	294576,	265539,	304823,	
TONSLAND,	706000,	882017,	774295,	800122,	
SOPCOF %,	67,	57,	62,	68,	

Table 1	Catch numbers at age				Numbers*10**-3					
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	1281,	24687,	24099,	47413,	11473,	3902,	10614,	17321,	31219,	32308,
4,	10954,	77924,	120704,	107659,	155171,	37652,	24172,	33931,	133576,	77942,
5,	29045,	64013,	113203,	112040,	146395,	201834,	129803,	27182,	71051,	148285,
6,	45233,	46867,	73827,	55500,	100751,	161336,	250472,	70702,	40737,	53480,
7,	62579,	37535,	49389,	22742,	40635,	84031,	86784,	87033,	38380,	18498,
8,	30037,	33673,	20562,	16863,	10713,	30451,	51091,	39213,	35786,	17735,
9,	19481,	23510,	24367,	10559,	11791,	13713,	14987,	17747,	13338,	23118,
10,	9172,	10589,	15651,	10553,	8557,	9481,	7465,	6219,	10475,	9483,
11,	6019,	4221,	8327,	5637,	6751,	4140,	3952,	3232,	3289,	3748,
12,	4133,	1288,	3565,	1752,	2370,	2406,	1655,	1220,	1070,	997,
13,	6750,	1002,	647,	468,	896,	867,	1292,	347,	252,	254,
14,	1662,	3322,	467,	173,	268,	355,	448,	299,	40,	161,
+gp,	1450,	611,	1044,	156,	123,	128,	166,	173,	141,	98,
0 TOTALNUM,	227796,	329242,	455852,	391515,	495894,	550296,	582901,	304619,	379354,	386107,
TONSLAND,	731982,	827180,	876795,	695546,	826021,	1147841,	1343068,	792557,	769313,	744607,
SOPCOF %,	78,	88,	75,	84,	78,	82,	84,	83,	88,	86,

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 1	Catch numbers at age				Numbers*10**-3					
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	37882,	45478,	42416,	13196,	5298,	15725,	55937,	34467,	3709,	2307,
4,	97865,	132655,	170566,	106984,	45912,	25999,	55644,	160048,	174585,	24545,
5,	64222,	123458,	167241,	205549,	97950,	78299,	34676,	69235,	267961,	238511,
6,	67425,	51167,	89460,	95498,	58575,	68511,	42539,	22061,	107051,	181239,
7,	23117,	38740,	28297,	35518,	19642,	25444,	37169,	26295,	26701,	79363,
8,	8429,	17376,	21996,	16221,	9162,	8438,	18500,	25139,	16399,	26989,
9,	7240,	5791,	7956,	11894,	6196,	3569,	5077,	11323,	11597,	13463,
10,	11675,	6778,	2728,	3884,	3553,	1467,	1495,	2329,	3657,	5092,
11,	4504,	5560,	2603,	1021,	783,	1161,	380,	687,	657,	1913,
12,	1843,	1682,	1647,	1025,	172,	131,	403,	316,	122,	414,
13,	354,	910,	392,	498,	387,	67,	77,	225,	124,	121,
14,	102,	280,	280,	129,	264,	91,	9,	40,	70,	23,
+gp,	226,	108,	103,	157,	131,	179,	70,	14,	46,	46,
0 TOTALNUM,	324884,	429983,	535685,	491574,	248025,	229081,	251976,	352179,	612679,	574026,
TONSLAND,	622042,	783221,	909266,	776337,	437695,	444930,	483711,	572605,	1074084,	1197226,
SOPCOF %,	88,	91,	92,	78,	82,	90,	94,	88,	96,	87,

Table 2.8. (Continued)

Table 1	Catch numbers at age			Numbers*10**-3						
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	7164,	7754,	35536,	294262,	91855,	45282,	85337,	39594,	78822,	8600,
4,	10792,	13739,	45431,	131493,	437377,	59798,	114341,	168609,	45400,	77484,
5,	25813,	11831,	26832,	61000,	203772,	226646,	79993,	136335,	88495,	43677,
6,	137829,	9527,	12089,	20569,	47006,	118567,	118236,	52925,	56823,	31943,
7,	96420,	59290,	7918,	7248,	12630,	29522,	47872,	61821,	25407,	16815,
8,	31920,	52003,	34885,	8328,	4370,	9353,	13962,	23338,	31821,	8274,
9,	8933,	12093,	22315,	19130,	2523,	2617,	4051,	5659,	9408,	10974,
10,	3249,	2434,	4572,	4499,	5607,	1555,	936,	1521,	1227,	1785,
11,	1232,	762,	1215,	677,	2127,	1928,	558,	610,	913,	427,
12,	260,	418,	353,	195,	322,	575,	442,	271,	446,	103,
13,	106,	149,	315,	81,	151,	231,	139,	122,	748,	59,
14,	39,	42,	121,	59,	83,	15,	26,	92,	48,	38,
+gp,	35,	25,	40,	55,	62,	37,	53,	54,	51,	45,
0 TOTALNUM,	323792,	170067,	191622,	547596,	807885,	496126,	465946,	490951,	339609,	200224,
TONSLAND,	933246,	689048,	565254,	792685,	1102433,	829377,	867463,	905301,	698715,	440538,
SOPCOF %,	97,	112,	108,	114,	103,	90,	102,	99,	100,	107,

Table 1	Catch numbers at age			Numbers*10**-3						
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	3911,	3407,	8948,	3108,	6942,	24634,	28968,	13648,	9828,	5085,
4,	17086,	9466,	20933,	19594,	14240,	45769,	70993,	137106,	22774,	17313,
5,	81986,	20803,	19345,	20473,	18807,	27806,	78672,	98210,	135347,	32165,
6,	40061,	63433,	28084,	17656,	20086,	19418,	25215,	61407,	54379,	81756,
7,	17664,	21788,	42496,	17004,	15145,	11369,	11711,	13707,	21015,	27854,
8,	7442,	9933,	8395,	18329,	8287,	3747,	4063,	3866,	3304,	5501,
9,	3508,	4267,	2878,	2545,	5988,	1557,	976,	910,	1236,	827,
10,	3196,	1311,	708,	646,	783,	768,	726,	455,	519,	290,
11,	678,	882,	271,	229,	232,	137,	557,	187,	106,	41,
12,	79,	109,	260,	74,	153,	36,	136,	227,	69,	13,
13,	24,	37,	27,	58,	49,	31,	28,	21,	43,	1,
14,	26,	3,	5,	20,	12,	32,	34,	59,	14,	11,
+gp,	8,	1,	5,	5,	8,	8,	14,	20,	5,	16,
0 TOTALNUM,	175669,	135440,	132355,	99741,	90732,	135312,	222093,	329823,	248639,	170873,
TONSLAND,	380434,	399038,	363730,	289992,	277651,	307920,	430113,	523071,	434939,	332481,
SOPCOF %,	97,	110,	108,	90,	95,	102,	102,	102,	100,	99,

Table 1	Catch numbers at age			Numbers*10**-3						
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	1911,	4963,	21835,	10094,	6531,	4879,	7655,	12827,	31887,	7513,
4,	7551,	10933,	36015,	46182,	59444,	42587,	28782,	36491,	88874,	76700,
5,	12999,	16467,	27494,	63578,	102548,	115329,	80711,	69633,	48972,	92167,
6,	17827,	20342,	23392,	33623,	59766,	98485,	100509,	83017,	40493,	31072,
7,	30007,	19479,	18351,	14866,	32504,	32036,	54590,	65768,	34513,	15773,
8,	6810,	25193,	13541,	9449,	10019,	7334,	10545,	28392,	26354,	15976,
9,	828,	3888,	18321,	6571,	6163,	3014,	2023,	4651,	6583,	8897,
10,	179,	428,	2529,	12593,	3671,	1725,	930,	1151,	965,	1848,
11,	59,	48,	264,	1749,	7528,	1174,	462,	373,	197,	196,
12,	15,	12,	82,	377,	995,	1920,	230,	213,	69,	40,
13,	6,	1,	3,	63,	121,	222,	809,	144,	42,	33,
14,	5,	1,	9,	22,	19,	41,	84,	238,	22,	8,
+gp,	2,	2,	1,	1,	4,	1,	1,	1,	53,	30,
0 TOTALNUM,	78199,	101757,	161837,	199168,	289313,	308747,	287331,	302899,	279024,	250253,
TONSLAND,	212000,	319158,	513234,	581611,	771086,	739999,	732228,	762403,	592624,	483613,
SOPCOF %,	101,	95,	103,	101,	101,	100,	101,	100,	101,	99,

Table 2.9

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 2	Catch weights at age (kg)			
YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,
0 SOPCOFAC,	.6735,	.5708,	.6152,	.6799,

Table 2.9 (Continued)

Table 2		Catch weights at age (kg)								
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,
0 SOPCOFAC,	.7781,	.8813,	.7499,	.8396,	.7790,	.8170,	.8448,	.8346,	.8831,	.8562,

Run title : Arctic Cod (run: SVPBJA06/V06)

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Table 2		Catch weights at age (kg)								
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,
0 SOPCOFAC,	.8819,	.9069,	.9175,	.7829,	.8184,	.8965,	.9415,	.8787,	.9561,	.8743,

Table 2		Catch weights at age (kg)								
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,
0 SOPCOFAC,	.9734,	1.1182,	1.0788,	1.1430,	1.0271,	.9007,	1.0236,	.9928,	1.0037,	1.0713,

Table 2		Catch weights at age (kg)								
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.6500,	.6500,	.6500,	.8400,	1.4200,	.9400,	.6400,	.4900,	.5400,	.7400,
4,	1.0000,	1.0000,	1.0000,	1.3700,	1.9300,	1.3700,	1.2700,	.8800,	.8500,	.9600,
5,	1.5500,	1.5500,	1.5500,	2.0900,	2.4900,	2.0200,	1.8800,	1.5500,	1.3200,	1.3100,
6,	2.3500,	2.3500,	2.3500,	2.8600,	3.1400,	3.2200,	2.7900,	2.3300,	2.2400,	1.9200,
7,	3.4500,	3.4500,	3.4500,	3.9900,	3.9100,	4.6300,	4.4900,	3.4400,	3.5200,	2.9300,
8,	4.7000,	4.7000,	4.7000,	5.5800,	4.9100,	6.0400,	5.8400,	5.9200,	5.3500,	4.6400,
9,	6.1700,	6.1700,	6.1700,	7.7700,	6.0200,	7.6600,	6.8300,	8.6000,	8.0600,	7.5200,
10,	7.7000,	7.7000,	7.7000,	9.2900,	7.4000,	9.8100,	7.6900,	9.6000,	9.5100,	9.1200,
11,	9.2500,	9.2500,	9.2500,	11.5500,	8.1300,	11.8000,	9.8100,	12.1700,	11.3600,	11.0800,
12,	10.8500,	10.8500,	10.8500,	16.2000,	8.5700,	14.1600,	10.7100,	13.7200,	14.0900,	11.4700,
13,	12.5000,	12.5000,	12.5000,	16.4200,	7.9900,	14.1700,	12.9100,	15.4100,	18.7100,	12.5000,
14,	13.9000,	13.9000,	13.9000,	16.9600,	9.7800,	13.5200,	9.5900,	10.4300,	12.8900,	19.4700,
+gp,	15.0000,	15.0000,	15.0000,	24.4600,	10.6400,	15.3300,	16.3100,	19.9500,	10.1600,	14.6800,
0 SOPCOFAC,	.9731,	1.1050,	1.0767,	.8953,	.9483,	1.0182,	1.0160,	1.0224,	1.0001,	.9879,

Table 2.9 (Continued)

Table 2	Catch weights at age (kg)									
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	.8100,	1.0500,	1.1600,	.8100,	.8200,	.7700,	.7900,	.6700,	.6800,	.6300,
4,	1.2200,	1.4500,	1.5700,	1.5200,	1.3000,	1.2000,	1.1100,	1.0400,	1.0500,	1.0200,
5,	1.6400,	2.1500,	2.2100,	2.1600,	2.0600,	1.7800,	1.6100,	1.5300,	1.6200,	1.5400,
6,	2.2200,	2.8900,	3.1000,	2.7900,	2.8900,	2.5900,	2.4600,	2.2200,	2.3000,	2.3400,
7,	3.2400,	3.7500,	4.2700,	4.0700,	3.2100,	3.8100,	3.8200,	3.4200,	3.3000,	3.2100,
8,	4.6800,	4.7100,	5.1900,	5.5300,	5.2000,	4.9900,	5.7200,	5.2000,	4.8600,	4.2900,
9,	7.3000,	6.0800,	6.1400,	6.4700,	6.8000,	6.2300,	6.7400,	7.1900,	6.8700,	6.0000,
10,	9.8400,	8.8200,	7.7700,	7.1900,	7.5700,	8.0500,	8.0400,	7.7300,	9.3000,	6.7300,
11,	13.2500,	11.8000,	10.1200,	7.9800,	8.0100,	8.7400,	9.2800,	8.6100,	10.3000,	10.0800,
12,	16.8800,	16.5800,	11.5400,	10.1100,	9.4800,	9.2200,	10.4000,	11.0700,	15.0500,	13.8700,
13,	7.9700,	19.3300,	12.5000,	14.8000,	11.7600,	11.3100,	11.0800,	8.5900,	14.3500,	12.4300,
14,	14.6400,	14.1700,	15.8100,	12.5900,	11.7200,	17.5700,	9.7100,	12.6300,	13.7100,	9.2000,
+gp,	15.0000,	16.6300,	6.5200,	10.4000,	19.7900,	21.1100,	24.2400,	15.0000,	15.0000,	17.2200,
0 SOPCOFAC,	1.0108,	.9521,	1.0270,	1.0127,	1.0090,	1.0030,	1.0147,	1.0004,	1.0072,	.9948,
1										

Table 2.10

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 3	Stock weights at age (kg)			
YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,

Table 3	Stock weights at age (kg)									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,

1

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 3	Stock weights at age (kg)									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,

Table 2.10 (Continued)

Table 3	Stock weights at age (kg)									
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,

Table 3	Stock weights at age (kg)									
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.6500,	.6500,	.6500,	.3720,	.4210,	.4130,	.3110,	.1910,	.2120,	.2990,
4,	1.0000,	1.0000,	1.0000,	.9230,	1.1550,	.8750,	.8800,	.5060,	.4040,	.5200,
5,	1.5500,	1.5500,	1.5500,	1.5970,	1.8060,	1.6030,	1.4700,	1.2790,	.7900,	.8680,
6,	2.3500,	2.3500,	2.3500,	2.4420,	2.7930,	2.8100,	2.4670,	1.9400,	1.9030,	1.4770,
7,	3.4500,	3.4500,	3.4500,	3.8210,	3.7770,	4.0590,	3.9150,	3.2800,	2.9770,	2.6860,
8,	4.7000,	4.7000,	4.7000,	4.7580,	4.5660,	5.8330,	5.8100,	5.1710,	4.3920,	4.6280,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	7.6850,	6.5800,	6.5230,	7.8120,	7.0480,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	10.1170,	6.8330,	9.3000,	12.1120,	9.9800,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	14.2900,	11.0040,	13.1500,	13.1070,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,

Table 3	Stock weights at age (kg)									
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	.3980,	.5180,	.4400,	.3440,	.2250,	.2010,	.1950,	.2020,	.2170,	.2030,
4,	.7050,	1.1360,	.9310,	1.1720,	.7530,	.4850,	.4870,	.5210,	.5330,	.5200,
5,	1.1820,	1.7430,	1.8120,	1.8200,	1.4200,	1.1400,	.9710,	1.0790,	1.1610,	1.1740,
6,	1.7190,	2.4280,	2.7160,	2.8230,	2.4130,	2.1180,	2.0540,	1.8780,	1.9390,	2.0310,
7,	2.4580,	3.2140,	3.8950,	4.0310,	3.8250,	3.4700,	3.5270,	3.3690,	2.9450,	3.0340,
8,	3.5650,	4.5380,	5.1760,	5.4970,	5.4160,	4.9380,	5.5030,	5.2630,	4.5740,	4.4640,
9,	4.7100,	6.8800,	6.7740,	6.7650,	6.6310,	7.1600,	7.7670,	8.9270,	7.4230,	6.4820,
10,	7.8010,	10.7190,	9.5980,	8.5710,	7.6300,	9.1190,	10.1590,	12.1540,	10.3670,	10.2690,
11,	8.9560,	9.4450,	12.4270,	9.2500,	8.1120,	10.1010,	10.6690,	10.8980,	11.7380,	10.8820,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,

1

Table 2.11

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 5	Proportion mature at age			
YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.11 (Continued)

Table 5	Proportion mature at age									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

1

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 5	Proportion mature at age									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5	Proportion mature at age									
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5	Proportion mature at age									
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0500,	.0800,	.0500,	.0100,	.0500,	.0100,	.0200,	.0000,
5,	.0000,	.0000,	.1000,	.1000,	.1800,	.0900,	.0800,	.0700,	.0500,	.0500,
6,	.0000,	.0000,	.3400,	.3000,	.3100,	.3600,	.1900,	.1800,	.3300,	.1800,
7,	.0000,	.0000,	.6500,	.7300,	.5600,	.5500,	.5300,	.2200,	.5300,	.4100,
8,	1.0000,	1.0000,	.8200,	.8800,	.9000,	.8500,	.7100,	.4600,	.6200,	.6900,
9,	1.0000,	1.0000,	.9200,	.9700,	.9900,	.9600,	.6200,	.5000,	1.0000,	.8500,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	.9000,	.7500,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.11 (Continued)

Table 5 YEAR,	Proportion mature at age			1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0100,	.0400,	.0100,	.0300,	.0100,	.0000,	.0000,	.0000,	.0100,	.0000,
5,	.0500,	.0600,	.1200,	.0900,	.1100,	.0700,	.0200,	.0200,	.0400,	.0100,
6,	.2100,	.2800,	.4300,	.3000,	.3300,	.3300,	.2600,	.1400,	.1900,	.1000,
7,	.5800,	.6500,	.7500,	.6100,	.6000,	.6200,	.6300,	.5600,	.4400,	.4500,
8,	.7700,	.8300,	.9300,	.9100,	.8100,	.7400,	.8300,	.8200,	.8200,	.7900,
9,	.8600,	.9700,	.9700,	.9700,	.9700,	.9500,	.9800,	.9500,	.9300,	.8800,
10,	.9800,	1.0000,	1.0000,	.9900,	.9900,	.9800,	1.0000,	.9500,	.9800,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	.9900,	1.0000,	1.0000,	.9500,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

1

Table 2.12

North-East Arctic cod (Sub-areas I and II) (run name: XSABJA36)

106

FLT01: Russian Trawl/Acoustic survey (ages 1-8) (Catch: Unknown) ((Catch: Unknown) (Effort: Unknown)
1982 1999

1 1 0.90 1.00

1 8

1	6	181	141	51	13	26	7	0
1	89	43	56	73	47	20	8	11
1	92	142	162	86	50	31	11	4
1	49	430	303	405	188	49	19	6
1	22	91	565	161	106	30	8	3
1	2	40	59	426	54	31	6	1
1	2	25	77	78	190	25	6	1
1	1	6	34	88	118	155	114	26
1	31	78	38	44	66	60	113	18
1	59	98	110	62	58	77	56	46
1	78	395	485	182	69	53	52	40
1	28	131	647	597	334	91	34	33
1	33	120	300	475	500	180	61	14
1	64	46	124	267	287	126	27	8
1	134	99	68	113	164	114	44	10
1	48	184	174	76	59	33	14	5
1	52	232	558	271	70	28	17	6
1	33	160	318	531	178	32	14	9

FLT02: Norwegian trawl catch and effort age 9 - 14 (Catch: Thous (Catch: Unknown) (Effort: Unknown)

1985 1999

1 1 0.00 1.00

9 14

0.45	263	82	15	1	11	11
0.58	78	239	83	44	2	1
0.95	185	99	34	54	5	49
1.14	144	25	4	14	26	0
0.76	140	66	18	0	0	4
0.51	47	16	3	0	0	0
0.66	124	6	1	0	0	0
0.42	1434	168	32	12	0	0
0.41	811	2007	460	58	3	1
0.85	761	458	937	136	12	1
0.71	438	70	35	223	0	0
0.68	298	185	88	31	131	5
1.02	452	96	56	25	59	35
1.22	1154	221	22	6	6	1
1.10	1510	213	25	2	9	0

FLT03: Russian trawl catch and effort ages 9 - 14 (Catch: Thousa (Catch: Unknown) (Effort: Unknown)

1985 1999

1 1 0.00 1.00

9 14

0.70	291	77	30	6	0	0
1.52	87	59	22	3	1	0
2.10	127	95	37	11	2	0
2.75	442	215	53	12	3	0
2.12	140	47	11	0	0	0
1.11	204	49	14	2	0	0
1.56	791	71	16	4	1	0
2.50	3852	689	62	10	0	0
2.64	2019	1778	68	13	2	0
2.96	1237	595	167	40	5	0
3.88	684	345	146	21	1	0
3.73	364	164	34	10	0	0
4.92	488	99	34	10	0	0
6.77	559	88	34	13	1	0
6.39	882	171	0	0	0	0

Table 2.12 (Continued)

FLT04: NorBarTrSur revised 1999 (Catch: Unknown) (Effort: Unknown)

1980 1999

1 1 0.99 1.00

1 8

-1	343	164	233	400	384	48	10	3
-1	29	283	277	236	155	160	14	2
-1	134	250	523	433	170	58	32	10
-1	3791	975	283	214	117	41	4	1
-1	6600	1668	1260	199	77	33	2	1
1	3996	8050	1439	641	83	19	3	0
1	4450	2404	3911	543	157	20	5	0
1	728	1480	805	1733	205	36	5	0
1	156	464	759	378	902	98	9	1
1	567	284	349	346	206	272	16	4
1	2201	459	337	257	215	122	127	6
1	5709	1583	577	178	128	77	43	27
1	4204	2739	1401	725	158	62	39	22
1	5358	2965	3102	1474	506	93	24	16
1	5415	2746	2414	2559	767	185	24	8
1	7076	1700	1154	1372	1061	240	29	4
1	10451	2380	640	704	527	283	57	9
1	6437	3960	1813	365	259	178	86	10
1	3401	2118	1732	581	134	65	51	12
1	2483	2352	1321	1083	269	43	20	12

FLT05: NorBarLofAcSur revised 1999 (Catch: Unknown) (Effort: Unknown)

1984 1999

1 1 0.99 1.00

1 11

1	4463	1530	1416	203	150	157	33	12	11	5	0
1	2439	4996	1343	684	116	77	31	2	0	4	1
1	341	628	2049	502	174	15	30	7	0	0	0
1	263	504	355	578	109	39	2	0	1	0	0
1	80	170	344	214	670	166	32	5	1	0	1
1	249	148	206	262	269	668	72	6	4	0	0
1	2195	502	346	293	339	367	500	36	2	2	0
1	5621	1765	658	216	185	284	254	824	44	16	2
1	4947	3572	1911	1131	354	255	252	277	443	49	7
1	5772	3498	4045	2174	894	224	120	94	39	179	27
1	2929	1662	1598	2166	1041	291	43	43	31	26	81
1	3398	929	705	872	891	446	64	10	4	9	15
1	4305	1883	517	497	422	499	205	22	5	0	8
1	6329	4277	1826	424	338	339	247	49	8	2	0
1	3043	1500	964	453	123	113	187	92	10	2	2
1	2214	2451	1588	1456	492	127	68	51	11	6	2

FLT06: NorSvaTrSur revised 1999 (Catch: Unknown) (Effort: Unknown)

1983 1999

1 1 0.60 0.85

1 8

1	1912	170	43	44	13	11	5	8
1	5984	1068	63	33	34	13	3	3
1	2806	4477	811	215	98	39	7	3
1	498	1823	2606	325	110	19	7	2
1	488	1177	1471	1372	202	50	5	3
1	26	268	308	244	372	71	15	1
1	40	14	121	113	93	147	30	4
1	950	103	70	109	170	114	174	16
1	1445	880	224	61	95	102	85	132
1	1680	1256	818	379	84	39	44	21
1	1579	1531	1160	448	168	34	24	15
1	1056	1493	1031	485	397	186	43	16
1	4652	671	1014	808	825	431	146	32
1	5532	1956	600	381	351	320	177	23
1	2432	2091	550	182	103	102	69	20
1	1899	2722	1685	628	171	82	56	27
1	1050	1792	1322	1062	208	40	39	21

Table 2.13

Lowestoft VPA Version 3.1

9/05/2000 18:12

Extended Survivors Analysis

Arctic Cod (run: XSABJA36/X36)

CPUE data from file fleet

Catch data for 54 years. 1946 to 1999. Ages 1 to 15.

Fleet,	First,	Last,	First,	Last,	Alpha,	Beta
,	year,	year,	age,	age	,	
FLT01: Russian Trawl,	1982,	1999,	1,	8,	.900,	1.000
FLT02: Norwegian tra,	1985,	1999,	9,	14,	.000,	1.000
FLT03: Russian trawl,	1985,	1999,	9,	14,	.000,	1.000
FLT04: NorBarTrSur r,	1980,	1999,	1,	8,	.990,	1.000
FLT05: NorBarLofAcSu,	1984,	1999,	1,	11,	.990,	1.000
FLT06: NorSvaTrSur r,	1983,	1999,	1,	8,	.600,	.850

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 6

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 6

Catchability independent of age for ages >= 13

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

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

Prior weighting not applied

Tuning converged after 25 iterations

Regression weights

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

Fishing mortalities

Age,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999
1,	.049,	.102,	.465,	2.543,	1.753,	1.858,	1.939,	2.410,	1.462,	1.039
2,	.060,	.234,	.144,	.442,	.646,	.917,	1.036,	1.044,	.618,	.516
3,	.009,	.018,	.041,	.079,	.208,	.539,	.462,	.334,	.402,	.190
4,	.062,	.062,	.127,	.096,	.201,	.296,	.341,	.298,	.378,	.187
5,	.134,	.187,	.221,	.347,	.340,	.334,	.401,	.544,	.525,	.530
6,	.230,	.321,	.442,	.460,	.646,	.576,	.538,	.692,	.726,	.708
7,	.247,	.424,	.539,	.564,	1.168,	.893,	.749,	.829,	.704,	.686
8,	.376,	.339,	.595,	.597,	.979,	.944,	.867,	1.232,	.999,	.863
9,	.341,	.383,	.444,	.658,	1.052,	.943,	.752,	1.360,	1.165,	1.230
10,	.410,	.296,	.463,	.634,	1.009,	1.013,	.892,	1.511,	1.324,	1.412
11,	.474,	.181,	.300,	.687,	1.040,	1.143,	.853,	1.224,	1.342,	1.152
12,	.180,	.163,	.536,	.945,	1.159,	.844,	.716,	1.420,	.782,	1.207
13,	.606,	.016,	.056,	1.094,	.958,	.906,	1.146,	1.607,	1.410,	1.180
14,	.288,	.186,	.198,	.719,	1.316,	1.094,	1.145,	1.475,	1.361,	1.274

1

XSA population numbers (Thousands)

Table 2.13 (Continued)

AGE YEAR ,	1,	2,	3,	4,	5,	6,	7,	8,	9,	10,
1990 ,	1.44E+06,	5.40E+05,	2.46E+05,	1.39E+05,	1.14E+05,	9.58E+04,	1.51E+05,	2.40E+04,	3.17E+03,	5.89E+02,
1991 ,	1.74E+06,	1.13E+06,	4.16E+05,	2.00E+05,	1.07E+05,	8.19E+04,	6.23E+04,	9.68E+04,	1.35E+04,	1.85E+03,
1992 ,	3.06E+06,	1.28E+06,	7.30E+05,	3.35E+05,	1.54E+05,	7.24E+04,	4.87E+04,	3.34E+04,	5.64E+04,	7.55E+03,
1993 ,	2.43E+07,	1.58E+06,	9.09E+05,	5.74E+05,	2.42E+05,	1.01E+05,	3.81E+04,	2.32E+04,	1.51E+04,	2.96E+04,
1994 ,	9.61E+06,	1.56E+06,	8.29E+05,	6.88E+05,	4.27E+05,	1.40E+05,	5.21E+04,	1.77E+04,	1.05E+04,	6.38E+03,
1995 ,	2.03E+07,	1.36E+06,	6.71E+05,	5.52E+05,	4.60E+05,	2.49E+05,	6.00E+04,	1.33E+04,	5.46E+03,	2.99E+03,
1996 ,	2.89E+07,	2.59E+06,	4.46E+05,	3.21E+05,	3.36E+05,	2.70E+05,	1.14E+05,	2.01E+04,	4.23E+03,	1.74E+03,
1997 ,	2.12E+07,	3.40E+06,	7.53E+05,	2.30E+05,	1.87E+05,	1.84E+05,	1.29E+05,	4.43E+04,	6.92E+03,	1.63E+03,
1998 ,	7.67E+06,	1.56E+06,	9.79E+05,	4.41E+05,	1.40E+05,	8.87E+04,	7.54E+04,	4.61E+04,	1.06E+04,	1.45E+03,
1999 ,	3.14E+06,	1.46E+06,	6.89E+05,	5.36E+05,	2.48E+05,	6.77E+04,	3.51E+04,	3.05E+04,	1.39E+04,	2.70E+03,

Estimated population abundance at 1st Jan 2000

, 0.00E+00, 9.10E+05, 7.11E+05, 4.66E+05, 3.64E+05, 1.19E+05, 2.73E+04, 1.45E+04, 1.05E+04, 3.33E+03,

Taper weighted geometric mean of the VPA populations:

, 4.79E+06, 1.16E+06, 5.35E+05, 3.41E+05, 2.14E+05, 1.18E+05, 5.70E+04, 2.18E+04, 7.10E+03, 2.28E+03,

Standard error of the weighted Log(VPA populations) :

, 1.3898, .7335, .5762, .5570, .5447, .5560, .5832, .7714, .9620, 1.0936,

YEAR ,	AGE			
	11,	12,	13,	14,
1990 ,	1.73E+02,	1.00E+02,	1.46E+01,	2.21E+01,
1991 ,	3.20E+02,	8.81E+01,	6.86E+01,	6.52E+00,
1992 ,	1.12E+03,	2.18E+02,	6.12E+01,	5.53E+01,
1993 ,	3.89E+03,	6.82E+02,	1.05E+02,	4.74E+01,
1994 ,	1.29E+04,	1.60E+03,	2.17E+02,	2.87E+01,
1995 ,	1.90E+03,	3.72E+03,	4.12E+02,	6.81E+01,
1996 ,	8.90E+02,	4.97E+02,	1.31E+03,	1.36E+02,
1997 ,	5.84E+02,	3.10E+02,	1.99E+02,	3.41E+02,
1998 ,	2.95E+02,	1.41E+02,	6.14E+01,	3.27E+01,
1999 ,	3.17E+02,	6.31E+01,	5.26E+01,	1.23E+01,

Estimated population abundance at 1st Jan 2000

, 5.38E+02, 8.20E+01, 1.54E+01, 1.32E+01,

Taper weighted geometric mean of the VPA populations:

, 7.14E+02, 2.70E+02, 1.10E+02, 4.31E+01,

Standard error of the weighted Log(VPA populations) :

, 1.2923, 1.3048, 1.1504, 1.0423,

1

Log catchability residuals.

Fleet : FLT01: Russian Trawl

Age ,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989
1 ,	99.99,	99.99,	-.24,	1.74,	1.01,	1.00,	.63,	-.55,	-.84,	-1.90
2 ,	99.99,	99.99,	1.82,	-.17,	.48,	.65,	.54,	.23,	.21,	-1.22
3 ,	99.99,	99.99,	1.05,	.37,	.14,	.27,	.01,	-.09,	.38,	.04
4 ,	99.99,	99.99,	.21,	.48,	.40,	.57,	-.25,	-.20,	-.11,	.25
5 ,	99.99,	99.99,	-1.10,	.06,	.13,	1.14,	-.09,	-.87,	-.46,	.19
6 ,	99.99,	99.99,	-.38,	-.30,	.30,	.74,	.21,	-.24,	-.97,	-.06
7 ,	99.99,	99.99,	-1.75,	-.73,	.27,	.77,	-.08,	-.20,	-.76,	1.32
8 ,	99.99,	99.99,	99.99,	-.12,	-.08,	.84,	.13,	-1.00,	-.79,	1.81
9 ,	No data for this fleet at this age									
10 ,	No data for this fleet at this age									
11 ,	No data for this fleet at this age									
12 ,	No data for this fleet at this age									
13 ,	No data for this fleet at this age									
14 ,	No data for this fleet at this age									

Table 2.13 (Continued)

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.32	.72	.68	-.58	-.15	-.25	.09	-.10	.23	.39
2	.24	-.18	.71	-.14	-.05	-.46	-.41	-.20	.45	.15
3	-.25	-.13	.22	.20	-.10	-.24	-.23	-.26	.22	.11
4	-.10	-.24	-.02	.20	-.07	-.16	-.15	-.11	.12	.25
5	-.14	-.14	-.33	.72	.50	-.07	-.19	-.39	.04	.29
6	-.11	.38	.24	.47	1.00	.00	-.21	-.93	-.33	.06
7	-.06	.30	.58	.42	1.27	.05	-.24	-1.43	-.82	-.27
8	.02	-.47	.70	.87	.65	.35	.08	-1.06	-1.13	-.45
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

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

Age	6	7	8
Mean Log q	-6.8538	-6.7180	-6.6740
S.E(Log q)	.5332	.7881	.8361

Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

1	.85	.938	11.38	.79	18	.74	-10.67
2	.78	1.022	9.84	.69	18	.52	-8.69
3	.60	3.152	9.84	.86	18	.24	-7.65
4	.65	2.944	9.11	.88	18	.22	-7.17
5	.88	.472	7.53	.61	18	.45	-6.89

Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Q

6	1.41	-1.007	4.88	.38	18	.75	-6.85
7	1.81	-1.113	3.29	.16	18	1.41	-6.72
8	1.58	-1.143	4.75	.28	17	1.30	-6.67

1

Fleet : FLT02: Norwegian tra

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	99.99	99.99	99.99	99.99	99.99	.86	-.08	.24	-.06	.40
10	99.99	99.99	99.99	99.99	99.99	.02	1.64	.91	-.75	.85
11	99.99	99.99	99.99	99.99	99.99	.07	.76	.53	-.84	.56
12	99.99	99.99	99.99	99.99	99.99	-2.45	1.56	.72	.37	99.99
13	99.99	99.99	99.99	99.99	99.99	.36	-1.97	-.31	.64	99.99
14	99.99	99.99	99.99	99.99	99.99	.48	-1.48	1.54	99.99	-.03

Age , 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999

1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	-1.16	-1.88	-.38	.49	.22	.46	.29	.05	.31	.43
10	-.49	-2.92	-.47	.74	.22	-.71	.79	.04	.74	.22
11	-.79	-2.89	-.18	1.44	.37	-.78	.83	.54	.15	.24
12	99.99	99.99	.28	.91	.26	-.03	.00	.13	-.94	-.96
13	99.99	99.99	99.99	-.50	-.62	99.99	.27	1.12	-.24	.34
14	99.99	99.99	99.99	-.96	-.94	99.99	-.73	.01	-1.42	99.99

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

Age	9	10	11	12	13	14
Mean Log q	-2.1180	-2.1523	-2.2733	-1.9644	-1.5871	-1.5871
S.E(Log q)	.6996	1.0546	1.0611	.8203	.7690	1.0517

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Table 2.13 (Continued)

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e.	Mean Q
9,	1.12,	-.463,	1.32,	.61,	15,	.81,	-2.12,
10,	.96,	.122,	2.35,	.54,	15,	1.07,	-2.15,
11,	.79,	1.121,	3.20,	.74,	15,	.82,	-2.27,
12,	.81,	1.021,	2.71,	.80,	12,	.66,	-1.96,
13,	.92,	.283,	1.85,	.70,	10,	.76,	-1.59,
14,	.69,	1.157,	2.78,	.75,	9,	.59,	-2.13,

1

Fleet : FLT03: Russian trawl

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	99.99	99.99	99.99	99.99	99.99	1.50	.05	.05	1.16	.36
10	99.99	99.99	99.99	99.99	99.99	.47	.23	1.03	1.48	.44
11	99.99	99.99	99.99	99.99	99.99	1.52	-.33	1.02	2.07	.24
12	99.99	99.99	99.99	99.99	99.99	1.07	.08	.51	1.51	99.99
13	99.99	99.99	99.99	99.99	99.99	99.99	-.32	1.29	.91	99.99
14	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	.51	.09	-.20	.52	.44	.18	-.23	-.47	-1.15	-.88
10	.81	-.35	.11	-.29	.20	.14	-.07	-.55	-.94	-.80
11	1.17	.22	-.10	-1.13	-1.40	.14	-.63	-.34	.07	99.99
12	.30	.77	.48	-.28	-.04	-1.92	-.67	-.19	.29	99.99
13	99.99	.33	99.99	.55	.57	-1.97	99.99	99.99	-.43	99.99
14	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

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

Age	9	10	11	12	13	14
Mean Log q	-3.0971,	-3.1109,	-3.4720,	-4.1334,	-4.9014,	.0000,
S.E(Log q)	.6543,	.6545,	.9302,	.8669,	1.0817,	.0000,

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e.	Mean Q
9,	1.35,	-1.313,	1.07,	.59,	15,	.86,	-3.10,
10,	1.25,	-1.112,	1.96,	.68,	15,	.81,	-3.11,
11,	2.23,	-3.945,	-.43,	.54,	14,	1.31,	-3.47,
12,	2.46,	-4.027,	1.58,	.49,	13,	1.30,	-4.13,
13,	11.21,	-1.688,	6.02,	.01,	8,	10.39,	-4.90,
14,	.00,	.000,	.00,	.00,	0,	.00,	.00,

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Fleet : FLT04: NorBarTrSur r

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	99.99	99.99	99.99	99.99	99.99	.70	1.12	.40	-1.21	-.59
2	99.99	99.99	99.99	99.99	99.99	.66	.84	.81	.25	-.44
3	99.99	99.99	99.99	99.99	99.99	.09	.27	.28	.53	.05
4	99.99	99.99	99.99	99.99	99.99	.01	-.31	-.08	.03	.26
5	99.99	99.99	99.99	99.99	99.99	-.11	-.39	-.39	-.02	.02
6	99.99	99.99	99.99	99.99	99.99	-.70	-.69	-.58	-.11	-.01
7	99.99	99.99	99.99	99.99	99.99	-1.09	-.56	-.38	-.36	-.67
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.48	.24
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

Table 2.13 (Continued)

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-.13	.56	.04	-.02	.23	-.19	-.14	.16	-.20	.05
2	-.61	-.27	-.05	.04	.14	.12	-.18	-.05	-.08	-.01
3	-.33	-.43	-.26	.18	.17	.06	-.06	.14	-.10	-.14
4	.14	-.49	.03	-.03	.26	.10	.21	.04	-.22	-.11
5	.24	-.02	-.21	.25	-.02	.13	-.01	.17	-.02	-.09
6	.08	-.14	-.11	-.02	.53	.14	.19	.26	.02	-.14
7	.01	.00	.26	.04	.33	.11	-.01	.36	.25	.06
8	-.80	-.72	.39	.44	.39	-.04	.27	-.05	-.14	.14
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

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

Age	6	7	8
Mean Log q	-6.3158	-6.6525	-6.9244
S.E(Log q)	.2962	.3457	.4167

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.87	1.241	7.15	.90	15	.48	-5.90
2	.77	1.503	7.69	.81	15	.37	-5.77
3	.79	1.468	7.29	.84	15	.26	-5.76
4	.71	2.301	7.87	.86	15	.22	-5.83
5	.71	2.627	7.82	.90	15	.19	-6.02

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.76	2.236	7.62	.90	15	.19	-6.32
7	.78	1.726	7.62	.86	15	.25	-6.65
8	1.17	-.742	6.38	.69	12	.50	-6.92

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Fleet : FLT05: NorBarLofAcSu

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	99.99	99.99	99.99	99.99	.63	.66	-.64	.00	-1.25	-.80
2	99.99	99.99	99.99	99.99	.33	.37	.09	.29	.04	-.34
3	99.99	99.99	99.99	99.99	.45	.17	-.16	-.12	.15	-.06
4	99.99	99.99	99.99	99.99	.00	.11	-.34	-.81	-.40	.04
5	99.99	99.99	99.99	99.99	.11	-.28	-.61	-1.24	-.25	-.04
6	99.99	99.99	99.99	99.99	.63	-.09	-1.77	-1.29	-.37	.10
7	99.99	99.99	99.99	99.99	.13	.01	.00	-2.54	-.33	-.40
8	99.99	99.99	99.99	99.99	-.29	-1.57	-.33	99.99	-.49	-.97
9	99.99	99.99	99.99	99.99	.21	99.99	99.99	-1.18	-.80	.49
10	99.99	99.99	99.99	99.99	.22	-.94	99.99	99.99	99.99	99.99
11	99.99	99.99	99.99	99.99	99.99	-1.43	99.99	99.99	.46	99.99
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.27	.90	.52	.27	.00	-.54	-.63	.37	.02	.31
2	-.13	.02	.28	.24	-.09	-.14	-.27	-.03	-.17	.15
3	-.05	-.12	.08	.42	-.05	-.19	-.05	.23	-.44	.12
4	.21	-.39	.43	.37	.27	-.14	.00	.18	-.36	.20
5	.34	-.11	.17	.70	.27	.04	-.28	.23	-.45	.29
6	.39	.38	.52	.08	.20	-.02	-.03	.12	-.21	.16
7	.15	.54	.89	.42	-.32	-.34	.04	.18	.32	.05
8	-.62	1.08	1.31	.59	.46	-.74	-.45	-.07	.28	-.03
9	-1.34	.34	1.28	.38	.91	-.59	-.31	.28	-.12	-.23
10	-.44	.38	.26	.36	.34	.04	99.99	-.37	-.44	.13
11	99.99	-.76	-.65	-.15	.10	.43	.27	99.99	.48	.21
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

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

Age	6	7	8	9	10	11
Mean Log q	-5.5301	-5.4159	-5.3080	-5.4870	-4.6364	-3.9349
S.E(Log q)	.5034	.6591	.7351	.7405	.3853	.5320

Regression statistics :

Table 2.13 (Continued)

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e.	Mean Log q
1,	.82,	1.362,	7.96,	.85,	16,	.61,	-6.30,
2,	.62,	4.094,	9.03,	.92,	16,	.22,	-6.04,
3,	.70,	2.294,	8.10,	.86,	16,	.24,	-5.95,
4,	.78,	1.151,	7.44,	.73,	16,	.35,	-5.91,
5,	.94,	.235,	6.20,	.61,	16,	.45,	-5.81,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e.	Mean Q
6,	.97,	.116,	5.73,	.56,	16,	.51,	-5.53,
7,	.74,	1.053,	6.88,	.62,	16,	.48,	-5.42,
8,	.60,	2.778,	7.18,	.84,	15,	.35,	-5.31,
9,	.66,	2.759,	6.67,	.88,	14,	.38,	-5.49,
10,	.81,	2.296,	5.28,	.96,	11,	.25,	-4.64,
11,	1.00,	-.010,	3.93,	.87,	10,	.57,	-3.93,

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Fleet : FLT06: NorSvaTrSur r

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1,	99.99	99.99	99.99	1.46	1.67	1.50	.27	1.10	-1.82	-1.81
2,	99.99	99.99	99.99	-.30	.46	.58	.92	1.01	.73	-1.24
3,	99.99	99.99	99.99	-.62	-1.25	.14	.25	1.15	.46	.01
4,	99.99	99.99	99.99	-.20	-.56	-.21	-.17	.16	.27	.06
5,	99.99	99.99	99.99	-1.13	-.35	.30	-.36	-.08	-.26	-.25
6,	99.99	99.99	99.99	-1.26	-.97	.13	-.66	-.23	-.32	-.46
7,	99.99	99.99	99.99	-1.68	-1.59	-.74	-.73	-.95	-.39	-.48
8,	99.99	99.99	99.99	-.84	-.82	-.25	-.69	-.30	-1.19	-.44
9,	No data for this fleet at this age									
10,	No data for this fleet at this age									
11,	No data for this fleet at this age									
12,	No data for this fleet at this age									
13,	No data for this fleet at this age									
14,	No data for this fleet at this age									

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1,	.31	.53	.32	-.49	-.41	.21	.06	-.06	.15	.25
2,	-.66	-.09	-.05	-.02	.06	-.15	-.13	-.36	.39	.18
3,	-.69	-.47	-.18	-.16	-.08	.27	.31	-.33	.16	.25
4,	.15	-.59	.09	-.35	-.44	.15	.24	.08	.25	.31
5,	.44	.08	-.36	-.20	-.09	.41	.09	-.21	.47	.05
6,	.23	.34	-.41	-.87	.64	.85	.44	-.21	.33	-.13
7,	.01	.31	-.01	-.36	.35	1.23	.67	-.33	-.09	.30
8,	-.35	.34	-.25	-.22	.39	1.35	.55	-.12	-.03	.04
9,	No data for this fleet at this age									
10,	No data for this fleet at this age									
11,	No data for this fleet at this age									
12,	No data for this fleet at this age									
13,	No data for this fleet at this age									
14,	No data for this fleet at this age									

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

Age	6	7	8
Mean Log q,	-6.6471,	-6.4592,	-6.5498,
S.E(Log q),	.5393,	.6256,	.5975,

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e.	Mean Log q
1,	.88,	.646,	8.29,	.75,	17,	.84,	-7.33,
2,	.57,	1.857,	9.77,	.66,	17,	.55,	-6.66,
3,	.64,	1.462,	8.89,	.63,	17,	.46,	-6.50,
4,	.64,	2.088,	8.86,	.77,	17,	.32,	-6.68,
5,	.79,	1.160,	7.85,	.75,	17,	.33,	-6.66,

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e.	Mean Q
6,	.72,	1.382,	8.05,	.71,	17,	.37,	-6.65,
7,	.70,	1.362,	7.80,	.68,	17,	.42,	-6.46,
8,	.85,	.761,	7.08,	.71,	17,	.52,	-6.55,

1

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1998

Table 2.13 (Continued)

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	1345645.,	.769,	.000,	.00,	1,	.096,	.804
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	960804.,	.501,	.000,	.00,	1,	.227,	1.004
FLT05: NorBarLofAcSu,	1239183.,	.633,	.000,	.00,	1,	.142,	.850
FLT06: NorSvaTrSur r,	1167226.,	.875,	.000,	.00,	1,	.074,	.885

P shrinkage mean , 1158636., .73,,,,, .299, .889

F shrinkage mean , 288384., 1.00,,,,, .161, 1.911

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
909801.,	.32,	.25,	6,	.766,	1.039

1

Age 2 Catchability dependent on age and year class strength

Year class = 1997

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	833978.,	.494,	.023,	.05,	2,	.114,	.455
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	691540.,	.341,	.063,	.18,	2,	.234,	.527
FLT05: NorBarLofAcSu,	819600.,	.287,	.028,	.10,	2,	.351,	.461
FLT06: NorSvaTrSur r,	848873.,	.529,	.010,	.02,	2,	.100,	.448

P shrinkage mean , 534862., .58,,,,, .151, .641

F shrinkage mean , 351516., 1.00,,,,, .050, .861

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
711474.,	.18,	.08,	10,	.458,	.516

Age 3 Catchability dependent on age and year class strength

Year class = 1996

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	543451.,	.268,	.083,	.31,	3,	.231,	.165
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	414650.,	.242,	.027,	.11,	3,	.267,	.212
FLT05: NorBarLofAcSu,	475496.,	.220,	.096,	.44,	3,	.307,	.187
FLT06: NorSvaTrSur r,	621631.,	.385,	.050,	.13,	3,	.104,	.146

P shrinkage mean , 341006., .56,,,,, .069, .252

F shrinkage mean , 204057., 1.00,,,,, .022, .391

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
466490.,	.13,	.06,	14,	.493,	.190

1

Age 4 Catchability dependent on age and year class strength

Year class = 1995

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	453024.,	.209,	.049,	.23,	4,	.263,	.153
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	327995.,	.202,	.009,	.05,	4,	.273,	.205
FLT05: NorBarLofAcSu,	324499.,	.207,	.172,	.83,	4,	.233,	.207

Table 2.13 (Continued)

FLT06: NorSvaTrSur r,	459385.,	.274,	.093,	.34,	4,	.159,	.151
P shrinkage mean ,	213936.,	.54,,,,,				.055,	.300
F shrinkage mean ,	209712.,	1.00,,,,,				.016,	.305

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
364331.,	.11,	.07,	18,	.626,	.187

Age 5 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	122647.,	.195,	.114,	.59,	5,	.212,	.519
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	109564.,	.173,	.065,	.38,	5,	.299,	.566
FLT05: NorBarLoFAcSu,	119746.,	.195,	.148,	.76,	5,	.200,	.529
FLT06: NorSvaTrSur r,	127858.,	.216,	.091,	.42,	5,	.203,	.502
P shrinkage mean ,	118424.,	.56,,,,,				.065,	.533
F shrinkage mean ,	154364.,	1.00,,,,,				.020,	.432

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
119286.,	.10,	.05,	22,	.475,	.530

1

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

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	25217.,	.198,	.057,	.29,	6,	.204,	.749
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	25755.,	.162,	.035,	.22,	6,	.372,	.738
FLT05: NorBarLoFAcSu,	26836.,	.201,	.101,	.50,	6,	.196,	.717
FLT06: NorSvaTrSur r,	32877.,	.209,	.110,	.52,	6,	.199,	.618
F shrinkage mean ,	31256.,	1.00,,,,,				.029,	.642

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
27292.,	.10,	.04,	25,	.408,	.708

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

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	11211.,	.225,	.036,	.16,	7,	.169,	.821
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	15786.,	.173,	.027,	.15,	7,	.421,	.644
FLT05: NorBarLoFAcSu,	14039.,	.228,	.062,	.27,	7,	.182,	.701
FLT06: NorSvaTrSur r,	16764.,	.235,	.091,	.39,	7,	.186,	.616
F shrinkage mean ,	10151.,	1.00,,,,,				.042,	.878

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
14476.,	.11,	.04,	29,	.345,	.686

Table 2.13 (Continued)

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

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	7196.,	.242,	.121,	.50,	8,	.157,	1.102
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	12440.,	.176,	.033,	.19,	8,	.414,	.771
FLT05: NorBarLofAcSu,	10861.,	.237,	.072,	.30,	8,	.179,	.846
FLT06: NorSvaTrSur r,	10649.,	.257,	.041,	.16,	8,	.190,	.858

F shrinkage mean , 8208., 1.00,,,,, .060, 1.016

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
10550.,	.12,	.05,	33,	.378,	.863

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

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	2453.,	.223,	.236,	1.06,	8,	.108,	1.454
FLT02: Norwegian tra,	5136.,	.729,	.000,	.00,	1,	.079,	.943
FLT03: Russian trawl,	1375.,	.682,	.000,	.00,	1,	.090,	1.925
FLT04: NorBarTrSur r,	3753.,	.167,	.075,	.45,	8,	.266,	1.146
FLT05: NorBarLofAcSu,	3592.,	.313,	.096,	.31,	9,	.193,	1.176
FLT06: NorSvaTrSur r,	3250.,	.247,	.117,	.48,	8,	.121,	1.246

F shrinkage mean , 4225., 1.00,,,,, .143, 1.067

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3327.,	.19,	.07,	36,	.394,	1.230

1

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	500.,	.219,	.187,	.85,	8,	.036,	1.469
FLT02: Norwegian tra,	695.,	.711,	.046,	.06,	2,	.075,	1.225
FLT03: Russian trawl,	222.,	.544,	.147,	.27,	2,	.150,	2.143
FLT04: NorBarTrSur r,	520.,	.164,	.042,	.25,	8,	.087,	1.439
FLT05: NorBarLofAcSu,	600.,	.341,	.027,	.08,	10,	.391,	1.331
FLT06: NorSvaTrSur r,	563.,	.236,	.151,	.64,	8,	.041,	1.379

F shrinkage mean , 759., 1.00,,,,, .219, 1.164

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
538.,	.27,	.07,	39,	.254,	1.412

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

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian Trawl,	96.,	.244,	.164,	.67,	8,	.016,	1.046
FLT02: Norwegian tra,	112.,	.807,	.150,	.19,	3,	.107,	.949
FLT03: Russian trawl,	35.,	.561,	.190,	.34,	2,	.066,	1.796
FLT04: NorBarTrSur r,	96.,	.181,	.108,	.60,	8,	.040,	1.047
FLT05: NorBarLofAcSu,	82.,	.373,	.098,	.26,	11,	.464,	1.153
FLT06: NorSvaTrSur r,	114.,	.261,	.206,	.79,	8,	.019,	.938

F shrinkage mean , 84., 1.00,,,,, .289, 1.134

Table 2.13 (Continued)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
82.,	.35,	.06,	41,	.160,	1.152

1

Age 12 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: Russian Trawl,	16.,	.250,	.196,	.78,	8,	.009,	1.186
FLT02: Norwegian tra,	7.,	.716,	.253,	.35,	4,	.236,	1.785
FLT03: Russian trawl,	14.,	.621,	.192,	.31,	3,	.065,	1.303
FLT04: NorBarTrSur r,	14.,	.188,	.098,	.52,	8,	.021,	1.270
FLT05: NorBarLofAcSu,	18.,	.378,	.128,	.34,	11,	.184,	1.086
FLT06: NorSvaTrSur r,	20.,	.285,	.357,	1.26,	8,	.010,	1.026
F shrinkage mean ,	21.,	1.00,,,,,				.476,	.995

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
15.,	.51,	.09,	43,	.182,	1.207

Age 13 Catchability constant w.r.t. time and dependent on age

Year class = 1986

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: Russian Trawl,	15.,	.215,	.104,	.48,	8,	.011,	1.095
FLT02: Norwegian tra,	13.,	.582,	.291,	.50,	5,	.336,	1.168
FLT03: Russian trawl,	15.,	.617,	.139,	.23,	4,	.125,	1.091
FLT04: NorBarTrSur r,	15.,	.160,	.068,	.43,	8,	.024,	1.100
FLT05: NorBarLofAcSu,	13.,	.275,	.145,	.53,	9,	.017,	1.210
FLT06: NorSvaTrSur r,	15.,	.231,	.122,	.53,	8,	.011,	1.115
F shrinkage mean ,	13.,	1.00,,,,,				.475,	1.220

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
13.,	.52,	.06,	43,	.109,	1.180

1

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 13

Year class = 1985

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: Russian Trawl,	4.,	.224,	.105,	.47,	8,	.003,	1.027
FLT02: Norwegian tra,	2.,	.644,	.128,	.20,	5,	.104,	1.373
FLT03: Russian trawl,	2.,	.731,	.106,	.14,	5,	.066,	1.527
FLT04: NorBarTrSur r,	4.,	.164,	.087,	.53,	8,	.008,	1.087
FLT05: NorBarLofAcSu,	3.,	.324,	.062,	.19,	11,	.034,	1.122
FLT06: NorSvaTrSur r,	3.,	.233,	.110,	.47,	8,	.004,	1.164
F shrinkage mean ,	3.,	1.00,,,,,				.781,	1.252

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3.,	.79,	.03,	46,	.037,	1.274

1

Table 2.14

Run title : Arctic Cod (run: XSABJA36/X36)

At 9/05/2000 18:13

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age			
YEAR,	1946,	1947,	1948,	1949,
AGE				
1,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,
3,	.0060,	.0019,	.0003,	.0023,
4,	.0199,	.0246,	.0124,	.0209,
5,	.0528,	.1095,	.0744,	.1497,
6,	.0987,	.2013,	.1989,	.3644,
7,	.1814,	.4268,	.5192,	.5105,
8,	.2012,	.2607,	.3667,	.3849,
9,	.3138,	.4297,	.5515,	.4044,
10,	.3027,	.4443,	.3950,	.4015,
11,	.3248,	.9143,	.5630,	.7328,
12,	.3226,	.5693,	.6202,	.5180,
13,	.3612,	.6037,	.5979,	.6598,
14,	.3270,	.5974,	.5500,	.5478,
+gp,	.3270,	.5974,	.5500,	.5478,
0 FBAR 5-10,	.1918,	.3120,	.3510,	.3692,

Table 8	Fishing mortality (F) at age									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
1,	.0000,	.0007,	.0000,	.0000,	.0000,	.0000,	.0001,	.0011,	.0000,	.0005,
2,	.0001,	.0012,	.0007,	.0001,	.0000,	.0007,	.0017,	.0063,	.0034,	.0029,
3,	.0020,	.0252,	.0224,	.0331,	.0197,	.0158,	.0267,	.0238,	.0712,	.0529,
4,	.0320,	.1603,	.1656,	.1320,	.1447,	.0831,	.1282,	.1119,	.2577,	.2551,
5,	.1165,	.2638,	.3690,	.2283,	.2670,	.2841,	.4536,	.2080,	.3606,	.5085,
6,	.2921,	.2792,	.5538,	.3109,	.3309,	.5309,	.6892,	.4810,	.5504,	.5094,
7,	.4070,	.4213,	.5352,	.3262,	.3947,	.5101,	.6167,	.5466,	.5269,	.5227,
8,	.3473,	.4007,	.4316,	.3498,	.2509,	.5850,	.6816,	.6360,	.4546,	.4967,
9,	.4711,	.5058,	.5720,	.4133,	.4427,	.5905,	.6499,	.5354,	.4609,	.6053,
10,	.5495,	.5101,	.7665,	.5246,	.7064,	.7918,	.7661,	.6235,	.7143,	.7103,
11,	1.0438,	.5304,	1.0193,	.7069,	.7744,	.9332,	.9536,	.9388,	.8189,	.6082,
12,	1.0030,	.6557,	1.2790,	.6073,	.7502,	.7113,	1.3990,	.9198,	.9930,	.6339,
13,	.5540,	.7159,	.8405,	.5375,	.7378,	.6918,	1.1392,	1.5206,	.4791,	.6787,
14,	.7313,	.5886,	.9051,	.5626,	.6887,	.7510,	.9927,	.9175,	.6998,	.6532,
+gp,	.7313,	.5886,	.9051,	.5626,	.6887,	.7510,	.9927,	.9175,	.6998,	.6532,
0 FBAR 5-10,	.3639,	.3968,	.5380,	.3589,	.3988,	.5487,	.6429,	.5051,	.5113,	.5588,

Run title : Arctic Cod (run: XSABJA36/X36)

At 9/05/2000 18:13

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
1,	.0005,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0069,	.0021,	.0032,	.0000,	.0008,	.0014,	.0006,	.0008,	.0000,	.0013,
3,	.0538,	.0556,	.0658,	.0310,	.0172,	.0223,	.0394,	.0296,	.0242,	.0228,
4,	.2246,	.2695,	.3040,	.2350,	.1437,	.1101,	.1028,	.1515,	.2057,	.2209,
5,	.3459,	.4910,	.6469,	.7399,	.3514,	.3883,	.2103,	.1797,	.4073,	.4798,
6,	.4590,	.5144,	.8233,	1.0064,	.4803,	.4458,	.3781,	.2007,	.4649,	.5367,
7,	.4319,	.5255,	.6057,	.9669,	.5728,	.3962,	.4655,	.4261,	.3984,	.7676,
8,	.4814,	.6849,	.6528,	.8744,	.7204,	.5204,	.5652,	.6729,	.5186,	.9268,
9,	.3868,	.7317,	.7987,	.9372,	1.0555,	.6973,	.6965,	.8392,	.7784,	1.1442,
10,	.7197,	.7765,	.9690,	1.3060,	.8360,	.7804,	.7255,	.8304,	.7309,	.9990,
11,	.9167,	.9493,	.7999,	1.3766,	1.0867,	.7376,	.4685,	.9118,	.5904,	1.1652,
12,	.6988,	1.1541,	.8511,	.8899,	.9400,	.5132,	.6208,	.9341,	.3900,	.9659,
13,	.4842,	.9413,	.9624,	.6846,	1.0840,	1.3556,	.6567,	.8836,	1.3487,	.8623,
14,	.6470,	.9205,	.8856,	1.0509,	1.0118,	.8253,	.6393,	.8893,	.7754,	1.0392,
+gp,	.6470,	.9205,	.8856,	1.0509,	1.0118,	.8253,	.6393,	.8893,	.7754,	1.0392,
0 FBAR 5-10,	.4708,	.6207,	.7494,	.9718,	.6694,	.5381,	.5069,	.5248,	.5497,	.8090,

Table 2.14 (Continued)

Table 8		Fishing mortality (F) at age									
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	
AGE											
1,	.0000,	.0000,	.0000,	.0000,	.0001,	.0000,	.0008,	.0000,	.0000,	.0000,	
2,	.0013,	.0019,	.0023,	.0140,	.0302,	.0017,	.0049,	.0157,	.0036,	.0015,	
3,	.0406,	.0212,	.0390,	.1949,	.2126,	.0829,	.1646,	.1330,	.1451,	.0485,	
4,	.1416,	.1022,	.1661,	.1981,	.4952,	.2087,	.3099,	.5651,	.2221,	.2077,	
5,	.3821,	.2277,	.2965,	.3516,	.5356,	.5202,	.4767,	.7531,	.6675,	.3457,	
6,	.5703,	.2355,	.3844,	.3903,	.5050,	.7002,	.5706,	.6803,	.8485,	.5422,	
7,	.6192,	.5174,	.3140,	.4205,	.4432,	.7012,	.6935,	.6759,	.8471,	.6596,	
8,	.8375,	.8320,	.6674,	.6424,	.4861,	.7020,	.8841,	.9059,	.9344,	.7555,	
9,	.9598,	.9326,	1.1402,	1.0097,	.4055,	.6122,	.7731,	1.2154,	1.2942,	1.0530,	
10,	.9964,	.7684,	1.2436,	.7421,	.9799,	.4724,	.4603,	.7656,	.9891,	.9511,	
11,	.7073,	.6722,	1.2207,	.5912,	1.0088,	1.2006,	.3074,	.6261,	1.8536,	1.2652,	
12,	.4561,	.5555,	.7818,	.6319,	.6318,	.8564,	1.0504,	.2401,	1.5011,	1.3535,	
13,	.7110,	.5185,	1.1510,	.4038,	1.7923,	1.4780,	.5108,	.9852,	2.4654,	.8287,	
14,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,	.7741,	1.6427,	1.1032,	
+gp,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,	.7741,	1.6427,	1.1032,	
0 FBAR 5-10,	.7276,	.5856,	.6743,	.5928,	.5592,	.6180,	.6430,	.8327,	.9302,	.7179,	

Table 8		Fishing mortality (F) at age									
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	
AGE											
1,	.0001,	.0000,	.0000,	.0000,	.2485,	.3610,	.5173,	.5235,	.7963,	.2169,	
2,	.0024,	.0012,	.0005,	.0002,	.0375,	.0575,	.8045,	.7982,	.1093,	.0020,	
3,	.0315,	.0249,	.0666,	.0206,	.0199,	.0533,	.1449,	.1135,	.0629,	.0327,	
4,	.1285,	.0993,	.2101,	.2035,	.1239,	.1706,	.2123,	.2274,	.1267,	.1283,	
5,	.3542,	.2280,	.3020,	.3275,	.3072,	.3779,	.4952,	.5101,	.3681,	.2654,	
6,	.6211,	.5137,	.5486,	.4993,	.6242,	.6043,	.7105,	.9441,	.5978,	.3979,	
7,	.6659,	.8485,	.7972,	.7776,	1.1347,	.9143,	.9453,	1.1621,	1.0684,	.7172,	
8,	.7031,	1.0497,	.9911,	1.0283,	1.2046,	1.0153,	1.0574,	1.0065,	1.0406,	.9440,	
9,	.8781,	1.2529,	1.0703,	.9871,	1.2616,	.7678,	.8209,	.7214,	1.1327,	.8204,	
10,	1.0903,	1.0270,	.7067,	.7452,	1.0014,	.5050,	1.0724,	1.2896,	1.3341,	.9238,	
11,	1.3353,	1.0958,	.6026,	.5206,	.6646,	.4589,	.8721,	.9283,	1.3811,	.3145,	
12,	.8553,	.7986,	1.2627,	.3227,	.8150,	.1971,	1.2246,	1.1806,	1.1701,	.5911,	
13,	1.6986,	1.4850,	.4618,	1.1734,	.3682,	.3734,	.2319,	.6036,	.7382,	.0401,	
14,	1.1858,	1.1455,	.8293,	.7572,	.8307,	.4386,	.9324,	1.1135,	1.1232,	.4174,	
+gp,	1.1858,	1.1455,	.8293,	.7572,	.8307,	.4386,	.9324,	1.1135,	1.1232,	.4174,	
0 FBAR 5-10,	.7188,	.8200,	.7360,	.7275,	.9223,	.6974,	.8503,	.9390,	.9236,	.6781,	

Table 8		Fishing mortality (F) at age									
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
1,	.0486,	.1024,	.4647,	2.5428,	1.7532,	1.8584,	1.9393,	2.4095,	1.4621,	1.0387,	1.6368,
2,	.0597,	.2343,	.1441,	.4421,	.6458,	.9170,	1.0362,	1.0439,	.6176,	.5157,	.7257,
3,	.0086,	.0183,	.0405,	.0794,	.2076,	.5385,	.4624,	.3336,	.4022,	.1903,	.3087,
4,	.0621,	.0624,	.1266,	.0963,	.2014,	.2963,	.3411,	.2982,	.3782,	.1866,	.2877,
5,	.1342,	.1872,	.2205,	.3468,	.3399,	.3339,	.4008,	.5444,	.5255,	.5301,	.5334,
6,	.2303,	.3209,	.4419,	.4597,	.6465,	.5760,	.5382,	.6923,	.7264,	.7081,	.7089,
7,	.2473,	.4242,	.5393,	.5644,	1.1682,	.8929,	.7492,	.8289,	.7043,	.6861,	.7398,
8,	.3757,	.3392,	.5953,	.5971,	.9788,	.9436,	.8670,	1.2325,	.9992,	.8630,	1.0315,
9,	.3406,	.3827,	.4443,	.6582,	1.0519,	.9425,	.7522,	1.3599,	1.1651,	1.2295,	1.2515,
10,	.4097,	.2960,	.4626,	.6342,	1.0093,	1.0132,	.8925,	1.5115,	1.3236,	1.4125,	1.4159,
11,	.4739,	.1813,	.3005,	.6869,	1.0402,	1.1429,	.8530,	1.2242,	1.3420,	1.1517,	1.2393,
12,	.1805,	.1632,	.5358,	.9449,	1.1591,	.8440,	.7156,	1.4204,	.7821,	1.2074,	1.1366,
13,	.6057,	.0162,	.0557,	1.0942,	.9584,	.9063,	1.1463,	1.6065,	1.4102,	1.1804,	1.3990,
14,	.2878,	.1857,	.1984,	.7189,	1.3163,	1.0944,	1.1449,	1.4754,	1.3614,	1.2745,	1.3704,
+gp,	.2878,	.1857,	.1984,	.7189,	1.3163,	1.0944,	1.1449,	1.4754,	1.3614,	1.2745,	1.3704,
0 FBAR 5-10,	.2896,	.3250,	.4507,	.5434,	.8658,	.7837,	.7000,	1.0283,	.9073,	.9049,	

Table 2.15

Run title : Arctic Cod (run: XSABJA36/X36)
 At 9/05/2000 18:13
 Terminal Fs derived using XSA (With F shrinkage)

Table 10		Stock number at age (start of year)				Numbers*10**4
YEAR,	1946,	1947,	1948,	1949,		
AGE						
1,	66341,	70273,	106144,	163378,		
2,	51752,	54316,	57535,	86903,		
3,	73615,	42370,	44470,	47104,		
4,	58252,	59909,	34625,	36396,		
5,	40607,	46753,	47855,	27998,		
6,	19514,	31536,	34306,	36371,		
7,	9221,	14475,	21113,	23022,		
8,	9319,	6297,	7734,	10284,		
9,	24555,	6239,	3972,	4388,		
10,	9572,	14689,	3324,	1874,		
11,	4023,	5790,	7712,	1833,		
12,	3837,	2380,	1900,	3596,		
13,	1991,	2275,	1103,	837,		
14,	764,	1136,	1019,	497,		
+gp,	295,	997,	1087,	562,		
0 TOTAL,	373658,	359433,	373899,	445043,		

Table 2.15 (Continued)

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10** ⁻⁴				
	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
1,	179535,	240135,	97038,	41110,	66355,	121461,	75345,	103765,	119663,	139570,
2,	133763,	146991,	196460,	79448,	33658,	54327,	99444,	61680,	84866,	97971,
3,	71150,	109508,	120199,	160739,	65039,	27556,	44450,	81282,	50183,	69247,
4,	38476,	58137,	87424,	96230,	127312,	52211,	22208,	35432,	64981,	38262,
5,	29183,	30510,	40547,	60655,	69045,	90194,	39340,	15995,	25939,	41115,
6,	19737,	21265,	19187,	22954,	39522,	43283,	55582,	20464,	10636,	14808,
7,	20684,	12066,	13169,	9029,	13772,	23242,	20839,	22843,	10357,	5022,
8,	11313,	11273,	6483,	6313,	5335,	7598,	11425,	9209,	10827,	5007,
9,	5730,	6545,	6182,	3447,	3643,	3398,	3466,	4731,	3991,	5626,
10,	2398,	2929,	3231,	2857,	1867,	1916,	1542,	1481,	2268,	2061,
11,	1027,	1133,	1440,	1229,	1384,	754,	711,	587,	650,	909,
12,	721,	296,	546,	425,	496,	522,	243,	224,	188,	235,
13,	1754,	217,	126,	124,	190,	192,	210,	49,	73,	57,
14,	354,	825,	87,	44,	60,	74,	79,	55,	9,	37,
+gp,	305,	150,	191,	40,	27,	26,	29,	31,	31,	22,
0 TOTAL,	516130,	641979,	592310,	484646,	427704,	426755,	374910,	357829,	384663,	419951,

Run title : Arctic Cod (run: XSABJA36/X36)

At 9/05/2000 18:13
Terminal Fs derived using XSA (With F shrinkage)

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10** ⁻⁴				
	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
1,	110133,	71502,	51084,	117419,	238801,	194890,	25566,	16842,	29709,	61126,
2,	114217,	90127,	58540,	41824,	96135,	195505,	159562,	20932,	13789,	24323,
3,	79977,	92866,	73636,	47774,	34242,	78647,	159838,	130560,	17124,	11290,
4,	53772,	62052,	71918,	56450,	37920,	27556,	62968,	125803,	103775,	13684,
5,	24274,	35169,	38801,	43448,	36537,	26892,	20208,	46519,	88517,	69167,
6,	20245,	14063,	17623,	16635,	16973,	21051,	14932,	13407,	31822,	48225,
7,	7285,	10474,	6884,	6334,	4978,	8596,	11036,	8377,	8981,	16367,
8,	2438,	3873,	5070,	3075,	1972,	2299,	4736,	5673,	4479,	4937,
9,	2494,	1233,	1598,	2161,	1050,	786,	1118,	2203,	2370,	2183,
10,	2515,	1387,	486,	589,	693,	299,	320,	456,	779,	891,
11,	829,	1002,	522,	151,	131,	246,	112,	127,	163,	307,
12,	405,	272,	318,	192,	31,	36,	96,	58,	42,	74,
13,	102,	165,	70,	111,	65,	10,	18,	42,	19,	23,
14,	24,	51,	53,	22,	46,	18,	2,	8,	14,	4,
+gp,	52,	20,	19,	26,	22,	35,	16,	3,	9,	8,
0 TOTAL,	418762,	384256,	326622,	336211,	469597,	556865,	460530,	371009,	301591,	252608,

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10** ⁻⁴				
	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
1,	153496,	274668,	80195,	96752,	92889,	52683,	97803,	30064,	20834,	22863,
2,	50045,	125672,	224876,	65658,	79213,	76041,	43134,	80010,	24614,	17057,
3,	19889,	40920,	102691,	183687,	53007,	62923,	62150,	35142,	64485,	20080,
4,	9034,	15636,	32801,	80861,	123765,	35087,	47420,	43162,	25189,	45664,
5,	8983,	6420,	11558,	22744,	54305,	61754,	23316,	28478,	20082,	16515,
6,	35047,	5019,	4186,	7035,	13102,	26023,	30052,	11852,	10980,	8434,
7,	23084,	16223,	3247,	2333,	3899,	6474,	10578,	13906,	4914,	3848,
8,	6219,	10175,	7918,	1942,	1255,	2049,	2629,	4329,	5792,	1725,
9,	1600,	2204,	3625,	3326,	836,	632,	832,	889,	1432,	1863,
10,	569,	502,	710,	949,	992,	456,	280,	314,	216,	321,
11,	269,	172,	190,	168,	370,	305,	233,	145,	120,	66,
12,	78,	108,	72,	46,	76,	110,	75,	140,	63,	15,
13,	23,	41,	51,	27,	20,	33,	38,	22,	90,	12,
14,	8,	9,	20,	13,	15,	3,	6,	19,	7,	6,
+gp,	7,	5,	6,	12,	11,	7,	12,	11,	7,	7,
0 TOTAL,	308353,	497774,	472147,	465554,	423755,	324581,	318558,	248483,	178826,	138477,

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10** ⁻⁴				
	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
1,	22940,	25126,	59955,	81859,	213065,	138416,	114882,	49113,	81511,	81921,
2,	18719,	18779,	20571,	49087,	67019,	136055,	78988,	56069,	23822,	30097,
3,	13945,	15289,	15356,	16834,	40181,	52852,	105164,	28929,	20664,	17485,
4,	15662,	11063,	12209,	11763,	13501,	32249,	41026,	74483,	21145,	15887,
5,	30376,	11277,	8202,	8102,	7857,	9765,	22262,	27166,	48576,	15251,
6,	9570,	17451,	7350,	4964,	4781,	4731,	5479,	11108,	13355,	27524,
7,	4015,	4210,	8548,	3477,	2467,	2097,	2117,	2204,	3538,	6014,
8,	1629,	1689,	1475,	3153,	1308,	649,	688,	673,	565,	995,
9,	663,	660,	484,	448,	923,	321,	193,	196,	202,	163,
10,	532,	226,	154,	136,	137,	214,	122,	69,	78,	53,
11,	102,	146,	66,	62,	53,	41,	106,	34,	16,	17,
12,	15,	22,	40,	30,	30,	22,	21,	36,	11,	3,
13,	3,	5,	8,	9,	18,	11,	15,	5,	9,	3,
14,	4,	0,	1,	4,	2,	10,	6,	10,	2,	4,

Table 2.15 (Continued)

	+gp,	1,	0,	1,	1,	2,	2,	3,	3,	1,	5,		
0	TOTAL,	118176,	105944,	134421,	179929,	351345,	377437,	371072,	250099,	213493,	195422,		
	Table 10	Stock number at age (start of year)											
		Numbers*10**-4											
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 46-97	AMST 46-97
AGE													
1,	144470,	173554,	306306,	2428493,	961425,	2029236,	2885450,	2122029,	767064,	313986,	0,	112185,	295177,
2,	53992,	112666,	128268,	157576,	156367,	136354,	259055,	339733,	156114,	145537,	90980,	68978,	90069,
3,	24593,	41645,	72973,	90925,	82915,	67118,	44621,	75255,	97930,	68920,	71147,	49616,	61627,
4,	13855,	19962,	33478,	57373,	68759,	55161,	32070,	23007,	44137,	53628,	46649,	37810,	46866,
5,	11440,	10661,	15354,	24151,	42661,	46024,	33580,	18668,	13980,	24756,	36433,	26449,	32323,
6,	9576,	8190,	7238,	10083,	13978,	24863,	26986,	18414,	8867,	6767,	11929,	15468,	18875,
7,	15137,	6227,	4865,	3810,	5213,	5996,	11443,	12899,	7545,	3511,	2729,	7697,	9634,
8,	2403,	9678,	3336,	2323,	1774,	1327,	2010,	4429,	4610,	3054,	1448,	3429,	4637,
9,	317,	1351,	5644,	1506,	1047,	546,	423,	692,	1057,	1390,	1055,	1490,	2618,
10,	59,	185,	755,	2963,	638,	299,	174,	163,	145,	270,	333,	612,	1398,
11,	17,	32,	112,	389,	1287,	190,	89,	58,	29,	32,	54,	250,	724,
12,	10,	9,	22,	68,	160,	372,	50,	31,	14,	6,	8,	99,	363,
13,	1,	7,	6,	10,	22,	41,	131,	20,	6,	5,	2,	41,	202,
14,	2,	1,	6,	5,	3,	7,	14,	34,	3,	1,	1,	16,	106,
+gp,	1,	1,	1,	0,	1,	0,	0,	0,	8,	5,	1,		
TOTAL,	275875,	384170,	578365,	2779675,	1336250,	2367535,	3296095,	2615434,	1101511,	621868,	262769,		

Table 2.16

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 4	Natural Mortality (M) at age			
YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,
14,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,

Table 4	Natural Mortality (M) at age									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
14,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

1

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Table 2.17

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38
 Traditional vpa using file input for terminal F

Table 8	Fishing mortality (F) at age			
YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.0061,	.0019,	.0004,	.0023,
4,	.0200,	.0248,	.0125,	.0210,
5,	.0532,	.1102,	.0749,	.1504,
6,	.0993,	.2023,	.1999,	.3651,
7,	.1825,	.4274,	.5195,	.5109,
8,	.2024,	.2622,	.3679,	.3862,
9,	.3147,	.4311,	.5528,	.4061,
10,	.3048,	.4450,	.3973,	.4043,
11,	.3259,	.9118,	.5630,	.7344,
12,	.3237,	.5694,	.6207,	.5184,
13,	.3622,	.6033,	.5977,	.6603,
14,	.3270,	.5970,	.5500,	.5480,
+gp,	.3270,	.5970,	.5500,	.5480,
0 FBAR 5-10,	.1928,	.3130,	.3521,	.3705,

Table 8	Fishing mortality (F) at age									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.0020,	.0254,	.0226,	.0334,	.0198,	.0159,	.0269,	.0240,	.0717,	.0534,
4,	.0322,	.1610,	.1663,	.1328,	.1456,	.0836,	.1290,	.1126,	.2588,	.2562,
5,	.1172,	.2649,	.3696,	.2293,	.2683,	.2855,	.4541,	.2093,	.3618,	.5090,
6,	.2932,	.2803,	.5537,	.3120,	.3322,	.5317,	.6884,	.4816,	.5511,	.5106,
7,	.4079,	.4224,	.5356,	.3276,	.3960,	.5111,	.6171,	.5471,	.5274,	.5241,
8,	.3488,	.4020,	.4333,	.3515,	.2527,	.5857,	.6813,	.6365,	.4561,	.4979,
9,	.4728,	.5075,	.5729,	.4160,	.4450,	.5923,	.6503,	.5366,	.4632,	.6068,
10,	.5515,	.5125,	.7663,	.5266,	.7096,	.7926,	.7674,	.6246,	.7143,	.7125,
11,	1.0403,	.5341,	1.0159,	.7076,	.7754,	.9373,	.9519,	.9381,	.8179,	.6097,
12,	1.0011,	.6563,	1.2718,	.6083,	.7511,	.7142,	1.3983,	.9166,	.9897,	.6349,
13,	.5544,	.7174,	.8383,	.5386,	.7379,	.6943,	1.1371,	1.5109,	.4801,	.6784,
14,	.7310,	.5890,	.9050,	.5630,	.6890,	.7510,	.9930,	.9180,	.7000,	.6530,
+gp,	.7310,	.5890,	.9050,	.5630,	.6890,	.7510,	.9930,	.9180,	.7000,	.6530,
0 FBAR 5-10,	.3652,	.3983,	.5386,	.3605,	.4006,	.5498,	.6431,	.5059,	.5123,	.5602,

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38
 Traditional vpa using file input for terminal F

Table 8	Fishing mortality (F) at age									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.0543,	.0561,	.0662,	.0312,	.0174,	.0225,	.0398,	.0298,	.0244,	.0230,
4,	.2262,	.2714,	.3055,	.2360,	.1445,	.1109,	.1036,	.1525,	.2069,	.2218,
5,	.3474,	.4932,	.6486,	.7385,	.3525,	.3894,	.2117,	.1811,	.4088,	.4809,
6,	.4602,	.5160,	.8237,	1.0025,	.4812,	.4470,	.3797,	.2024,	.4671,	.5384,
7,	.4341,	.5271,	.6079,	.9645,	.5734,	.3980,	.4673,	.4284,	.4012,	.7688,
8,	.4840,	.6873,	.6546,	.8753,	.7205,	.5218,	.5672,	.6742,	.5221,	.9271,
9,	.3890,	.7346,	.8022,	.9358,	1.0530,	.6979,	.6973,	.8395,	.7795,	1.1416,
10,	.7213,	.7772,	.9720,	1.3019,	.8351,	.7809,	.7263,	.8296,	.7333,	.9966,
11,	.9184,	.9483,	.8010,	1.3726,	1.0823,	.7375,	.4721,	.9097,	.5924,	1.1604,
12,	.7006,	1.1525,	.8511,	.8909,	.9420,	.5148,	.6223,	.9372,	.3923,	.9634,
13,	.4870,	.9410,	.9633,	.6872,	1.0812,	1.3471,	.6584,	.8824,	1.3452,	.8615,
14,	.6470,	.9210,	.8860,	1.0510,	1.0120,	.8250,	.6390,	.8890,	.7750,	1.0390,
+gp,	.6470,	.9210,	.8860,	1.0510,	1.0120,	.8250,	.6390,	.8890,	.7750,	1.0390,
0 FBAR 5-10,	.4727,	.6226,	.7515,	.9697,	.6693,	.5392,	.5082,	.5259,	.5520,	.8089,

Table 8	Fishing mortality (F) at age									
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.0409,	.0213,	.0393,	.1960,	.2137,	.0836,	.1658,	.1339,	.1460,	.0489,
4,	.1422,	.1028,	.1672,	.1995,	.4961,	.2101,	.3120,	.5660,	.2235,	.2090,
5,	.3829,	.2286,	.2977,	.3533,	.5373,	.5215,	.4784,	.7536,	.6679,	.3477,
6,	.5713,	.2368,	.3854,	.3919,	.5072,	.7015,	.5724,	.6815,	.8479,	.5443,
7,	.6214,	.5195,	.3159,	.4217,	.4455,	.7036,	.6962,	.6783,	.8468,	.6614,
8,	.8390,	.8338,	.6701,	.6437,	.4875,	.7042,	.8867,	.9088,	.9357,	.7563,
9,	.9599,	.9343,	1.1369,	1.0102,	.4089,	.6137,	.7769,	1.2138,	1.2913,	1.0535,
10,	.9938,	.7720,	1.2387,	.7436,	.9818,	.4778,	.4636,	.7738,	.9912,	.9531,
11,	.7081,	.6731,	1.2199,	.5939,	1.0065,	1.1997,	.3136,	.6315,	1.8483,	1.2629,
12,	.4587,	.5585,	.7819,	.6391,	.6365,	.8546,	1.0522,	.2469,	1.4951,	1.3561,
13,	.7109,	.5224,	1.1459,	.4069,	1.7817,	1.4679,	.5124,	.9914,	2.4481,	.8319,
14,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,	.6260,	.7740,	1.6430,	1.1030,
+gp,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,	.6260,	.7740,	1.6430,	1.1030,
0 FBAR 5-10,	.7281,	.5875,	.6741,	.5941,	.5614,	.6204,	.6457,	.8350,	.9301,	.7194,

Table 2.17 (Continued)

Table 8	Fishing mortality (F) at age									
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.0318,	.0252,	.0671,	.0208,	.0195,	.0533,	.0328,	.0554,	.0546,	.0329,
4,	.1295,	.1003,	.2115,	.2049,	.1251,	.1722,	.2134,	.2282,	.1274,	.1292,
5,	.3562,	.2298,	.3044,	.3296,	.3094,	.3805,	.4981,	.5108,	.3686,	.2665,
6,	.6232,	.5163,	.5512,	.5030,	.6266,	.6070,	.7135,	.9444,	.5981,	.3986,
7,	.6686,	.8498,	.7995,	.7804,	1.1334,	.9150,	.9459,	1.1597,	1.0656,	.7158,
8,	.7061,	1.0487,	.9910,	1.0291,	1.2012,	1.0152,	1.0553,	1.0065,	1.0376,	.9403,
9,	.8777,	1.2466,	1.0669,	.9868,	1.2559,	.7699,	.8246,	.7237,	1.1290,	.8189,
10,	1.0907,	1.0217,	.7064,	.7451,	1.0002,	.5076,	1.0708,	1.2879,	1.3205,	.9203,
11,	1.3284,	1.0970,	.6013,	.5223,	.6657,	.4628,	.8731,	.9280,	1.3708,	.3136,
12,	.8595,	.7972,	1.2606,	.3233,	.8144,	.1992,	1.2209,	1.1738,	1.1608,	.5898,
13,	1.6922,	1.4771,	.4635,	1.1699,	.3688,	.3761,	.2349,	.6073,	.7351,	.0403,
14,	1.1860,	1.1460,	.8290,	.7570,	.8310,	.4390,	.9320,	1.1140,	1.1230,	.4170,
+gp,	1.1860,	1.1460,	.8290,	.7570,	.8310,	.4390,	.9320,	1.1140,	1.1230,	.4170,
0 FBAR 5-10,	.7204,	.8188,	.7366,	.7290,	.9211,	.6992,	.8514,	.9388,	.9199,	.6767,

Table 8	Fishing mortality (F) at age										
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97-99
AGE											
3,	.0087,	.0134,	.0341,	.0129,	.0097,	.0104,	.0237,	.0222,	.0435,	.0130,	.0262,
4,	.0626,	.0631,	.1276,	.0942,	.1062,	.0991,	.1176,	.2037,	.2678,	.1730,	.2148,
5,	.1352,	.1885,	.2226,	.3465,	.3154,	.3277,	.3239,	.5357,	.4988,	.5300,	.5215,
6,	.2317,	.3226,	.4439,	.4635,	.6440,	.5787,	.5349,	.6912,	.7096,	.7080,	.7029,
7,	.2485,	.4260,	.5414,	.5672,	1.1664,	.8944,	.7532,	.8312,	.7056,	.6860,	.7410,
8,	.3769,	.3409,	.5972,	.6003,	.9786,	.9449,	.8712,	1.2327,	1.0015,	.8630,	1.0324,
9,	.3421,	.3845,	.4466,	.6613,	1.0518,	.9430,	.7580,	1.3590,	1.1678,	1.2300,	1.2522,
10,	.4117,	.2981,	.4652,	.6372,	1.0105,	1.0139,	.8948,	1.5091,	1.3218,	1.4130,	1.4146,
11,	.4747,	.1833,	.3033,	.6902,	1.0400,	1.1426,	.8579,	1.2213,	1.3404,	1.1520,	1.2379,
12,	.1802,	.1645,	.5400,	.9455,	1.1574,	.8475,	.7222,	1.4199,	.7854,	1.2070,	1.1374,
13,	.6033,	.0163,	.0563,	1.0964,	.9595,	.9085,	1.1496,	1.6036,	1.4088,	1.1800,	1.3974,
14,	.2880,	.1860,	.1980,	.7190,	1.3160,	1.0940,	1.1450,	1.4750,	1.3610,	1.2750,	1.3703,
+gp,	.2880,	.1860,	.1980,	.7190,	1.3160,	1.0940,	1.1450,	1.4750,	1.3610,	1.2750,	
0 FBAR 5-10,	.2910,	.3268,	.4528,	.5460,	.8611,	.7838,	.6893,	1.0265,	.9009,	.9050,	

Table 2.18

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Traditional vpa using file input for terminal F

Table 10	Stock number at age (start of year)				Numbers*10**-3					
YEAR,	1946,	1947,	1948,	1949,						
AGE										
3,	729759,	419945,	440690,	466659,						
4,	577378,	593856,	343181,	360680,						
5,	402340,	463337,	474296,	277476,						
6,	193326,	312345,	339774,	360304,						
7,	91289,	143315,	208895,	227780,						
8,	92234,	62274,	76524,	101732,						
9,	243263,	61677,	39226,	43365,						
10,	94499,	145389,	32812,	18477,						
11,	39824,	57041,	76281,	18056,						
12,	37987,	23537,	18764,	35568,						
13,	19708,	22500,	10905,	8259,						
14,	7582,	11233,	10077,	4911,						
+gp,	2951,	9971,	10868,	5616,						
0 TOTAL,	2532139,	2326420,	2082293,	1928882,						

Table 10	Stock number at age (start of year)					Numbers*10**-3				
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	705512,	1085887,	1190838,	1592007,	644331,	272941,	440230,	805056,	497100,	684731,
4,	381173,	576467,	866758,	953214,	1260619,	517173,	219942,	350846,	643484,	378823,
5,	289152,	302188,	401768,	600907,	683389,	892276,	389461,	158284,	256655,	406695,
6,	195448,	210551,	189840,	227305,	391157,	427856,	549073,	202487,	105123,	146333,
7,	204758,	119357,	130245,	89345,	136226,	229741,	205835,	225835,	102422,	49602,
8,	111891,	111493,	64051,	62414,	52717,	75066,	112827,	90922,	106986,	49487,
9,	56609,	64632,	61067,	33999,	35956,	33524,	34216,	46738,	39388,	55509,
10,	23654,	28887,	31856,	28193,	18363,	18865,	15181,	14620,	22376,	20292,
11,	10097,	11156,	14166,	12121,	13632,	7395,	6992,	5770,	6409,	8968,
12,	7093,	2921,	5355,	4199,	4890,	5140,	2371,	2210,	1849,	2316,
13,	17340,	2134,	1241,	1229,	1871,	1889,	2060,	480,	723,	563,
14,	3494,	8155,	853,	439,	587,	733,	773,	541,	87,	366,
+gp,	3048,	1500,	1906,	396,	269,	264,	286,	313,	305,	223,
0 TOTAL,	2009268,	2525329,	2959943,	3605769,	3244010,	2482864,	1979246,	1904102,	1782908,	1803909,

Table 2.18 (Continued)

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Traditional vpa using file input for terminal F

Table 10		Stock number at age (start of year)					Numbers*10**-3				
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	
AGE											
3,	790432,	918948,	729959,	473302,	338955,	778090,	1582377,	1292665,	169748,	111969,	
4,	531452,	612962,	711327,	559366,	375592,	272729,	622847,	1245045,	1027225,	135629,	
5,	240046,	347043,	382559,	429087,	361707,	266135,	199849,	459765,	875147,	683854,	
6,	200146,	138853,	173517,	163745,	167870,	208175,	147618,	132409,	314070,	476086,	
7,	71903,	103421,	67855,	62337,	49195,	84947,	109007,	82674,	88546,	161181,	
8,	24045,	38137,	49982,	30249,	19454,	22702,	46716,	55931,	44102,	48535,	
9,	24627,	12133,	15704,	21266,	10321,	7749,	11030,	21692,	23334,	21422,	
10,	24772,	13665,	4765,	5765,	6830,	2948,	3157,	4496,	7671,	8762,	
11,	8147,	9860,	5143,	1476,	1284,	2426,	1105,	1250,	1606,	3017,	
12,	3991,	2662,	3127,	1890,	306,	356,	950,	564,	412,	727,	
13,	1005,	1622,	689,	1093,	635,	98,	174,	417,	181,	228,	
14,	234,	506,	518,	215,	450,	176,	21,	74,	141,	39,	
+gp,	518,	195,	191,	262,	223,	347,	162,	26,	93,	77,	
0	TOTAL,	1921318,	2200005,	2145336,	1750051,	1332822,	1646877,	2725012,	3297008,	2552277,	1651525,

Table 10		Stock number at age (start of year)					Numbers*10**-3				
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	
AGE											
3,	197050,	404979,	1015588,	1818301,	524848,	621888,	614692,	347896,	638508,	198602,	
4,	89589,	154864,	324567,	799413,	1223748,	347028,	468311,	426392,	249147,	451736,	
5,	88953,	63623,	114402,	224808,	536116,	610053,	230294,	280667,	198208,	163125,	
6,	346146,	49659,	41444,	69546,	129276,	256488,	296491,	116858,	108151,	83213,	
7,	227518,	160064,	32085,	23080,	38479,	63735,	104120,	136945,	48400,	37925,	
8,	61173,	100065,	77949,	19154,	12395,	20179,	25821,	42495,	56897,	16992,	
9,	15724,	21644,	35588,	32653,	8238,	6232,	8170,	8710,	14021,	18274,	
10,	5600,	4930,	6962,	9348,	9735,	4481,	2762,	3076,	2118,	3156,	
11,	2648,	1697,	1865,	1652,	3638,	2986,	2275,	1423,	1162,	644,	
12,	774,	1068,	709,	451,	747,	1089,	737,	1361,	619,	150,	
13,	227,	401,	500,	266,	195,	323,	379,	211,	871,	114,	
14,	79,	91,	194,	130,	145,	27,	61,	186,	64,	62,	
+gp,	71,	54,	64,	121,	108,	66,	124,	109,	68,	73,	
0	TOTAL,	1035551,	963139,	1651918,	2998922,	2487668,	1934577,	1754236,	1366327,	1318233,	974066,

Table 10		Stock number at age (start of year)					Numbers*10**-3				
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	
AGE											
3,	137776,	151224,	151915,	166279,	396759,	523460,	1043035,	286792,	204690,	173017,	
4,	154839,	109270,	120735,	116303,	133331,	318377,	406173,	738670,	209561,	157305,	
5,	300099,	111370,	80926,	80007,	77581,	96326,	219438,	268644,	481388,	151045,	
6,	94328,	172076,	72462,	48870,	47111,	46616,	53905,	109177,	131977,	272609,	
7,	39533,	41411,	84070,	34188,	24194,	20613,	20800,	21622,	34765,	59414,	
8,	16026,	16585,	14495,	30944,	12826,	6377,	6759,	6613,	5551,	9806,	
9,	6530,	6476,	4758,	4405,	9052,	3159,	1892,	1926,	1979,	1610,	
10,	5217,	2223,	1524,	1340,	1344,	2111,	1198,	679,	765,	524,	
11,	996,	1435,	655,	616,	521,	405,	1040,	336,	153,	167,	
12,	149,	216,	392,	294,	299,	219,	209,	356,	109,	32,	
13,	32,	52,	80,	91,	174,	108,	147,	50,	90,	28,	
14,	41,	5,	10,	41,	23,	99,	61,	95,	22,	35,	
+gp,	12,	2,	10,	10,	15,	25,	25,	32,	8,	51,	
0	TOTAL,	755577,	612344,	532032,	483388,	703232,	1017895,	1754683,	1434993,	1071059,	825645,

Table 2.18 (Continued)

Table 10		Stock number at age (start of year)					Numbers*10**3						
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,		
GMST 46-97	AMST 46-97												
AGE													
3,	242745,	411664,	721296,	898695,	819535,	663331,	441321,	745241,	975840,	697957,	0,	491117,	610063,
4,	137064,	197017,	330890,	566902,	679577,	545135,	316958,	227546,	437072,	534486,	472510,	374150,	463812,
5,	113185,	105404,	151438,	238445,	421163,	454562,	331691,	184410,	138122,	245029,	363219,	261503,	319631,
6,	94738,	80952,	71469,	99242,	137694,	244969,	266002,	181613,	87505,	66786,	118081,	152740,	186471,
7,	149827,	61523,	48000,	37538,	51112,	58922,	112430,	126807,	74358,	34663,	26937,	75907,	95093,
8,	23777,	95674,	32899,	22870,	17430,	13035,	19723,	43344,	45215,	30063,	14292,	33790,	45737,
9,	3135,	13354,	55702,	14823,	10273,	5363,	4148,	6757,	10345,	13598,	10384,	14671,	25828,
10,	581,	1823,	7443,	29177,	6265,	2938,	1710,	1592,	1421,	2635,	3254,	6024,	13787,
11,	171,	315,	1108,	3827,	12631,	1867,	873,	572,	288,	310,	525,	2455,	7133,
12,	100,	87,	215,	670,	1571,	3655,	488,	303,	138,	62,	80,	972,	3582,
13,	14,	68,	60,	103,	213,	404,	1282,	194,	60,	52,	15,	401,	1995,
14,	22,	6,	55,	47,	28,	67,	133,	333,	32,	12,	13,	157,	1045,
+gp,	9,	13,	6,	2,	6,	2,	2,	1,	77,	45,	13,		
0	TOTAL,	765368,	967900,	1420582,	1912341,	2157498,	1994250,	1496761,	1518712,	1770473,	1625697,	1009323,	

Table 2.19

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Traditional vpa using file input for terminal F

Table 14		Stock biomass at age with SOP (start of year)				Tonnes
YEAR,	1946,	1947,	1948,	1949,		
AGE						
3,	319484,	155796,	176218,	206222,		
4,	388881,	338946,	211119,	245213,		
5,	420031,	409900,	452256,	292401,		
6,	305996,	418940,	491203,	575651,		
7,	212127,	282203,	443355,	534265,		
8,	291975,	167054,	221258,	325070,		
9,	1010922,	217200,	148890,	181907,		
10,	490091,	638956,	155427,	96725,		
11,	248106,	301148,	434074,	113551,		
12,	277601,	145755,	125243,	262369,		
13,	165923,	160524,	83856,	70184,		
14,	70979,	89115,	86166,	46410,		
+gp,	29811,	85369,	100283,	57272,		
0	TOTALBIO,	4231927,	3410905,	3129347,	3007242,	

Table 14		Stock biomass at age with SOP (start of year)						Tonnes			
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	
AGE											
3,	356818,	622063,	580483,	868813,	326239,	144950,	241749,	436726,	285346,	381075,	
4,	296587,	508055,	650013,	800311,	981969,	422544,	185815,	292810,	568267,	324350,	
5,	348728,	412806,	467016,	782001,	825113,	1129969,	509997,	204757,	351314,	539731,	
6,	357378,	436076,	334564,	448482,	716033,	821488,	1090111,	397132,	218163,	294433,	
7,	549654,	362914,	336980,	258795,	366094,	647580,	599943,	650250,	312051,	146520,	
8,	409188,	461829,	225761,	246292,	193003,	288253,	448006,	356647,	444057,	199144,	
9,	271768,	351454,	282562,	176126,	172812,	168998,	178355,	240672,	214619,	293243,	
10,	141720,	196032,	183954,	182264,	110144,	118685,	98753,	93950,	152155,	133780,	
11,	72674,	90949,	98267,	94131,	98226,	55885,	54641,	44543,	52356,	71026,	
12,	59878,	27933,	43569,	38256,	41332,	45565,	21737,	20009,	17715,	21516,	
13,	168648,	23508,	11630,	12898,	18222,	19295,	21757,	5003,	7986,	6021,	
14,	37788,	99898,	8888,	5126,	6357,	8320,	9072,	6276,	1064,	4362,	
+gp,	35576,	19828,	21441,	4989,	3149,	3237,	3628,	3919,	4047,	2865,	
0	TOTALBIO,	3106404,	3613344,	3245128,	3918483,	3858692,	3874768,	3463564,	2752695,	2629141,	2418065,

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Traditional vpa using file input for terminal F

Table 14		Stock biomass at age with SOP (start of year)					Tonnes				
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	
AGE											
3,	453124,	541705,	435351,	240863,	180308,	453419,	968383,	738326,	105490,	63634,	
4,	468709,	555894,	652676,	437940,	307381,	244505,	586415,	1094041,	982109,	118587,	
5,	328145,	487836,	544074,	520710,	458827,	369820,	291647,	626205,	1296900,	926783,	
6,	414814,	295925,	374144,	301268,	322850,	438584,	326611,	273421,	705648,	978219,	
7,	218779,	323583,	214797,	168376,	138900,	262739,	354078,	250631,	292065,	486201,	
8,	99670,	162555,	215547,	111306,	74827,	95656,	206720,	230991,	198178,	199451,	
9,	134012,	67891,	88905,	102726,	52116,	42861,	64072,	117605,	137648,	115564,	
10,	168225,	95425,	33668,	34751,	43038,	20352,	22886,	30424,	56473,	58988,	
11,	66464,	82711,	43650,	10690,	9719,	20116,	9627,	10162,	14203,	24397,	
12,	38187,	26198,	31131,	16055,	2720,	3464,	9704,	5382,	4275,	6898,	
13,	11079,	18382,	7897,	10697,	6495,	1096,	2051,	4585,	2164,	2491,	
14,	2865,	6374,	6608,	2341,	5121,	2197,	272,	902,	1879,	469,	
+gp,	6851,	2653,	2623,	3075,	2742,	4664,	2286,	341,	1333,	1013,	
0	TOTALBIO,	2410924,	2667130,	2651070,	1960798,	1605043,	1959472,	2844752,	3383015,	3798365,	2982695,

Table 2.19 (Continued)

Table 14		Stock biomass at age with SOP (start of year)						Tonnes			
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	
AGE											
3,	124673,	294342,	712129,	1350916,	350383,	364085,	408968,	224513,	416583,	138301,	
4,	87204,	173164,	350133,	913736,	1256863,	312566,	479350,	423337,	250079,	483965,	
5,	134206,	110269,	191291,	398284,	853467,	851681,	365369,	431916,	308372,	270883,	
6,	791785,	130487,	105064,	186806,	312020,	542892,	713177,	272649,	255106,	209503,	
7,	764038,	617475,	119411,	91015,	136346,	198050,	367680,	469075,	167605,	140176,	
8,	279857,	525879,	395218,	102896,	59832,	85423,	124218,	198294,	268415,	85561,	
9,	94433,	149321,	236875,	230278,	52205,	34634,	51595,	53354,	86832,	120797,	
10,	41973,	42443,	57829,	82270,	76990,	31078,	21771,	23513,	16372,	26032,	
11,	23841,	17554,	18610,	17463,	34567,	24878,	21541,	13064,	10785,	6379,	
12,	8173,	12956,	8296,	5591,	8321,	10640,	8181,	14664,	6745,	1741,	
13,	2764,	5598,	6745,	3794,	2501,	3642,	4852,	2613,	10925,	1523,	
14,	1067,	1420,	2916,	2069,	2066,	336,	868,	2567,	893,	918,	
+gp,	1033,	912,	1040,	2081,	1665,	895,	1910,	1626,	1023,	1173,	
0	TOTALBIO,	2355046,	2081820,	2205560,	3387197,	3147225,	2460801,	2569480,	2131187,	1799735,	1486952,

Table 14		Stock biomass at age with SOP (start of year)						Tonnes			
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	
AGE											
3,	87150,	108614,	106319,	55381,	158404,	220131,	329566,	56005,	43399,	51106,	
4,	150681,	120741,	129996,	96112,	146040,	283660,	363143,	382143,	84672,	80808,	
5,	452663,	190745,	135057,	114396,	132872,	157226,	327728,	351295,	380338,	129519,	
6,	215717,	446829,	183348,	106849,	124781,	133381,	135108,	216551,	251179,	397768,	
7,	132725,	157864,	312290,	116958,	86660,	85195,	82734,	72509,	103508,	157653,	
8,	73297,	86132,	73350,	131819,	55537,	37875,	39899,	34963,	24383,	44833,	
9,	39209,	44149,	31607,	24335,	52968,	24721,	12646,	12847,	15461,	11211,	
10,	39093,	18912,	12636,	9240,	9817,	21746,	8315,	6456,	9264,	5165,	
11,	8967,	14668,	6525,	5099,	4569,	5891,	11630,	4519,	2010,	1528,	
12,	1574,	2590,	4583,	2856,	3077,	2421,	2300,	3946,	1180,	342,	
13,	384,	714,	1073,	1019,	2065,	1380,	1867,	644,	1126,	345,	
14,	548,	73,	145,	511,	305,	1396,	861,	1352,	313,	485,	
+gp,	182,	26,	156,	138,	219,	377,	382,	495,	120,	762,	
0	TOTALBIO,	1202192,	1192058,	997084,	664713,	777315,	975399,	1316179,	1143725,	916954,	881525,

Table 14		Stock biomass at age with SOP (start of year)						Tonnes			
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	
AGE											
3,	97654,	203032,	325946,	313080,	186058,	133735,	87320,	150596,	213274,	140951,	
4,	97671,	213095,	316382,	672852,	516334,	265195,	156624,	118597,	234628,	276493,	
5,	135226,	174923,	281820,	439485,	603443,	519776,	326798,	199055,	161508,	286174,	
6,	164610,	187140,	199355,	283721,	335251,	520421,	554385,	341200,	170887,	134940,	
7,	372244,	188268,	192012,	153239,	197267,	205081,	402359,	427375,	220553,	104624,	
8,	85679,	413379,	174884,	127313,	95251,	64562,	110126,	228205,	208293,	133504,	
9,	14925,	87475,	387519,	101552,	68733,	38518,	32694,	60341,	77341,	87684,	
10,	4583,	18606,	73371,	253251,	48230,	26872,	17628,	19353,	14840,	26915,	
11,	1547,	2835,	14140,	35850,	103387,	18917,	9447,	6238,	3406,	3359,	
12,	1097,	899,	2395,	7359,	17202,	39782,	5368,	3288,	1510,	667,	
13,	183,	814,	776,	1298,	2687,	5069,	16264,	2425,	755,	641,	
14,	308,	86,	787,	659,	393,	932,	1882,	4624,	447,	166,	
+gp,	133,	185,	94,	32,	89,	25,	24,	21,	1162,	672,	
0	TOTALBIO,	975861,	1490736,	1969481,	2389691,	2174326,	1838884,	1720920,	1561319,	1308606,	1196789,

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Table 2.20

Run title : Arctic Cod (run: SVPBJA06/V06)
 At 9/05/2000 18:38

Traditional vpa using file input for terminal F

Table 15		Spawning stock biomass with SOP (spawning time)				Tonnes
YEAR,	1946,	1947,	1948,	1949,		
AGE						
3,	0,	0,	0,	0,		
4,	0,	0,	0,	0,		
5,	0,	0,	0,	0,		
6,	0,	0,	0,	0,		
7,	0,	0,	0,	0,		
8,	291975,	167054,	221258,	325070,		
9,	1010922,	217200,	148890,	181907,		
10,	490091,	638956,	155427,	96725,		
11,	248106,	301148,	434074,	113551,		
12,	277601,	145755,	125243,	262369,		
13,	165923,	160524,	83856,	70184,		
14,	70979,	89115,	86166,	46410,		
+gp,	29811,	85369,	100283,	57272,		
0 TOTSPBIO,	2585409,	1805121,	1355197,	1153489,		

Table 15		Spawning stock biomass with SOP (spawning time)						Tonnes		
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	409188,	461829,	225761,	246292,	193003,	288253,	448006,	356647,	444057,	199144,
9,	271768,	351454,	282562,	176126,	172812,	168998,	178355,	240672,	214619,	293243,
10,	141720,	196032,	183954,	182264,	110144,	118685,	98753,	93950,	152155,	133780,
11,	72674,	90949,	98267,	94131,	98226,	55885,	54641,	44543,	52356,	71026,
12,	59878,	27933,	43569,	38256,	41332,	45565,	21737,	20009,	17715,	21516,
13,	168648,	23508,	11630,	12898,	18222,	19295,	21757,	5003,	7986,	6021,
14,	37788,	99898,	8888,	5126,	6357,	8320,	9072,	6276,	1064,	4362,
+gp,	35576,	19828,	21441,	4989,	3149,	3237,	3628,	3919,	4047,	2865,
0 TOTSPBIO,	1197239,	1271431,	876072,	760081,	643244,	708237,	835948,	771019,	894000,	731957,

Run title : Arctic Cod (run: SVPBJA06/V06)

At 9/05/2000 18:38

Traditional vpa using file input for terminal F

Table 15		Spawning stock biomass with SOP (spawning time)						Tonnes		
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	99670,	162555,	215547,	111306,	74827,	95656,	206720,	230991,	198178,	199451,
9,	134012,	67891,	88905,	102726,	52116,	42861,	64072,	117605,	137648,	115564,
10,	168225,	95425,	33668,	34751,	43038,	20352,	22886,	30424,	56473,	58988,
11,	66464,	82711,	43650,	10690,	9719,	20116,	9627,	10162,	14203,	24397,
12,	38187,	26198,	31131,	16055,	2720,	3464,	9704,	5382,	4275,	6898,
13,	11079,	18382,	7897,	10697,	6495,	1096,	2051,	4585,	2164,	2491,
14,	2865,	6374,	6608,	2341,	5121,	2197,	272,	902,	1879,	469,
+gp,	6851,	2653,	2623,	3075,	2742,	4664,	2286,	341,	1333,	1013,
0 TOTSPBIO,	527354,	462188,	430028,	291642,	196777,	190406,	317618,	400391,	416152,	409271,

Table 15		Spawning stock biomass with SOP (spawning time)						Tonnes		
YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	279857,	525879,	395218,	102896,	59832,	85423,	124218,	198294,	268415,	85561,
9,	94433,	149321,	236875,	230278,	52205,	34634,	51595,	53354,	86832,	120797,
10,	41973,	42443,	57829,	82270,	76990,	31078,	21771,	23513,	16372,	26032,
11,	23841,	17554,	18610,	17463,	34567,	24878,	21541,	13064,	10785,	6379,
12,	8173,	12956,	8296,	5591,	8321,	10640,	8181,	14664,	6745,	1741,
13,	2764,	5598,	6745,	3794,	2501,	3642,	4852,	2613,	10925,	1523,
14,	1067,	1420,	2916,	2069,	2066,	336,	868,	2567,	893,	918,
+gp,	1033,	912,	1040,	2081,	1665,	895,	1910,	1626,	1023,	1173,
0 TOTSPBIO,	453141,	756084,	727531,	446441,	238146,	191526,	234936,	309696,	401990,	244124,

Table 2.20 (Continued)

Table 15		Spawning stock biomass with SOP (spawning time)						Tonnes			
YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	
AGE											
3,	0,	0,	0,	554,	0,	0,	0,	0,	0,	0,	
4,	0,	0,	6500,	7689,	7302,	2837,	18157,	3821,	1693,	0,	
5,	0,	0,	13506,	11440,	23917,	14150,	26218,	24591,	19017,	6476,	
6,	0,	0,	62338,	32055,	38682,	48017,	25670,	38979,	82889,	71598,	
7,	0,	0,	202989,	85379,	48530,	46857,	43849,	15952,	54859,	64638,	
8,	73297,	86132,	60147,	116000,	49984,	32194,	28328,	16083,	15117,	30935,	
9,	39209,	44149,	29078,	23605,	52438,	23732,	7841,	6423,	15461,	9530,	
10,	39093,	18912,	12636,	9240,	9817,	19571,	7483,	4842,	9264,	5165,	
11,	8967,	14668,	6525,	5099,	4569,	5891,	11630,	4519,	2010,	1528,	
12,	1574,	2590,	4583,	2856,	3077,	2421,	2300,	3946,	1180,	342,	
13,	384,	714,	1073,	1019,	2065,	1380,	1867,	644,	1126,	345,	
14,	548,	73,	145,	511,	305,	1396,	861,	1352,	313,	485,	
+gp,	182,	26,	156,	138,	219,	377,	382,	495,	120,	762,	
0	TOTSPBIO,	163255,	167265,	399675,	295585,	240905,	198823,	174588,	121648,	203050,	191803,

Table 15		Spawning stock biomass with SOP (spawning time)						Tonnes			
YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	
AGE											
3,	0,	0,	3259,	0,	0,	0,	0,	0,	0,	0,	
4,	977,	8524,	3164,	20186,	5163,	0,	0,	0,	2346,	0,	
5,	6761,	10495,	33818,	39554,	66379,	36384,	6536,	3981,	6460,	2862,	
6,	34568,	52399,	85723,	85116,	110633,	171739,	144140,	47768,	32469,	13494,	
7,	215902,	122374,	144009,	93476,	118360,	127150,	253486,	239330,	97043,	47081,	
8,	65973,	343105,	162642,	115855,	77154,	47776,	91405,	187128,	170800,	105468,	
9,	12836,	84850,	375893,	98506,	66671,	36592,	32040,	57324,	71928,	77162,	
10,	4492,	18606,	73371,	250719,	47748,	26335,	17628,	18385,	14544,	26915,	
11,	1547,	2835,	14140,	35850,	102354,	18917,	9447,	5927,	3406,	3359,	
12,	1097,	899,	2395,	7359,	17202,	39782,	5368,	3288,	1510,	667,	
13,	183,	814,	776,	1298,	2687,	5069,	16264,	2425,	755,	641,	
14,	308,	86,	787,	659,	393,	932,	1882,	4624,	447,	166,	
+gp,	133,	185,	94,	32,	89,	25,	24,	21,	1162,	672,	
0	TOTSPBIO,	344776,	645172,	900071,	748609,	614833,	510700,	578220,	570201,	402870,	278486,

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Table 2.21

Run title : Arctic Cod (run: SVPBJA06/V06)
 At 9/05/2000 18:38

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR	5-10,
1946,	729759,	4231927,	2585409,	706000,	.2731,	.6735,		.1928,
1947,	419945,	3410905,	1805121,	882017,	.4886,	.5708,		.3130,
1948,	440690,	3129347,	1355197,	774295,	.5714,	.6152,		.3521,
1949,	466659,	3007242,	1153489,	800122,	.6937,	.6799,		.3705,
1950,	705512,	3106404,	1197239,	731982,	.6114,	.7781,		.3652,
1951,	1085887,	3613344,	1271431,	827180,	.6506,	.8813,		.3983,
1952,	1190838,	3245128,	876072,	876795,	1.0008,	.7499,		.5386,
1953,	1592007,	3918483,	760081,	695546,	.9151,	.8396,		.3605,
1954,	644331,	3858692,	643244,	826021,	1.2841,	.7790,		.4006,
1955,	272941,	3874768,	708237,	1147841,	1.6207,	.8170,		.5498,
1956,	440230,	3463564,	835948,	1343068,	1.6066,	.8448,		.6431,
1957,	805056,	2752695,	771019,	792557,	1.0279,	.8346,		.5059,
1958,	497100,	2629141,	894000,	769313,	.8605,	.8831,		.5123,
1959,	684731,	2418065,	731957,	744607,	1.0173,	.8562,		.5602,
1960,	790432,	2410924,	527354,	622042,	1.1796,	.8819,		.4727,
1961,	918948,	2667130,	462188,	783221,	1.6946,	.9069,		.6226,
1962,	729959,	2651070,	430028,	909266,	2.1144,	.9175,		.7515,
1963,	473302,	1960798,	291642,	776337,	2.6620,	.7829,		.9697,
1964,	338955,	1605043,	196777,	437695,	2.2243,	.8184,		.6693,
1965,	778090,	1959472,	190406,	444930,	2.3367,	.8965,		.5392,
1966,	1582377,	2844752,	317618,	483711,	1.5229,	.9415,		.5082,
1967,	1292665,	3383015,	400391,	572605,	1.4301,	.8787,		.5259,
1968,	169748,	3798365,	416152,	1074084,	2.5810,	.9561,		.5520,
1969,	111969,	2982695,	409271,	1197226,	2.9253,	.8743,		.8089,
1970,	197050,	2355046,	453141,	933246,	2.0595,	.9734,		.7281,
1971,	404979,	2081820,	756084,	689048,	.9113,	1.1182,		.5875,
1972,	1015588,	2205560,	727531,	565254,	.7769,	1.0788,		.6741,
1973,	1818301,	3387197,	446441,	792685,	1.7756,	1.1430,		.5941,
1974,	524848,	3147225,	238146,	1102433,	4.6292,	1.0271,		.5614,
1975,	621888,	2460801,	191526,	829377,	4.3304,	.9007,		.6204,
1976,	614692,	2569480,	234936,	867463,	3.6923,	1.0236,		.6457,
1977,	347896,	2131187,	309696,	905301,	2.9232,	.9928,		.8350,
1978,	638508,	1799735,	401990,	698715,	1.7381,	1.0037,		.9301,
1979,	198602,	1486952,	244124,	440538,	1.8046,	1.0713,		.7194,
1980,	137776,	1202192,	163255,	380434,	2.3303,	.9731,		.7204,
1981,	151224,	1192058,	167265,	399038,	2.3857,	1.1050,		.8188,
1982,	151915,	997084,	399675,	363730,	.9101,	1.0767,		.7366,
1983,	166279,	664713,	295585,	289992,	.9811,	.8953,		.7290,
1984,	396759,	777315,	240905,	277651,	1.1525,	.9483,		.9211,
1985,	523460,	975399,	198823,	307920,	1.5487,	1.0182,		.6992,
1986,	1043035,	1316179,	174588,	430113,	2.4636,	1.0160,		.8514,
1987,	286792,	1143725,	121648,	523071,	4.2999,	1.0224,		.9388,
1988,	204690,	916954,	203050,	434939,	2.1420,	1.0001,		.9199,
1989,	173017,	881525,	191803,	332481,	1.7335,	.9879,		.6767,
1990,	242745,	975861,	344776,	212000,	.6149,	1.0108,		.2910,
1991,	411664,	1490736,	645172,	319158,	.4947,	.9521,		.3268,
1992,	721296,	1969481,	900071,	513234,	.5702,	1.0270,		.4528,
1993,	898695,	2389691,	748609,	581611,	.7769,	1.0127,		.5460,
1994,	819535,	2174326,	614833,	771086,	1.2541,	1.0090,		.8611,
1995,	663331,	1838884,	510700,	739999,	1.4490,	1.0030,		.7838,
1996,	441321,	1720920,	578220,	732228,	1.2663,	1.0147,		.6893,
1997,	745241,	1561319,	570201,	762403,	1.3371,	1.0004,		1.0265,
1998,	975840,	1308606,	402870,	592624,	1.4710,	1.0072,		.9009,
1999,	697957,	1196789,	278486,	483613,	1.7366,	.9948,		.9050,
Arith.								
Mean	618464,	2282254,	573785,	675738,	1.6454			.6328,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),				
1								

Table 2.22

North-East Arctic cod (Sub-areas I and II)

Prediction with management option table: Input data

Year: 1999								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	697957.00	0.3771	0.0000	0.0000	0.0000	0.203	0.0130	0.630
4	534486.00	0.2133	0.0000	0.0000	0.0000	0.520	0.1730	1.020
5	245029.00	0.2000	0.0100	0.0000	0.0000	1.174	0.5300	1.540
6	66786.000	0.2000	0.1000	0.0000	0.0000	2.031	0.7080	2.340
7	34663.000	0.2000	0.4500	0.0000	0.0000	3.034	0.6860	3.210
8	30063.000	0.2000	0.7900	0.0000	0.0000	4.464	0.8630	4.290
9	13598.000	0.2000	0.8800	0.0000	0.0000	6.482	1.2300	6.000
10	2635.000	0.2000	1.0000	0.0000	0.0000	10.269	1.4130	6.730
11	310.000	0.2000	1.0000	0.0000	0.0000	10.882	1.1520	10.080
12	62.000	0.2000	1.0000	0.0000	0.0000	10.850	1.2070	13.870
13	52.000	0.2000	1.0000	0.0000	0.0000	12.500	1.1800	12.430
14	12.000	0.2000	1.0000	0.0000	0.0000	13.900	1.2750	9.200
15+	45.000	0.2000	1.0000	0.0000	0.0000	15.000	1.2750	17.200
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms
Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	711470.00	0.3328	0.0000	0.0000	0.0000	0.194	0.0262	0.660
4	.	0.2000	0.0000	0.0000	0.0000	0.465	0.2148	1.037
5	.	0.2000	0.0700	0.0000	0.0000	1.205	0.5215	1.563
6	.	0.2000	0.2000	0.0000	0.0000	1.980	0.7029	2.287
7	.	0.2000	0.5400	0.0000	0.0000	3.123	0.7410	3.310
8	.	0.2000	0.8500	0.0000	0.0000	4.163	1.0324	4.783
9	.	0.2000	0.9500	0.0000	0.0000	5.474	1.2522	6.687
10	.	0.2000	1.0000	0.0000	0.0000	8.342	1.4146	7.920
11	.	0.2000	1.0000	0.0000	0.0000	9.812	1.2379	9.663
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.1374	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	1.3974	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	1.3703	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	1.3703	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms
Year: 2001								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	473913.00	0.3328	0.0000	0.0000	0.0000	0.205	0.0262	0.660
4	.	0.2000	0.0000	0.0000	0.0000	0.506	0.2148	1.037
5	.	0.2000	0.0400	0.0000	0.0000	1.180	0.5215	1.563
6	.	0.2000	0.1600	0.0000	0.0000	1.983	0.7029	2.287
7	.	0.2000	0.4800	0.0000	0.0000	3.034	0.7410	3.310
8	.	0.2000	0.8200	0.0000	0.0000	4.400	1.0324	4.783
9	.	0.2000	0.9200	0.0000	0.0000	6.460	1.2522	6.687
10	.	0.2000	0.9900	0.0000	0.0000	9.668	1.4146	7.920
11	.	0.2000	1.0000	0.0000	0.0000	10.810	1.2379	9.663
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.1374	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	1.3974	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	1.3703	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	1.3703	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANBJA05
Date and time: 11MAY00:13:37

Table 2.23

Thursday, May 11, 2000

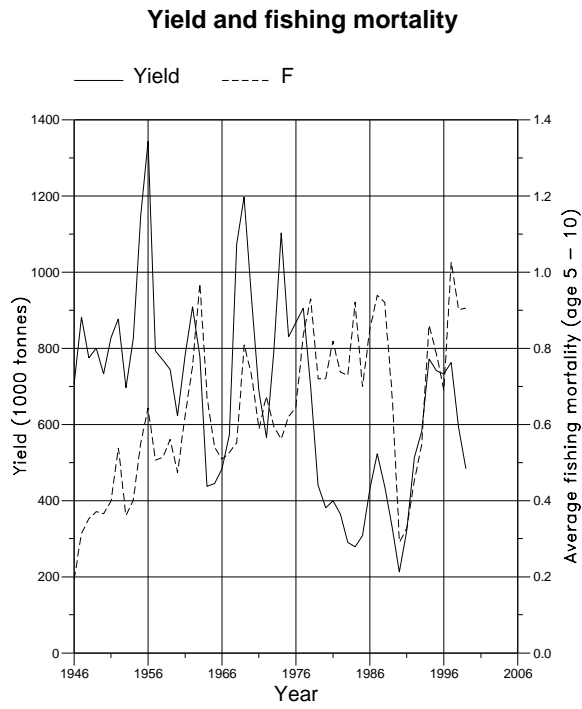
North-East Arctic cod (Sub-areas I and II)

Prediction with management option table

Year: 1999					Year: 2000					Year: 2001	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.9928	0.8985	1203032	279947	483613	0.0000	0.0000	1266249	262467	0	1987932	520888
.	0.0500	0.0472	.	262467	38931	1942618	499641
.	0.1000	0.0944	.	262467	76589	1898883	479369
.	0.1500	0.1416	.	262467	113027	1856659	460022
.	0.2000	0.1888	.	262467	148292	1815884	441555
.	0.2500	0.2360	.	262467	182434	1776497	423922
.	0.3000	0.2832	.	262467	215495	1738442	407084
.	0.3500	0.3304	.	262467	247518	1701665	391000
.	0.4000	0.3776	.	262467	278545	1666113	375633
.	0.4500	0.4248	.	262467	308614	1631737	360948
.	0.5000	0.4721	.	262467	337761	1598489	346912
.	0.5500	0.5193	.	262467	366024	1566325	333493
.	0.6000	0.5665	.	262467	393434	1535203	320661
.	0.6500	0.6137	.	262467	420025	1505080	308387
.	0.7000	0.6609	.	262467	445827	1475917	296645
.	0.7500	0.7081	.	262467	470871	1447679	285410
.	0.8000	0.7553	.	262467	495183	1420328	274656
.	0.8500	0.8025	.	262467	518791	1393831	264362
.	0.9000	0.8497	.	262467	541721	1368155	254505
.	0.9500	0.8969	.	262467	563998	1343270	245065
.	1.0000	0.9441	.	262467	585645	1319144	236023
.	1.0500	0.9913	.	262467	606684	1295751	227359
.	1.1000	1.0385	.	262467	627138	1273063	219056
.	1.1500	1.0857	.	262467	647027	1251053	211098
.	1.2000	1.1329	.	262467	666371	1229697	203468
.	1.2500	1.1801	.	262467	685190	1208971	196152
.	1.3000	1.2273	.	262467	703501	1188853	189135
.	1.3500	1.2745	.	262467	721321	1169320	182403
.	1.4000	1.3217	.	262467	738669	1150351	175944
.	1.4500	1.3689	.	262467	755559	1131926	169746
.	1.5000	1.4162	.	262467	772008	1114027	163796
.	1.5500	1.4634	.	262467	788030	1096634	158083
.	1.6000	1.5106	.	262467	803639	1079730	152598
.	1.6500	1.5578	.	262467	818850	1063298	147330
.	1.7000	1.6050	.	262467	833675	1047321	142269
.	1.7500	1.6522	.	262467	848127	1031785	137406
.	1.8000	1.6994	.	262467	862218	1016674	132733
.	1.8500	1.7466	.	262467	875960	1001973	128241
.	1.9000	1.7938	.	262467	889364	987669	123923
.	1.9500	1.8410	.	262467	902441	973749	119771
.	2.0000	1.8882	.	262467	915201	960199	115777
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANBJA05
 Date and time : 11MAY00:13:37
 Computation of ref. F: Simple mean, age 5 - 10
 Basis for 1999 : TAC constraints

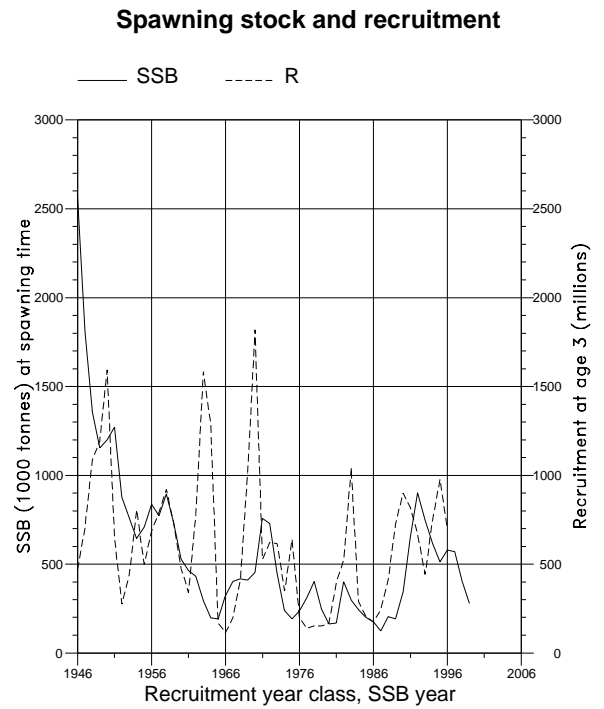
Figure 2.1 a



(run: SVPHS07)

A

Figure 2.1.b



(run: SVPHS07)

B

Figure 2.2. Northeast cod, M2 from cannibalism vs. capelin stock size

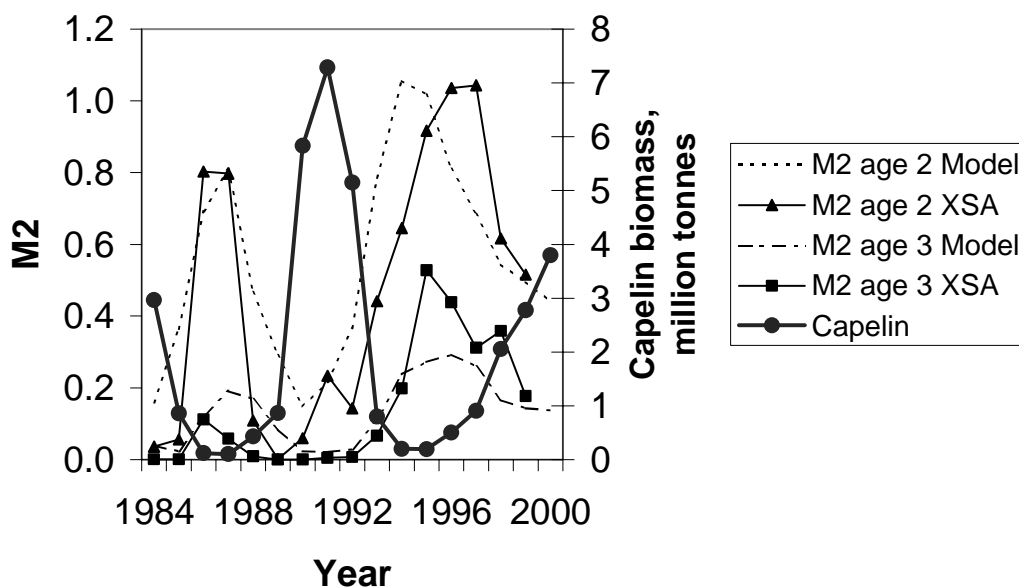
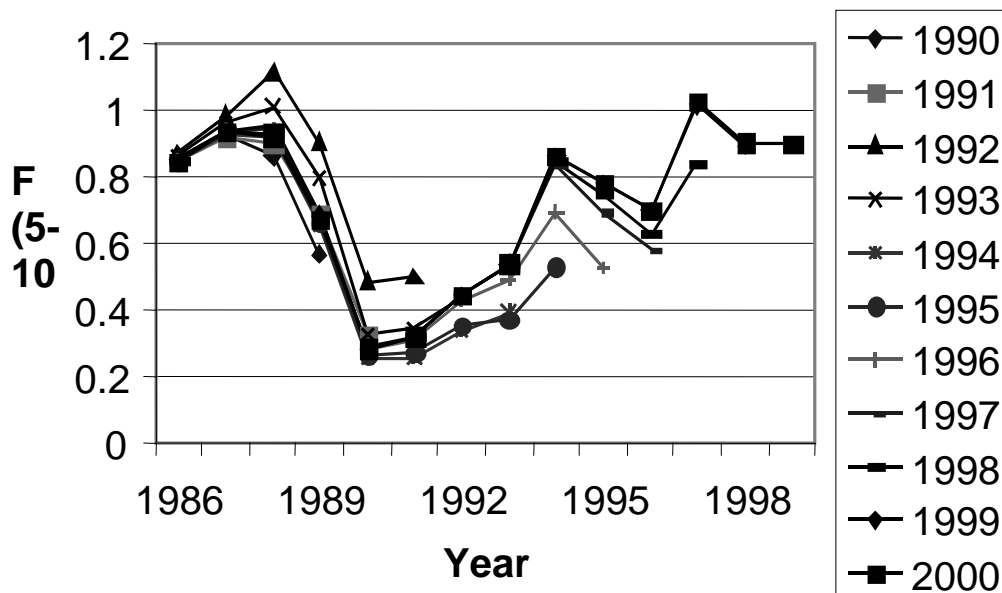


Fig 2.3 Retrospective analysis NEA cod, cannibalism included



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

3.1 Status of the Fisheries

The nominal catch by country is given in Table 3.1. Haddock is mainly fished by trawl as a by-catch in the fishery for cod. Occasionally there is also a directed trawl fishery for haddock. In recent years Norway and Russia have accounted for more than 90% of the landings (Table 3.1). The landings in 1997 and 1998 were 148,741 and 94 269 t, respectively, and only 71% and 73% of the TAC was taken. In 1999 the TAC was reduced to 78 000 t. and the provisional landings are 76 000 t. The agreed TAC for 2000 is 62 000t, which corresponds to exploitation at F_{pa} – level (0.35).

The annual catch at age including 1999 is presented in Table 3.2. For comparison the Norwegian landings in numbers by age in the 1. quarter of 1999 and 2000 are plotted in Figure 3.1. Four year old haddock (1996 year class) is the dominant year class in the fishery in Q1 2000, while in 1999 older fish (age 5-10) contributed most. The mean length of the 1996 year class is currently just above the minimum landing size of 39 and 44 cm in the Russian and Norwegian Economic Zones, respectively. The Russian maturity ogive for the 1996 year class (Table 3.3) indicates that most of 4 year olds are still immature.

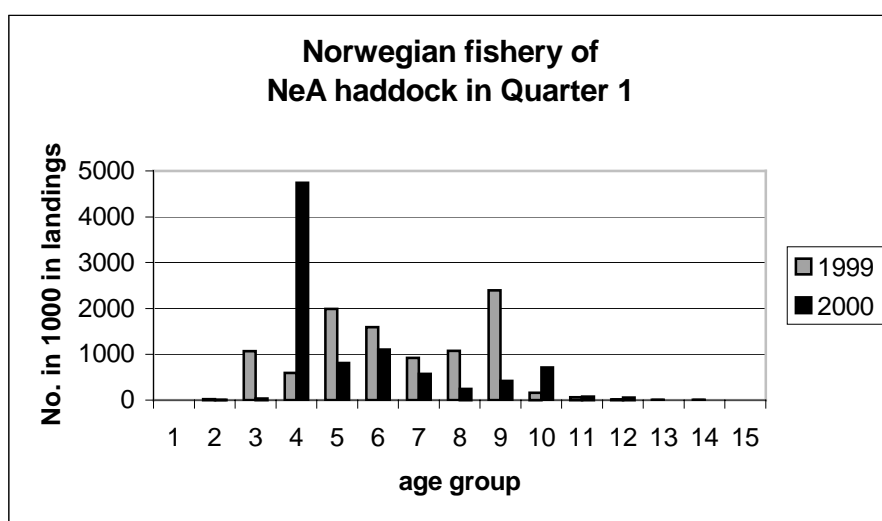


Figure 3.1. Norwegian landings of NeA haddock in numbers by age in Q1 1999 and 2000

3.2 Survey results

Norwegian bottom trawl and acoustic survey

Norway provided preliminary indices from the 2000 Barents Sea bottom trawl and acoustic survey in January-March. Like in 1999 there was full area coverage. Due to the restriction of the survey to the Norwegian Economic Zone in 1997 and 1998, adjustments were made to the abundance indices using the same procedure as for cod. Tables 3.4 and 3.5 show the time series of abundance estimates (acoustic and bottom trawl, respectively) from this survey. High indices, caused by the period of good recruitment around 1990, can be tracked from year to year in both series and the 1990 year class appears as the strongest for age groups 3–8. Recruitment at age 3 of the 1992-1997 year classes are all well below those of the 1989-1991 year classes which have supported the fishery in the recent period. The 1998 (at ages 1 and 2) and 1999 (age 1) year classes seems to be at least of average strength. The indices for age 5 and older haddock are at a low level.

Russian bottom trawl and acoustic survey

Russia provided indices from the 1999 Barents Sea trawl and acoustic survey (Tables 3.6 and 3.7) which was carried out in October-December. The Russian survey shows the same main trends as the Norwegian survey. From 1995 onwards there has been a substantial change in the method for calculating acoustic indices. The acoustic survey (Table 3.7) is therefore excluded from the VPA tuning until a longer time series with the new method is established.

Estimates of the abundance of 0-group haddock from the International 0-group survey are presented in Table 3.8. The 0-group indices for haddock were good from 1990 to 1994, average from 1995 to 1997, good in 1998 and average in 1999.

3.3 Exploratory XSA Assessment

Because some of the data still are preliminary given the time constraint, only an exploratory XSA estimate of the stock was done. The input data were those from last year, with the addition of catch at age data for 1999 and survey data for 1999 and early 2000. Consumption by cod was recalculated with the same procedure as used last year. The same XSA options as used last year were applied. No attempt was made to explore the sensitivity to these options, explore other options, or to re-evaluate their validity given the present information. Thus, this XSA estimate should be considered as purely exploratory.

The summary of the results are given in Table 3.9. The results are in line with the decreasing trend in SSB that was expected by last years WG, and indicate a fairly stable fishing mortality since 1997. The recent fishing mortality is higher and the SSB lower (by approximately 13% for 1999) than estimated in last years assessment. The estimated fishing mortality is now slightly above F_{lim} (0.49), but the estimated SSB is still above B_{pa} (80 000t).

The assessments of this stock are known to be unstable (ICES CM 2000/ACFM:3). The deviation of recent stock abundance between this exploratory run and last years assessment is well within the range observed previously. However, it seems clear that there are unresolved problems with this assessment, and no attempt were made to investigate the methodological aspects of the assessment this time.

3.4 Conclusions

The survey results confirm the decline in stock numbers, and consequently in SSB, which was expected by ACFM last year.

The 1989-1991 year classes were strong and have supported the fishery in recent years. Since 1995 recruitment at age 3 has been low, except for the 1996 year class for which survey evidence is conflicting. The 1998 year class appears to be stronger than the previous ones, and the 1999 year class may also be so.

The 1999 fishery was still dominated by age 5 and older fish. However, in 2000 about half the Norwegian landings in numbers so far are comprised of the 1996 year class, which has just reached minimum landing size. This indicates that the older year classes may by now have been depleted.

An exploratory XSA gave results in line with these observations, but indicated a higher fishing mortality in recent year than estimated previously. It now appears that the fishing mortality in recent years may be slightly above F_{lim} . The SSB still appears to be above B_{pa} , but is expected to decline.

Table 3.1 North-East Arctic HADDOCK. Nominal catch (t) by countries
Sub-area I and Divisions IIa and IIb combined. (Data provided by Working Group members).

Year	Faroe Islands	France	German Dem.Re.	Fed. Re. Germ.	Norway	Poland	United Kingdom	Russia ²	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	-	181,726
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	Spain	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	1,113	116	78	1,324	57,273	72	435	31,293	41	91,745
1989	1,218	125	26	171	31,825	1	590	20,903	-	54,859
1990	875	-	5	128	17,634	-	494	6,605	-	25,741
1991	1,117	60	Greenld	219	19,285	-	514	12,388	22	33,605
1992	1,093	151	1,719	387	30,203	38	596	19,699	1	53,887
1993	546	1,215	880	1,165	36,590	76	1,802	34,700	646	77,619
1994	2,761	678	770	2,412	64,688	22	4,673	44,484	877	121,365
1995	2,833	598	1,097	2,675	72,864	14	3,108	54,516	718	138,423
1996	3,743	538	1,510	942	89,500	669	2,275	74,131	217	173,525
1997	3,327	540	1,877	972	97,789	364	2,340	41,228	304	148,741
1998 ¹	1,903	241	854	385	68,747	257	1,229	20,559	94	94,269
1999 ¹	432	83	252	450	42,933	649	733	30,520	95	76,147

¹ Provisional figures.

² USSR prior to 1991.

Table 3.2. Arctic Haddock (run: SVPSME10/V10) At 10/05/2000 11:48

YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
AGE										
3	3189	65643	6012	64528	6563	1154	16437	2074	1727	20318
4	37949	9178	151996	13013	154696	10689	5922	24704	5914	7826
5	35344	18014	13634	70781	5885	176678	14713	7942	31438	7243
6	18849	13551	9850	5431	27590	4993	127879	12535	5820	14040
7	28868	6808	4693	2867	3233	28273	3182	46619	12748	3154
8	9199	6850	3237	1080	1302	1445	8003	1087	17565	2237
9	1979	3322	2434	424	712	271	450	1971	822	5918
10	1093	1182	606	315	319	100	200	356	1072	285
11	853	734	534	393	126	50	80	17	226	316
12	867	178	185	202	68	30	60	0	79	71
13	712	81	138	121	51	15	30	33	89	4
+gp	545	355	23	289	298	5	15	126	207	109
TOTALNUM	139447	125896	193342	159444	200843	223703	176971	97464	77707	61521
TONSLAND	132125	120077	127660	123920	156788	202286	213924	123583	112672	88211
SOPCOF %	45	65	51	57	60	47	55	57	61	80
YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
3	40117	15430	39604	28567	22305	5911	26157	15917	657	1520
4	71280	56858	30947	72995	49162	46161	22469	41373	67632	1963
5	13718	63354	49028	19036	30592	40032	62724	13505	41267	44526
6	7138	8706	33923	13627	5800	12578	28840	25736	7748	18956
7	6268	3578	3209	9290	3518	1672	5711	8878	15599	3611
8	1587	4407	1344	1243	2709	970	578	1617	5292	4925
9	2352	788	1778	561	831	893	435	218	655	1624
10	2015	527	243	410	104	122	188	175	182	315
11	497	1287	247	80	206	204	186	155	101	43
12	70	67	483	84	235	123	25	75	115	43
13	30	60	20	168	121	14	8	27	18	14
+gp	12	20	8	44	69	457	22	14	52	9
TOTALNUM	145084	155082	160834	146105	115652	109137	147343	107690	139318	77549
TONSLAND	155454	193234	187888	146744	98900	118079	160621	136486	181726	130502
SOPCOF %	84	80	74	74	62	69	66	79	79	80
YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
3	23004	1978	230217	70205	9684	10037	13989	55967	47311	17540
4	2408	24359	22245	258773	41702	14088	13449	22043	18812	35290
5	1870	1257	42846	24018	88112	33871	6808	7368	4076	10645
6	21996	918	3196	6873	5828	49711	20789	2586	1389	1429
7	7948	9279	1606	419	4138	2135	40044	7781	1626	812
8	1974	3056	6737	423	382	1236	1247	11043	2596	546
9	1978	826	2630	1681	618	92	1350	311	6215	1466
10	726	1043	897	525	2043	131	193	388	162	2310
11	166	369	989	147	935	500	280	96	258	181
12	26	130	538	339	276	147	652	101	3	87
13	52	27	53	68	457	53	332	84	74	2
+gp	44	8	67	27	202	234	340	98	65	53
TOTALNUM	62192	43250	312021	363498	154377	112235	99473	107866	82587	70361
TONSLAND	86601	78908	265317	320065	221138	175758	137218	110158	95422	103623
SOPCOF %	75	101	86	83	86	81	62	77	95	112

(Table 3.2. Continued)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	627	486	883	704	456	29548	25596	3928	794	1050
4	22878	2561	900	1930	841	1153	61470	88297	9031	3951
5	21794	22124	3372	884	836	546	1013	52611	50868	12305
6	2971	10685	12203	1374	307	715	376	586	19465	23032
7	250	1034	2625	3282	765	316	346	207	382	3423
8	504	162	344	906	2250	634	144	123	65	247
9	230	162	75	52	499	1312	295	74	35	11
10	842	72	80	37	70	416	484	119	44	36
11	1299	330	91	29	25	50	112	175	142	12
12	111	564	320	21	36	5	35	87	135	22
13	35	27	204	21	44	1	3	4	22	17
+gp	15	42	34	91	185	57	7	19	11	15
TOTALNUM	51556	38249	21131	9331	6314	34753	89881	146230	80994	44121
TONSLAND	87889	77153	46955	21607	17661	41270	96585	150659	91744	55122
SOPCOF %	103	98	93	91	91	97	90	98	99	96
YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
3	518	3968	12342	13398	3202	1347	1704	2303	2532	18672
4	1174	1967	12652	25902	45943	13565	5790	6347	14301	7058
5	1871	1886	2411	13154	34257	74583	36543	12086	8628	14902
6	4138	2876	1740	2784	8750	21227	74463	33929	7671	5326
7	6754	4442	2070	973	1709	3530	10834	49680	12607	3093
8	851	4422	2619	1297	693	385	1980	4810	18708	5210
9	389	398	2737	2131	1200	310	438	557	1173	5365
10	50	21	241	2011	1844	469	295	192	238	481
11	3	1	12	314	1655	344	251	161	39	109
12	3	7	4	55	281	627	228	134	36	47
13	9	2	1	9	46	39	790	121	50	14
+gp	15	7	1	6	2	2	23	147	113	60
TOTALNUM	15775	19997	36830	62034	99582	116428	133339	110467	66096	60337
TONSLAND	25816	33605	53886	77619	121365	138423	173525	148741	94269	75895
SOPCOF %	96	96	101	100	100	100	100	100	101	101

Table 3.3 North-East Arctic HADDOCK. Maturity at age in percent from Russian data

Year	Age									
	3	4	5	6	7	8	9	10	11	12
1981	1	12	64	73	96	100	100	-	-	-
1982	9	55	73	93	96	100	93	-	-	-
1983	17	70	100	99	99	100	-	-	-	-
1984	7	14	35	47	74	82	89	-	-	-
1985	2	8	80	93	96	91	96	-	-	-
1986	+	22	53	86	86	100	83	100	-	-
1987	-	1	21	53	100	100	-	100	-	-
1988	-	3	33	51	-	-	-	-	-	-
1989	-	4	30	63	82	100	-	-	-	-
1990	-	2	30	54	77	87	80	100	-	-
1991	-	7	30	50	80	92	100	100	-	-
1992	2	13	50	62	77	80	94	100	-	-
1993	2	22	49	76	79	88	88	87	100	100
1994	-	2	13	41	90	88	100	100	97	100
1995	-	2	12	42	81	88	100	87	100	94
1996	-	-	10	36	78	86	90	93	90	100
1997	-	3	10	29	60	82	100	83	100	100
1998	-	5	28	50	66	81	91	100	-	100
1999	1	17	50	71	81	91	92	100	100	-
2000*		6	37	61	68	90	94	94	100	100

* Preliminary data

Table 3.4. North-East Arctic HADDOCK. Results from the Norwegian bottom trawl survey in the Barents Sea in January-March. Index of number of fish at age. Indices for 1983-1998 revised August 1999.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	3.1	7.3	2.3	7.8	1.8	5.3	0.5	0.2			28.3
1982	3.9	1.5	1.7	1.8	1.9	4.8	2.4	0.2			18.2
1983	2919.3	4.8	3.1	2.4	0.9	1.9	2.5	0.7	-	-	2935.5
1984	3832.6	514.6	18.9	1.5	0.8	0.2	0.1	0.4	0.1	-	4369.2
1985	1901.1	1593.8	475.9	14.7	0.5	0.5	0.1	0.1	0.4	0.3	3987.4
1986	665.0	370.3	384.6	110.8	0.6	0.2	0.1	0.1	0.1	0.1	1531.9
1987	163.8	79.9	154.4	290.2	52.9	-	-	-	-	0.3	741.6
1988	35.4	15.3	25.3	68.9	116.4	13.8	0.1	-	-	-	275.0
1989	81.2	9.5	14.1	21.6	34.0	32.7	3.4	0.1	-	-	196.5
1990	644.1	54.6	4.5	3.4	5.0	9.2	11.8	1.8	0.0	0.0	734.5
1991	2006.0	300.3	33.4	5.1	4.2	2.7	1.7	4.2	0.0	-	2357.7
1992	1659.4	1375.5	150.5	24.4	2.1	0.6	0.7	1.6	2.3	0.0	3217.0
1993	727.9	599.0	507.7	105.6	10.5	0.6	0.4	0.3	0.4	1.1	1953.4
1994	603.2	228.0	339.5	436.6	49.7	3.4	0.2	0.1	0.2	0.6	1661.5
1995	1463.6	179.3	53.6	171.1	339.5	34.5	2.8	0.0	0.1	0.0	2244.6
1996	309.5	263.6	52.5	48.1	148.6	252.8	11.6	0.9	-	0.1	1087.6
1997 ¹	1268.0	67.9	86.1	28.0	19.4	46.7	62.2	3.5	0.1	-	1581.8
1998 ¹	212.9	137.9	22.7	33.2	13.2	3.4	8.0	8.1	0.7	0.1	440.0
1999	1244.9	57.6	59.8	12.2	10.2	2.8	1.0	1.7	1.1	0.0	1391.3
2000	847.1	452.2	27.2	35.4	8.4	4	0.8	0.3	0.7	0.2	1376.3

¹ Indices adjusted to account for limited area coverage.
Survey area extended from 1993 onwards.

Table 3.5. North-East Arctic HADDOCK. Results from the Norwegian acoustic survey in the Barents Sea in January-March. Stock numbers in millions. New TS and rock-hopper gear (1981-1988 back-calculated from bobbins gear). Corrected for length dependent effective spread of the trawl.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	7	14	5	21	60	18	1	+	+	+	126
1982	9	2	3	4	4	10	6	+	+	+	38
1983	-	5	2	3	1	1	4	2	+	+	18
1984	1,685	173	6	2	1	+	+	+	+	+	1,867
1985	1,809	839	274	6	+	+	+	1	+	+	2,929
1986	680	312	488	162	+	+	+	+	+	+	1,642
1987	111	26	71	190	47	+	+	+	-	+	445
1988	20	5	8	20	38	6	+	+	-	+	97
1989	58	6	8	10	17	19	2	+	-	+	120
1990	493	44	4	3	4	7	11	1	+	+	567
1991	1,938	265	49	7	2	2	2	4	+	-	2,269
1992	859	685	110	19	2	+	+	1	2	+	1,678
1993	1,424	690	565	99	10	+	+	1	+	2	2,791
1994	848	228	240	506	77	8	+	+	+	+	1,907
1995	1,380	285	36	113	391	40	2	+	+	1	2,248
1996	249	229	44	31	76	150	8	1	-	+	788
1997 ¹	798	32	66	22	15	48	47	3	+	+	1,031
1998 ¹	256	156	29	41	15	6	13	18	1	+	535
1999	856	46	57	13	14	4	1	2	2	+	995
2000	1024	509	32	65	19	10	2	1	2	+	1,664

¹ Indices adjusted to account for limited area coverage.
Survey area extended from 1993 onwards.

Table 3.6. North-East Arctic HADDOCK. Results from the Russian trawl survey in the Barents Sea and adjacent waters in late autumn (numbers per hour trawling).

Year	Age											Total	
	0	1	2	3	4	5	6	7	8	9	Older		
	Total - Sub-area I and Divisions IIa and IIb												
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
1989	2.2	1.8	2.4	0.4	1.4	4.1	8.1	1.1	0.1	+			21.6
1990	44.8	14.3	10.6	7.3	4.2	7.3	7.4	5.7	0.3	0.1			102.0
1991	16.7	42.9	17.6	6.2	0.9	0.3	0.6	1.8	1.5	0.2			88.7
1992	16.4	28.2	128.6	34.6	5.0	0.4	0.6	0.9	0.8	0.1			215.6
1993	3.5	4.8	35.7	198.5	35.6	4.8	0.8	0.4	0.4	-			284.5
1994	9.1	4.9	5.8	44.2	101.4	11.6	1.5	0.1	0.1	0.5			179.2
1995	6.4	7.2	4.2	3.1	12.3	37.0	4.0	0.5	0.1	0.3			75.1
1996 ¹	6.0	2.3	5.7	2.8	4.9	36.2	33.4	2.9	0.3	0.3			94.8
1997 ¹	1.8	4.6	1.9	3.2	3.2	1.0	2.7	1.0	0.8	-			20.2
1998	10.7	2.9	11.5	3.8	4.6	0.8	0.5	1.5	0.5	+			36.8
1999	11.7	28.9	6.1	19.6	3.9	3.7	0.8	0.3	0.7	0.7			76.4

¹) Adjusted data based on average 1985-1995 distribution.

Table 3.7. North-East Arctic HADDOCK. Results from the Russian trawl-acoustic survey in the Barents Sea and adjacent waters in late autumn 1985-1998. Index of number of fish at age.

Year	Age											Total
	0	1	2	3	4	5	6	7	8	9	10+	
1985 ¹	194	434	1,468	636	3	1	+	-	-	-	1	2,737
1986 ¹	34	37	208	917	910	2	+	+	+	-	+	2,109
1987 ²	6	16	29	62	197	61	+	-	-	+	12	383
1988 ²	2	1	3	18	83	301	46	-	-	-	+	454
1989 ¹	41	32	94	2	14	35	67	9	1	+	-	295
1990 ¹	594	176	75	28	17	23	43	44	4	1	-	1,004
1991 ¹	240	368	143	65	11	4	7	21	17	2	+	878
1992 ¹	199	245	758	218	35	3	4	7	6	+	+	1,475
1993 ¹	20	26	199	1,076	228	31	5	2	3	2	3	1,595
1994 ¹	118	51	39	252	591	76	9	+	1	1	3	1,141
1995 ¹	38	40	18	18	77	225	23	3	1	1	+	443
1996 ¹	281	44	148	93	69	280	242	19	3	1	1	1,181
1997 ¹	70	138	41	207	82	48	41	25	20	-	-	671
1998 ³	107	27	82	22	25	7	3	9	3	+	+	284
1999 ¹	222	330	43	129	25	29	7	3	7	2	+	798

¹ October-December

² September-October

³ November-January

Table 3.8.

Abundance indices of 0-group haddock in the Barents Sea and adjacent waters in 1965 - 1999.				
Area weighted abundance indices		Estimated logarithmic indices with 90% confidence limits of year class abundance		
Year	Indices	Indices	Confidence limits	
1965	7			
1966	1	0.01	0.00	0.03
1967	42	0.08	0.03	0.13
1968	8	0.00	0.00	0.02
1969	82	0.29	0.20	0.41
1970	115	0.64	0.42	0.91
1971	73	0.26	0.18	0.36
1972	46	0.16	0.09	0.27
1973	54	0.26	0.15	0.40
1974	147	0.51	0.39	0.68
1975	170	0.60	0.40	0.85
1976	112	0.38	0.24	0.51
1977	116	0.33	0.21	0.48
1978	61	0.12	0.07	0.19
1979	69	0.20	0.12	0.28
1980	54	0.15	0.10	0.20
1981	30	0.03	0.00	0.05
1982	90	0.38	0.30	0.52
1983	184	0.62	0.48	0.77
1984	255	0.78	0.60	0.99
1985	156	0.27	0.23	0.31
1986	160	0.39	0.28	0.52
1987	72	0.10	0.00	0.25
1988	86	0.13	0.05	0.34
1989	112	0.14	0.10	0.20
1990	227	0.61	0.48	0.75
1991	472	1.17	0.98	1.37
1992	313	0.87	0.71	1.06
1993	240	0.64	0.48	0.82
1994	282	0.64	0.49	0.81
1995	148	0.25	0.13	0.40
1996	196	0.39	0.25	0.56
1997	150	0.21	0.12	0.31
1998	593	0.59	0.44	0.76
1999	184	0.25	0.11	0.44

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RECRUITS Age 3	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	FBAR 4-7
1950	66401	269854	140642	132125	0.9394	0.4483	0.8412
1951	552707	439080	111584	120077	1.0761	0.6468	0.6273
1952	62333	317969	64151	127660	1.9900	0.5115	0.7325
1953	1030188	652917	81680	123920	1.5171	0.5709	0.5328
1954	122540	716191	124221	156788	1.2622	0.5998	0.3865
1955	52309	580934	176276	202286	1.1476	0.4730	0.5158
1956	169104	532421	237439	213924	0.9010	0.5526	0.4431
1957	53254	353841	197612	123583	0.6254	0.5668	0.4446
1958	68972	292205	155117	112672	0.7264	0.6119	0.5333
1959	324528	414699	133923	88211	0.6587	0.7979	0.3937
1960	242519	529752	128196	155454	1.2126	0.8371	0.4989
1961	109130	491160	133522	193234	1.4472	0.8017	0.6494
1962	240726	429465	122878	187888	1.5291	0.7438	0.8256
1963	274815	401756	91083	146744	1.6111	0.7422	0.8878
1964	320310	378959	62714	98900	1.5770	0.6155	0.6541
1965	100310	438630	92977	118079	1.2700	0.6922	0.5089
1966	240268	471103	126355	160621	1.2712	0.6598	0.6198
1967	290554	563800	160796	136486	0.8488	0.7910	0.4316
1968	19930	508650	180578	181726	1.0064	0.7910	0.5179
1969	17204	381506	177038	130502	0.7371	0.8023	0.4051
1970	163906	317335	157970	86601	0.5482	0.7531	0.3565
1971	95473	385513	179359	78908	0.4399	1.0074	0.2548
1972	1017665	873230	142238	265317	1.8653	0.8566	0.7047
1973	269594	844786	123371	320065	2.5943	0.8267	0.5806
1974	53611	704818	192463	221138	1.1490	0.8597	0.4951
1975	48488	531758	237013	175758	0.7416	0.8093	0.5129
1976	55634	293403	189763	137218	0.7231	0.6228	0.6933
1977	113796	240423	131728	110158	0.8363	0.7678	0.8416
1978	169923	262346	100106	95422	0.9532	0.9477	0.6710
1979	134079	319628	80817	103623	1.2822	1.1247	0.7435
1980	18855	250119	67787	87889	1.2965	1.0321	0.5649
1981	5622	186999	121928	77153	0.6328	0.9828	0.6170
1982	7938	112115	96624	46955	0.4860	0.9337	0.5091
1983	4732	60320	56978	21607	0.3792	0.9107	0.4232
1984	9317	46081	35048	17661	0.5039	0.9105	0.3350
1985	256463	143006	31510	41270	1.3097	0.9654	0.4401
1986	535218	291375	44939	96585	2.1492	0.9013	0.4892
1987	84702	227458	31202	150659	4.8286	0.9825	0.5414
1988	43310	161471	54123	91744	1.6951	0.9923	0.5165
1989	17549	127785	65311	55122	0.8440	0.9617	0.4047
1990	24378	126725	71366	25816	0.3617	0.9630	0.1635
1991	84014	162058	90432	33605	0.3716	0.9581	0.2397
1992	204390	243486	101209	53886	0.5324	1.0132	0.2891
1993	673421	483003	142342	77619	0.5453	1.0016	0.3721
1994	287140	525612	77459	121365	1.5668	0.9991	0.4717
1995	76315	505806	107916	138423	1.2827	1.0021	0.3901
1996	93565	433472	150210	173525	1.1552	0.9994	0.4390
1997	112944	324485	143314	148741	1.0379	0.9995	0.5372
1998	52052	219820	121617	94269	0.7751	1.0113	0.5101
1999	119205	188670	105480	75895	0.7195	1.0064	0.5109
Arith, Mean Units	183828 (Thousands)	375160 (Tonnes)	119008 (Tonnes)	122698 (Tonnes)	1.1392		0.5214

4 FUTURE CONSIDERATIONS AND ALTERNATIVE APPROACHES

4.1 Fleksibest

The Fleksibest model which is being developed as an alternative assessment method for the cod in particular, was presented to the WG at its last meeting (ICES 2000 - AFWG rep). Since then, an improved model for transferring mean growth to length distributions has been implemented, as well as, parallelisation of the code. Work is underway to include *i.a.* a broader range of objective functions with improved optimisation routines, as well as improved routines for post-processing and presentation of the results. The input data were updated with the current catch and survey data. A paper describing the method is now being prepared. Extensive exploration of the various model assumptions has been initiated. Some runs were presented to the WG, which show essentially the same trends in stock abundance and mortalities as the results presented to the last WG. The current plan is to use the model as an alternative assessment tool for cod at the next ordinary meeting of the Working Group.

4.2 Exploring stock abundance estimates using only survey data

In assessments where survey data are used to calibrate a VPA or a separable model, there sometimes appears to be a conflict between survey results and the magnitude and age structure of the catches. In some cases there may be doubts as to the correctness of the catch at age data. With respect to the NEA cod, this has been considered as a possible problem. However, for this stock the most conspicuous conflict is that the abundance according to the surveys fluctuates much more over time than indicated by the converged VPA. In order to explore the information about the stock abundance and age structure inherent in the survey data, it may be informative to attempt to estimate parameters in a stock model using only the survey data.

Since survey data are relative measures of the stock abundance, catchabilities are needed to translate survey indices to stock numbers. The usual assumption is that the a survey index I is related to the corresponding stock number N by a catchability q as: $I = q \cdot N$. Commonly, catchabilities are assumed to vary with age and be constant over the years. Two alternative ways of estimating the catchabilities have been explored by this Working Group: By comparing the survey data with converged VPA stock numbers (Nakken WD #1 and #2) or by fitting a population model with separable fishing mortalities.

4.2.1 Calibration of survey indices using converged VPA

Two working document by Nakken was presented. In the first (WD#1) the survey indices found from the Norwegian bottom trawl survey in winter and the acoustic indices of spawning of spawning biomass were calibrated to yield estimates of stock numbers at age and spawning stock biomass. Calibrations were carried out using linear regressions on converged VPA stock numbers an associated index values. Since 1993, the area covered by the bottom trawl surveys has been larger than in previous years and before carrying out regressions the bottom trawl indices were adjusted to compensate for this. The calibration period for the bottom trawl indices was 1981-1992 and that for the spawning stock biomass index was 1985-1995. For later years, the observed indices were used directly together with the calibration results to yield stock estimates.

The results, which are presented in detail in the Working Document, show that

1. The survey estimates of stock numbers of ages 5,6 and 7+ for the years 1993 through 1998 are closer to the 1999 VPA estimates than are the annual estimates.
2. The survey estimates of spawning stock biomass for 1996,1997 and 1998 are much lower than those from the various recent WG assessments, while for 1999 the survey estimate is close to that from the assessment.

Another working document by Nakken (WD#2) commenting on the WG's assessment of North-East Arctic cod in autumn 1999 was also presented. The document, which was written to ACFM prior to the meeting of the committee in autumn 1999 pointed out the discrepancies between the results of the annual assessments since 1995. The main point in the document was that the stock numbers of 4 and 5 year olds in 1999 probably were overestimated by the XSA. By comparing ratios between estimated stock numbers (1999 XSA) and corresponding swept area indices from Norwegian surveys over the period 1994 - 1999 it appeared that the 1999 ratios were high. Also, the 1999 stock numbers of 4 and 5 year olds from the XSA were substantially higher than the corresponding swept area stock estimates arrived at by the calibration method described above. The conclusions in the document were:

- Stock numbers of 6+ for 1999 as estimated by the WG fit with swept area survey estimates.

- Stock numbers of 5 and 4 year olds as estimated by the WG seem to high as compared with swept area indices and swept area stock estimates.
- Survey results indicate that the 1998 and 1999 year classes are less abundant than the preceding year classes.

4.2.2 Fitting a population with separable fishing mortalities

In a WD by Skagen (WD#4), a simple separable population model was constructed on a spreadsheet, basically on the principles suggested by Cook (1995) and applied lately to the VIaN herring stock (ICES C.M.2000/ACFM:10). The fishing mortality was assumed to be separable, with a selection pattern modelled as a logistic function. Separable fishing mortalities were assumed for the period 1987 - 1999. For the previous years, a simple VPA, using the reported catches was made, initiated with the estimated stock numbers for 1987. For each survey, the catchabilities at ages 1, 2 and 3+ were taken as parameters, while the catchability was assumed to be constant for ages 3 and older. In order to scale the population, a constraint was applied that the total modelled catch in tonnes over the years 1987-1999 should equal the reported catch.

Altogether, the stock estimates were relatively consistent, and it is remarkable that the catch residuals in the later years were modest, except for the youngest ages. However, for the years before 1993, the modelled catches were far below the observed ones. The SSB seems to have reached a maximum in 1992, after some years with rapid increase. The fishing mortality appeared to be near zero in that period. After 1992, the results indicate a rapid decline of the SSB and a mortality fluctuating at high levels. The analysis confirms the trends seen in the ordinary assessment, but also confirms the impression that the fluctuation over time have been stronger than the XSA indicates, and there is some indication that the fluctuations in relative survey abundance is stronger than what is compatible with the change in age composition. Thus, this investigation suggests that there may have been variations in the catchabilities in the late 1980'ies or early 1990'ies.

4.3 Management concerns for cod(WD #5 and #6)

It was noted that MBAL = 500 000 t currently used for this purpose doesn't seem to be well grounded (Borisov et al, WD #5). Strength of year classes to a greater extent depends on the variations in survival conditions of eggs, fry and juveniles (Kiseleva, WD #6). It was proposed to use the revised biological parameters of the population, such as growth rate, maturation, natural mortality coefficients, differentiated by age and years, or to use the reduced time series of observation to reflect the current state of the cod population, as well as to start works on the recruitment modelling taking into account the effect of environmental variations.

4.4 Observations on cod spawning in 2000 (oral presentation by Shevelev)

A considerable reduction in abundance of mature NEA cod on the spawning grounds off the Lofoten showed by the Norwegian acoustic survey in April 2000 can be partly explained by the increased water heat content and the predominance of the first-time spawners in the spawning stock. As a consequence, more cod spawned on the Northern spawning grounds. In early May, Russian research vessels reported about unusually high number (up to 10%) of just spawned cod in trawl catches of the Bear Island.

4.5 Sensitivity to some XSA tuning choices for NEA cod (WD #3)

As described in the 99 WG report here are some peculiar time trends in catchability for most age groups and survey fleets. Some of the important age groups show cyclic patterns with an increasing long term trend. Those trends seem to be significant compared to the year-to-year variability. It has been discussed whether it is caused by changes in the surveys or by variable additional mortality. The 1999 working group did not consider the subject to be sufficiently evaluated to introduce an alternative stock assessment. It was, however, recognised that some changes in survey methodology had taken place, but it is not obvious where each of the actual survey time series should be split. The change may not have taken place in the same year for all vessels involved, and some learning process is involved in most changes, thereby influencing the results for several years.

When there are doubts whether the recent data are comparable to older data, a wise procedure is to reduce the weights on older data in the tuning. (This is true irrespective of the likely reasons for the discrepancies; surveys, landing statistics, natural mortality). The time weighting used in the WG tuning is tricubic taper down weighting over 20 years, which is the program default. To examine the effect of reducing the influence of older data a tricubic taper down weighting over 10 years was applied. Both when tuning with one survey at a time and when tuning with all fleets in the

standard manner, the pattern was that this down weighting of old data reduced the 99 estimate of population size and increased the estimate of F in 99. Compared to the standard procedure the retrospective pattern improved.

5 REFERENCES

Cook, R.M. 1995. A simple model for the analysis of research vessel data to determine stock trends. ICES CM 1995/D:12.

Table A1 North-East Arctic COD. Catch per unit effort.

Year	Sub-area I			Division IIb			Division Iia		
	Norway ²	UK ³	Russia ⁴	Norway ²	UK ³	Russia 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	0.19	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	-	5.0
					Spain⁶			Russia⁴	
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)	0.92	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	1.82	1.05	1.73	0.67	3.3
1988	1.58	-	0.66	1.61	(1.36)	0.54	0.97	0.55	2.2
1989	1.49	-	0.71	0.41	2.70	0.45	0.78	0.43	3.6
1990	1.35	-	0.70	0.39	2.69	0.80	0.38	0.60	4.8
1991	1.38	-	0.67	0.29	4.96	0.76	0.50	0.90	-
1992	2.19	-	0.79	3.06	2.47	0.23	0.98	0.65	-
1993	2.33	-	0.85	2.98	3.38	1.00	1.74	1.03	-
1994	2.50	-	1.01	2.82	1.44	1.14	1.27	0.86	-
1995	1.57	-	0.59	2.73	1.65	1.10	1.00	1.01	-
1996			0.74		1.11	0.85		0.99	
1997			0.61			0.57		0.74	
1998			0.37			0.29		0.40	
1999 ¹			0.29			0.34		0.39	

¹Preliminary figures.²Norwegian data - t per 1 000 tonnage*hrs fishing.³United Kingdom data - t per 100 tonnage*hrs fishing.⁴Russian data - t per hr fishing.⁵Norwegian data - t per gillnet boat week in Lofoten.⁶Spanish 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 A2. North-east Arctic COD. Abundance indices (millions) from the Norwegian acoustic survey in the Barents Sea in January-March. New TS and rock-hopper gear (1981-1988 back-calculated from bobbin gear). Corrected for length-dependent effective spread of trawl. 1983-1999 re-calculated from raw data.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	8.0	82.0	40.0	63.0	106.0	103.0	16.0	3.0	1.0	1.0	423.0
1982	4.0	5.0	49.0	43.0	40.0	26.0	28.0	2.0	+	0.0	197.0
1983	60.5	2.8	5.3	14.3	17.4	11.1	5.6	3.0	0.5	0.1	120.5
1984	745.4	146.1	39.1	13.6	11.3	7.4	2.8	0.2	0.0	0.0	966.0
1985	69.1	446.3	153.0	141.6	19.7	7.6	3.3	0.2	0.1	0.0	840.9
1986	353.6	243.9	499.6	134.3	65.9	8.3	2.2	0.4	0.1	0.0	1308.2
1987	1.6	34.1	62.8	204.9	41.4	10.4	1.2	0.2	0.7	0.0	357.3
1988	2.0	26.3	50.4	35.5	56.2	6.5	1.4	0.2	0.0	0.0	178.4
1989	7.5	8.0	17.0	34.4	21.4	53.8	6.9	1.0	0.1	0.1	150.1
1990	81.1	24.9	14.8	20.6	26.1	24.3	39.8	2.4	0.1	0.0	234.1
1991	181.0	219.5	50.2	34.6	29.3	28.9	16.9	17.3	0.9	0.0	578.7
1992	241.4	562.1	176.5	65.8	18.8	13.2	7.6	4.5	2.8	0.2	1092.9
1993 ¹	1074.0	494.7	357.2	191.1	108.2	20.8	8.1	5.0	2.3	2.5	2264.0
1994 ¹	858.3	577.2	349.8	404.5	193.7	63.6	12.1	3.7	1.7	0.9	2465.4
1995 ¹	2619.2	292.9	166.2	159.8	210.1	68.8	16.7	2.1	0.7	1.0	3537.4
1996 ¹	2396.0	339.8	92.9	70.5	85.8	74.7	20.6	2.8	0.3	0.4	3083.8
1997 ^{1,2}	1623.5	430.5	188.3	51.7	49.3	37.2	22.3	4.0	0.7	0.1	2407.5
1998 ^{1,2}	3401.3	632.9	427.7	182.6	42.3	33.5	26.9	13.6	1.7	0.3	4762.8
1999	358.3	304.3	150.0	96.4	45.1	10.3	6.4	4.1	0.8	0.3	976.1
2000	154.1	221.4	245.1	158.8	142.0	45.3	9.5	4.6	2.9	1.0	984.7

¹ Survey covered a larger area

² Adjusted indices

Table A3. North-East Arctic COD. Abundance indices (millions) from the Norwegian bottom trawl survey in the Barents Sea in January-March. Rock-hopper gear (1981-1988 back-calculated from bobbins gear). Corrected for length-dependent effective spread of trawl. 1983-1999 values re-calculated from raw data.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	4.6	34.3	16.4	23.3	40	38.4	4.8	1	0.3	0	163.1
1982	0.8	2.9	28.3	27.7	23.6	15.5	16	1.4	0.2	0	116.4
1983	152.9	13.4	25.0	52.3	43.3	17.0	5.8	3.2	1.0	0.1	313.9
1984	2755.0	379.1	97.5	28.3	21.4	11.7	4.1	0.4	0.1	0.1	3297.7
1985	49.5	660.0	166.8	126.0	19.9	7.7	3.3	0.2	0.1	0.1	1033.6
1986	665.8	399.6	805.0	143.9	64.1	8.3	1.9	0.3	0.0	0.0	2089.1
1987	30.7	445.0	240.4	391.1	54.3	15.7	2.0	0.5	0.0	0.0	1179.8
1988	3.2	72.8	148.0	80.5	173.3	20.5	3.6	0.5	0.0	0.0	502.5
1989	8.2	15.6	46.4	75.9	37.8	90.2	9.8	0.9	0.1	0.1	285.0
1990	207.2	56.7	28.4	34.9	34.6	20.6	27.2	1.6	0.4	0.0	411.5
1991	460.5	220.1	45.9	33.7	25.7	21.5	12.2	12.7	0.6	0.0	832.7
1992	126.6	570.9	158.3	57.7	17.8	12.8	7.7	4.3	2.7	0.2	959.0
1993 ¹	534.5	420.4	273.9	140.1	72.5	15.8	6.2	3.9	2.2	2.4	1471.9
1994 ¹	1035.9	535.8	296.5	310.2	147.4	50.6	9.3	2.4	1.6	1.3	2391.0
1995 ¹	5253.1	541.5	274.6	241.4	255.9	76.7	18.5	2.4	0.8	1.1	6666.2
1996 ¹	5768.5	707.6	170.0	115.4	137.2	106.1	24.0	2.9	0.4	0.5	7032.5
1997 ¹²	4815.5	1045.1	238.0	64.0	70.4	52.7	28.3	5.7	0.9	0.5	6321.1
1998 ¹²	2418.5	643.7	396.0	181.3	36.5	25.9	17.8	8.6	1.0	0.5	3729.8
1999 ¹	484.6	340.1	211.8	173.2	58.1	13.4	6.5	5.1	1.2	0.4	1294.4
2000	128.8	248.3	235.2	132.1	108.3	26.9	4.3	2.0	1.2	0.4	887.5

¹ Survey covered a larger area

² Adjusted indices

Table A4. North East Arctic COD. Abundance at age (millions) from the Norwegian acoustic survey on the spawning grounds off Lofoten in March-April.

Year	5	6	7	8	9	10	11	12+	Sum
1985	0.68	7.45	12.36	3.11	1.15	1.01	0.45		26.21
1986	2.49	3.30	5.54	2.71	0.16		0.40	0.08	14.68
1987	8.77	7.04	0.23	2.83	0.04		0.03	0.03	18.97
1988	1.57	4.43	2.56	0.05	0.01	0.05			8.67
1989	0.04	13.20	9.73	2.20	0.38	0.12		0.06	25.73
1990	0.13	2.60	27.02	4.85	0.49	0.32			35.41
1991	0.00	5.00	19.83	32.67	2.75	0.19	0.17		60.61
1992	2.74	5.23	20.80	20.87	79.60	4.17	1.61	0.22	135.24
1993	4.87	14.58	17.35	20.22	25.44	41.95	4.74	0.71	129.86
1994	23.78	25.85	10.36	8.21	7.68	3.49	17.53	2.61	99.51
1995	6.49	35.24	12.34	2.27	3.60	2.56	2.15	7.96	72.61
1996	1.41	14.43	24.00	3.65	0.79	0.25	0.80	1.30	46.63
1997	0.40	4.95	27.56	16.50	1.50	0.42		0.75	52.08
1998	0.05	0.30	7.06	11.05	3.24	0.51	0.18	0.02	22.41
1999	0.25	1.92	4.84	14.58	8.42	0.75	0.19	0.10	31.05
2000	3.61	3.85	3.25	2.15	2.23	0.45	0.39	0.05	15.98

Table A5. North-east Arctic COD. Abundance indices (millions) from the Norwegian Bottom Trawl survey in the Svalbard area in September-October. Index of number of fish at each age. Rock-hopper gear (1983-1988 back-calculated from bobbins gear). Corrected for length-dependent effective spread of trawl.

Year	Age									Total
	1	2	3	4	5	6	7	8	9+	
1983	191.2	17.0	4.3	4.4	1.3	1.1	0.5	0.8	0.2	220.8
1984	598.4	106.8	6.3	3.3	3.4	1.3	0.3	0.3	0.3	720.3
1985	280.6	447.7	81.1	21.5	9.8	3.9	0.7	0.3	0.2	845.8
1986	49.8	182.3	260.6	32.5	11.0	1.9	0.7	0.2	0.1	539.1
1987	48.8	117.7	147.1	137.2	20.2	5.0	0.5	0.3	0.1	476.7
1988	2.6	26.8	30.8	24.4	37.2	7.1	1.5	0.1	0.1	130.6
1989	4.0	1.4	12.1	11.3	9.3	14.7	3.0	0.4	0.1	56.3
1990	95.0	10.3	7.0	10.9	17.0	11.4	17.4	1.6	0.3	170.8
1991	144.5	88.0	22.4	6.1	9.5	10.2	8.5	13.2	1.5	303.7
1992	168.0	125.6	81.8	37.9	8.4	3.9	4.4	2.1	4.5	436.6
1993	157.9	153.1	116.0	44.8	16.8	3.4	2.4	1.5	4.1	499.9
1994	105.6	149.3	103.1	48.5	39.7	18.6	4.3	1.6	3.0	473.7
1995	465.2	67.1	101.4	80.8	82.5	43.1	14.6	3.2	1.4	859.2
1996	553.2	195.6	60.0	38.1	35.1	32.0	17.7	2.3	0.9	934.9
1997	243.2	209.1	55.0	18.2	10.3	10.2	6.9	2.0	0.4	555.4
1998	189.9	272.2	168.5	62.8	17.1	8.2	5.6	2.7	0.5	727.4
1999	105.0	179.2	132.2	106.2	20.8	4.0	3.9	2.1	0.4	553.8

Table A6. North-east Arctic COD. Mean length at age(cm) from Norwegian surveys in January-March 1983-1999 values re-calculated from raw data.

Year	1	2	3	4	5	6	7	8
1978	14.2	23.1	32.1	45.9	54.2	64.6	67.6	76.9
1979	12.8	22.9	33.1	40.0	52.3	64.4	74.7	83.0
1980	17.6	24.8	34.2	40.5	52.5	63.5	73.6	83.6
1981	17.0	26.1	35.5	44.7	52.0	61.3	69.6	77.9
1982	14.8	25.8	37.6	46.3	54.7	63.1	70.8	82.9
1983	12.8	27.6	34.8	45.9	54.5	62.7	73.1	78.6
1984	14.2	28.4	35.8	48.6	56.6	66.2	74.1	79.7
1985	16.5	23.7	40.3	48.7	61.3	71.1	81.2	85.7
1986	11.9	21.6	34.4	49.9	59.8	69.4	80.3	93.8
1987	13.9	21.0	31.8	41.3	56.3	66.3	77.6	87.9
1988	15.3	23.3	29.7	38.7	47.6	56.8	71.7	79.4
1989	12.5	25.4	34.7	39.9	46.8	56.2	67.0	83.3
1990	14.4	27.9	39.4	47.1	53.8	60.6	68.2	79.2
1991	13.6	27.2	41.6	51.7	59.5	67.1	72.3	77.6
1992	13.2	23.9	41.3	49.9	60.2	68.4	76.1	82.8
1993	11.3	20.3	35.9	50.8	59.0	68.2	76.8	85.8
1994	12.0	18.3	30.5	44.7	55.4	64.3	73.5	82.4
1995	12.7	18.7	29.9	42.0	54.1	64.1	74.8	80.6
1996	12.6	19.6	28.1	41.0	49.3	61.4	72.2	85.3
1997 ¹	11.4	18.8	28.0	40.4	49.9	59.3	69.1	80.6
1998 ¹	10.9	17.4	28.7	40.0	50.5	58.9	67.5	76.3
1999	12.1	18.8	29.0	40.6	50.6	59.9	70.3	78.0
2000	13.0	21.0	28.7	39.7	51.5	61.6	70.5	75.7

¹ Adjusted lengths

Table A7. North-east Arctic COD. Weight (g) at age from Norwegian surveys in January-March

Year	Age							
	1	2	3	4	5	6	7	8
1983		190	372	923	1597	2442	3821	4758
1984	23	219	421	1155	1806	2793	3777	4566
1985		171	576	1003	2019	3353	5015	6154
1986		119	377	997	1623	2926	3838	7385
1987 ²	21	65	230	490	1380	2300	3970	
1988	24	114	241	492	892	1635	3040	4373
1989	16	158	374	604	947	1535	2582	4906
1990	26	217	580	1009	1435	1977	2829	4435
1991	18	196	805	1364	2067	2806	3657	4502
1992	20	136	619	1118	1912	2792	3933	5127
1993	9	71	415	1179	1743	2742	3977	5758
1994	13	55	259	788	1468	2233	3355	4908
1995	16	54	248	654	1335	2221	3483	4713
1996	15	62	210	636	1063	1999	3344	5514
1997 ¹	12	54	213	606	1112	1790	2851	4761
1998 ¹	10	47	231	579	1145	1732	2589	3930
1999	13	55	219	604	1161	1865	2981	3991
2000	17	77	210	559	1189	1978	2989	3797

¹ Adjusted weights² Estimated weights

Table A8. Northeast Arctic COD. Length at age in cm in the Lofoten survey

Year/age	5	6	7	8	9	10	11	12+
1985	59.6	71.1	79.0	88.2	97.3	105.2	114.0	
1986	62.7	70.0	80.0	89.4	86.6		105.8	115.0
1987	58.2	64.5	76.7	86.2	88.0		118.5	116.0
1988	53.1	67.1	71.6	94.0	97.0	119.6		
1989	54.0	59.0	69.8	80.8	96.6	103.0		125.0
1990	56.9	65.1	69.2	79.5	83.7	100.1		
1991	59.0	67.3	74.4	81.0	91.3	99.8	85.0	
1992	66.3	68.7	78.3	83.9	89.2	92.2	101.9	127.0
1993	58.3	66.1	72.8	83.6	87.4	92.7	95.4	111.2
1994	64.3	70.6	82.0	87.3	90.0	95.3	92.4	101.4
1995	61.5	69.7	77.8	84.4	92.6	96.7	100.3	99.5
1996	62.2	67.1	75.9	81.0	93.6	100.9	97.4	104.1
1997	63.7	68.6	74.2	83.8	99.9	108.4		109.0
1998	55.0	62.6	70.2	80.0	92.0	98.0	96.7	115.0
1999	52.7	67.0	69.4	78.6	85.8	100.3	102.0	125.0
2000	58.4	66.5	72.6	77.0	83.9	90.6	93.7	112.4

Table A9. Northeast Arctic COD. Mean weight at age (kg) in the Lofoten survey

Year	5	6	7	8	9	10	11	12+
1985	2.00	3.42	4.61	6.67	8.89	10.73	14.29	
1986	2.22	3.22	4.74	6.40	5.80		10.84	13.48
1987	1.44	1.94	3.61	5.40	5.64		13.15	12.55
1988	1.46	2.82	3.39	6.63	7.27	13.64		
1989	1.30	1.77	2.89	4.74	8.28	9.98		26.00
1990	1.54	2.32	2.55	3.78	4.77	8.80		
1991	2.21	2.52	3.51	5.18	7.40	11.36	5.35	
1992	2.56	2.85	3.99	5.43	6.35	8.03	9.50	17.80
1993	1.79	2.58	3.55	5.31	6.21	7.69	9.28	14.71
1994	2.31	3.27	5.06	6.39	6.64	7.92	7.73	10.10
1995	2.20	3.24	4.83	5.98	7.80	10.03	10.39	10.68
1996	2.22	2.75	4.11	5.63	7.92	10.53	10.58	12.08
1997	2.42	2.92	3.86	5.71	9.65	13.41		12.67
1998	1.88	2.09	2.98	4.85	7.92	9.91	11.05	18.34
1999	1.51	2.80	2.96	4.22	5.92	9.33	9.17	16.00
2000	1.71	2.50	3.16	3.85	5.32	7.07	7.62	12.84

Table A10 North-east Arctic COD. Results from the Russian trawl-acoustic survey in the Barents Sea and adjacent wates in the autumn. Stock number in millions.

Year	Age										Total	
	0	1	2	3	4	5	6	7	8	9 10+		
1985 ¹	45	105	895	422	255	83	44	50	21	2	16	1939
1986 ¹	60	53	141	980	444	183	56	62	19	0	2	2000
1987 ²	8	15	170	170	738	99	67	42	20	9	5	1344
1988 ²	+	+	43	161	106	245	34	10	2	+	+	602
1989 ¹	2	1	4	17	44	56	99	82	20	6	4	335
1990 ¹	29	22	57	29	35	52	46	89	14	2	1	376
1991 ¹	33	44	75	89	51	53	61	45	43	+	+	494
1992 ¹	228	61	333	317	110	45	37	38	29	22	3	1223
1993 ¹	9	10	45	215	243	136	43	14	14	8	11	783
1994 ¹	215	58	110	208	282	277	120	44	8	4	3	1332
1995 ¹	255	59	47	86	160	203	100	28	8	2	3	951
1996 ^{1,3,5}	210	297	188	130	201	290	276	123	23	1	3	1742
1997 ^{4,5}	342	98	263	216	99	68	49	27	9	1	1	1172
1998 ¹	7	28	117	299	147	41	17	11	4	1	+	673
1999 ¹	4	17	91	171	242	95	21	9	6	2	+	658
New method												
1995 ¹	2950	331	75	112	150	180	81	20	6	1	1	3907
1996 ^{1,3}	13765	5869	365	127	63	75	58	23	5	1	+	20352
1997 ⁴	1105	48	108	83	26	19	16	9	3	1	+	1418
1998 ¹	136	130	141	331	133	36	15	9	3	1	+	935
1999 ¹	161	67	265	264	199	76	16	7	5	2	+	1063

¹ October-December

² September-October

³ Area IIb not covered

⁴ Areas IIa, IIb covered in October-December, part of Area I covered in February-March 1998

⁵ Adjusted for incomplete area coverage

Table A11. North-East Arctic COD. Results from the Russian bottom 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	10+	
	<u>Sub-area I</u>											
1982	1.4	0.2	6.9	13.2	7.4	1.9	2.8	0.4	0.0	0.0	0.0	34.2
1983	4.3	8.0	5.1	4.6	5.4	5.9	2.7	0.7	1.2	0.1	0.0	38.0
1984	0.7	12.3	11.6	25.5	13.7	6.5	4.0	1.6	0.6	0.3	0.0	76.8
1985	3.3	2.9	51.3	35.2	53.1	25.2	4.4	1.8	0.8	0.1	0.1	178.2
1986	0.3	2.2	7.0	60.4	15.8	8.2	1.8	0.6	0.1	0.1	0.0	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
1989	0.4	0.1	1.0	3.5	11.2	15.4	20.8	16.1	3.7	0.7	0.3	73.4
1990	6.8	4.8	12.7	5.3	6.0	9.4	8.2	14.6	2.2	0.2	+	70.2
1991	3.1	5.9	10.9	14.0	7.5	7.7	8.1	5.5	4.2	0.3	0.1	67.3
1992	10.3	2.9	26.4	42.3	22.4	8.5	4.6	5.6	3.3	2.7	0.6	129.6
1993	1.7	1.1	7.8	67.9	89.5	47.2	16.0	4.6	4.2	2.0	3.2	245.3
1994	15.8	2.8	10.9	28.4	45.0	52.4	17.9	6.3	1.4	0.7	1.1	182.6
1995	24.8	7.3	3.8	13.1	30.4	40.5	13.8	3.1	1.1	0.3	0.3	138.5
1996	10.4	12.8	10.4	7.0	11.7	16.9	12.1	5.1	1.1	0.1	0.1	87.7
1997	-	-	-	-	-	-	-	-	-	-	-	-
1998	1.2	4.5	27.1	51.0	14.7	5.5	1.8	1.1	0.4	0.1	+	107.4
1999	0.5	2.0	11.8	29.3	31.9	14.8	3.3	1.1	0.6	0.2	0.1	95.6
	<u>Division IIa</u>											
1982	0.1	+	11.7	10.6	4.7	1.1	4.1	2.0	0.2	0.3	0.2	35.0
1983	0.7	0.4	0.3	1.5	6.4	5.0	2.1	1.3	1.2	0.1	0.2	19.2
1984	0.4	0.7	0.6	3.7	4.0	6.7	4.7	1.1	0.3	0.1	0.2	22.5
1985	0.2	0.2	1.4	3.7	9.5	12.6	6.4	2.5	0.6	0.1	0.1	37.6
1986	0.0	+	0.1	2.5	2.9	3.2	1.5	0.5	0.4	0.0	0.2	11.3
1987	0.0	0.0	0.0	0.0	3.0	1.7	2.3	0.9	0.1	0.0	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
1989	0.0	+	0.1	0.3	0.9	1.3	3.9	3.9	1.2	0.5	0.2	12.3
1990	0.0	+	0.3	1.1	1.6	2.2	1.9	4.4	0.9	0.1	+	12.5
1991	1.0	0.1	0.5	1.3	1.9	2.2	2.5	1.9	1.7	0.2	0.1	13.3
1992	0.4	0.3	0.3	2.7	3.8	3.0	2.2	2.1	1.8	1.3	0.1	18.0
1993	0.2	0.1	0.1	3.5	9.9	13.1	4.5	1.3	1.2	0.7	0.8	35.4
1994	0.2	0.1	0.3	4.0	28.3	46.2	22.4	6.3	1.4	0.8	1.6	116.6
1995	4.8	1.3	1.0	1.6	6.1	19.6	8.8	2.7	0.7	0.1	0.2	46.9
1996	4.3	15.6	7.1	5.7	9.2	12.4	6.9	1.7	0.4	+	+	63.5
1997	8.1	0.6	1.5	2.9	2.5	2.3	2.8	2.0	0.7	+	+	23.5
1998	0.4	1.8	1.1	11.9	10.8	6.7	5.6	3.8	1.6	0.1	0.1	43.8
1999	0.4	0.8	3.2	6.8	26.4	15.0	3.1	2.8	1.6	0.6	0.2	60.9

Table A11 (Continued)

	<u>Division IIb</u>											
1982	9.9	1.7	42.5	17.8	1.1	0.2	1.5	0.5	0.0	0.0	0.0	75.2
1983	9.7	14.9	5.0	9.4	11.0	2.6	0.7	0.8	0.7	0.1	0.1	55.0
1984	1.4	7.7	22.7	7.4	2.7	2.4	1.3	0.4	0.2	0.2	0.0	46.4
1985	9.1	9.4	45.2	32.3	32.8	11.5	5.3	1.8	0.3	0.0	0.1	147.8
1986	1.6	2.9	14.8	67.2	19.9	16.4	5.4	1.3	0.6	0.1	0.0	127.1
1987	0.0	0.2	5.6	11.0	64.4	4.0	2.2	0.5	0.1	0.0	0.0	88.0
1988	0.1	0.4	4.8	13.7	15.1	25.0	2.5	0.6	0.1	0.2	0.0	62.8
1989	0.6	0.1	0.3	3.8	6.4	6.1	9.2	5.4	0.2	0.4	0.2	33.7
1990	0.1	0.7	1.3	2.3	2.9	3.7	3.9	8.6	1.6	0.3	+	25.4
1991	6.4	7.1	10.1	8.4	5.2	6.3	8.2	6.5	5.9	0.5	0.1	64.7
1992	60.5	15.1	60.5	60.8	13.8	5.2	6.5	5.0	5.1	3.4	0.5	236.4
1993	4.7	5.9	23.8	60.3	44.6	24.7	5.6	3.2	3.4	2.5	3.6	182.3
1994	3.0	6.0	19.5	44.3	61.4	45.3	16.3	5.6	1.5	1.0	1.9	205.6
1995	36.0	8.6	7.7	18.3	35.5	21.7	13.6	2.3	0.5	0.1	0.3	144.6
1996	-	-	-	-	-	-	-	-	-	-	-	-
1997	15.9	7.3	25.7	20.1	7.0	4.2	2.3	0.8	0.3	+	+	83.6
1998	2.2	7.9	25.7	81.9	54.4	9.6	3.3	1.9	0.4	0.1	+	187.6
1999	2.3	6.6	27.0	44.6	93.5	23.6	3.7	1.7	1.0	0.2	+	203.8
	<u>Total (Sub-area I and Division IIa and IIb)</u>											
1982	3.7	0.6	18.1	14.1	5.1	1.3	2.6	0.7	0.0	0.1	0.0	46.3
1983	5.4	8.9	4.3	5.6	7.3	4.7	2.0	0.8	1.1	0.1	0.0	40.2
1984	0.9	9.2	14.2	16.2	8.6	5.0	3.1	1.1	0.4	0.3	0.1	59.1
1985	5.0	4.9	43.0	30.3	40.5	18.8	4.9	1.9	0.6	0.0	0.0	150.0
1986	0.7	2.2	9.1	56.5	16.1	10.6	3.0	0.8	0.3	0.1	0.0	99.4
1987	0.0	0.2	4.0	5.9	42.6	5.4	3.1	0.6	0.1	+	0.0	61.9
1988	0.1	0.2	2.5	7.7	7.8	19.0	2.5	0.6	0.1	0.2	0.0	40.8
1989	0.4	0.1	0.6	3.4	8.8	11.8	15.5	11.4	2.6	0.5	0.3	54.8
1990	4.0	3.1	7.8	3.8	4.4	6.6	6.0	11.3	1.8	0.2	+	49.0
1991	4.2	5.9	9.8	11.0	6.2	5.8	7.7	5.6	4.6	0.4	0.1	62.3
1992	30.6	7.8	39.5	48.5	18.2	6.9	5.3	5.2	4.0	2.9	0.5	169.4
1993	2.8	2.8	13.1	64.7	59.7	33.4	9.1	3.4	3.3	2.1	2.9	197.4
1994	11.2	3.3	12.0	30.0	47.5	50.0	18.0	6.1	1.4	0.8	1.3	181.5
1995	24.9	6.4	4.6	12.4	26.7	28.7	12.6	2.7	0.8	0.2	0.3	120.3
1996 ¹	9.3	13.4	9.9	6.8	11.3	16.4	11.4	4.4	1.0	0.1	0.1	84.2
1997 ¹	13.3	4.8	18.4	17.4	7.6	5.9	3.3	1.5	0.5	0.1	+	71.0
1998	1.5	5.2	23.2	55.8	27.1	7.0	2.8	1.7	0.6	0.1	+	125.0
1999	1.0	3.3	16.0	31.8	53.1	17.8	3.2	1.4	0.9	0.3	0.1	128.9

¹ Adjusted assuming area distribution as 1984-1995 average.

Table A12 North-East Arctic COD. Length at age (cm) from Russian surveys in November-December.

Year	Age									
	0	1	2	3	4	5	6	7	8	9
1984	15.7	22.3	30.7	44.3	51.7	63.6	73.4	82.5	88.4	97.0
1985	15.0	21.1	30.6	43.2	53.7	61.2	72.8	83.0	92.8	101.3
1986	15.2	19.7	28.3	39.0	51.8	62.2	70.9	83.0	91.3	104.0
1987	-	19.2	27.9	33.4	41.4	59.1	69.2	80.1	95.7	102.6
1988	11.3	21.3	28.7	36.2	43.9	53.3	65.3	79.5	85.0	-
1989	-	20.8	28.8	34.8	46.0	53.9	61.8	69.8	78.7	88.6
1990	16.0	24.0	30.4	46.5	54.9	62.5	69.7	77.6	87.8	102.0
1991	11.5	22.4	30.6	43.0	55.9	64.6	72.8	78.5	87.9	101.8
1992	11.3	21.3	31.9	50.1	59.8	69.1	78.6	84.0	90.8	97.5
1993	12.1	17.4	29.1	43.4	52.7	64.3	73.9	81.2	89.1	91.8
1994	12.2	20.3	26.3	33.7	47.4	58.7	70.6	80.8	90.1	96.1
1995	11.6	19.8	27.6	33.8	45.2	60.5	71.1	83.5	92.9	99.1
1996	10.2	20.0	28.1	36.7	48.7	58.9	70.5	80.0	93.6	102.7
1997	9.6	18.5	28.8	38.2	50.8	62.0	70.5	80.1	88.9	103.5
1998	11.4	19.0	28.0	36.4	50.5	61.0	70.7	80.3	91.1	102.5
1999	11.7	19.7	27.9	35.3	51.6	60.6	70.6	78.9	86.8	94.3

Table A13 North-East Arctic COD. Weight (g) at age from Russian surveys in November-December.

Year	Age										
	0	1	2	3	4	5	6	7	8	9	10
1984	26	90	250	746	1,187	2,234	3,422	5,027	6,479	9,503	-
1985	26	80	245	762	1,296	1,924	3,346	5,094	7,360	6,833	11,167
1986	25	63	191	506	1,117	1,940	2,949	4,942	7,406	9,300	-
1987	-	54	182	316	672	1,691	2,688	3,959	8,353	10,583	13,107
1988	15	78	223	435	789	1,373	2,609	4,465	5,816	-	-
1989	-	73	216	401	928	1,427	2,200	3,133	4,649	6,801	8,956
1990	28	106	230	908	1,418	2,092	2,897	4,131	6,359	10,078	13,540
1991	26	93	260	743	1,629	2,623	3,816	4,975	7,198	11,165	15,353
1992	10	76	273	1,165	1,895	2,971	4,377	5,596	7,319	9,452	12,414
1993	11	46	211	717	1,280	2,293	3,509	4,902	6,621	7,339	8,494
1994	12	69	153	316	919	1,670	2,884	4,505	6,520	8,207	9,812
1995	11	61	180	337	861	1,987	3,298	5,427	7,614	9,787	10,757
1996	7	64	191	436	1,035	1,834	3,329	5,001	8,203	10,898	11,358
1997	6	48	203	487	1,176	2,142	3,220	4,805	6,925	10,823	12,426
1998	11	55	187	435	1,186	2,050	3,096	4,759	7,044	11,207	12,593
1999	10	58	177	371	1,214	1,925	3,064	4,378	6,128	7,843	11,543

Table A14 Abundance indices of 0-group fish in the Barents Sea and adjacent waters in 1965–1999.

Year	Cod	Haddock	Polar cod		Redfish	Greenland halibut	Long rough dab
			West	East			
1965	6	7		0	159		66
1966	1	1		129	236		97
1967	34	42		165	44		73
1968	25	8		60	21		17
1969	93	82		208	295		26
1970	606	115		197	247	1	12
1971	157	73		181	172	1	81
1972	140	46		140	177	8	65
1973	684	54		(26)	385	3	67
1974	51	147		227	468	13	83
1975	343	170		75	315	21	113
1976	43	112		131	447	16	96
1977	173	116	157	70	472	9	72
1978	106	61	107	144	460	35	76
1979	94	69	23	302	980	22	69
1980	49	54	79	247	651	12	108
1981	65	30	149	73	861	38	95
1982	114	90	14	50	694	17	150
1983	386	184	48	39	851	16	80
1984	486	255	115	16	732	40	70
1985	742	156	60	334	795	36	86
1986	434	160	111	366	702	55	755
1987	102	72	17	155	631	41	174
1988	133	86	144	120	849	8	72
1989	202	112	206	41	698	5	92
1990	465	227	144	48	670	2	35
1991	766	472	90	239	200	1	28
1992	1,159	313	195	118	150	3	32
1993	910	240	171	156	162	11	55
1994	899	282	50	448	414	20	272
1995	1,069	148	6	-	220	15	66
1996	1,142	196	59	484	19	5	10
1997	1,077	150	129	453	50	13	42
1998	576	593	144	457	78	11	28
1999	194	184	116	696	27	13	66

Table A15 Estimated logarithmic indices with 90% confidence limits of year class abundance for 0-group herring, cod and haddock in the Barents Sea and adjacent waters 1965–1999.

Year	Herring ¹			Cod			Haddock		
	Index	Confidence limits		Index	Confidence limits		Index	Confidence limits	
1965				+					
1966	0.14	0.04	0.31	0.02	0.01	0.04	0.01	0.00	0.03
1967	0.00	-	-	0.04	0.02	0.08	0.08	0.03	0.13
1968	0.00	-	-	0.02	0.01	0.04	0.00	0.00	0.02
1969	0.01	0.00	0.04	0.25	0.17	0.34	0.29	0.20	0.41
1970	0.00	-	-	2.51	2.02	3.05	0.64	0.42	0.91
1971	0.00	-	-	0.77	0.57	1.01	0.26	0.18	0.36
1972	0.00	-	-	0.52	0.35	0.72	0.16	0.09	0.27
1973	0.05	0.03	0.08	1.48	1.18	1.82	0.26	0.15	0.40
1974	0.01	0.01	0.01	0.29	0.18	0.42	0.51	0.39	0.68
1975	0.00	-	-	0.90	0.66	1.17	0.60	0.40	0.85
1976	0.00	-	-	0.13	0.06	0.22	0.38	0.24	0.51
1977	0.01	0.00	0.03	0.49	0.36	0.65	0.33	0.21	0.48
1978	0.02	0.01	0.05	0.22	0.14	0.32	0.12	0.07	0.19
1979	0.09	0.01	0.20	0.40	0.25	0.59	0.20	0.12	0.28
1980	-	-	-	0.13	0.08	0.18	0.15	0.10	0.20
1981	0.00	-	-	0.10	0.06	0.18	0.03	0.00	0.05
1982	0.00	-	-	0.59	0.43	0.77	0.38	0.30	0.52
1983	1.77	1.29	2.33	1.69	1.34	2.08	0.62	0.48	0.77
1984	0.34	0.20	0.52	1.55	1.18	1.98	0.78	0.60	0.99
1985	0.23	0.18	0.28	2.46	2.22	2.71	0.27	0.23	0.31
1986	0.00	-	-	1.37	1.06	1.70	0.39	0.28	0.52
1987	0.00	0.00	0.03	0.17	0.01	0.40	0.10	0.00	0.25
1988	0.32	0.16	0.53	0.33	0.22	0.47	0.13	0.05	0.34
1989	0.59	0.49	0.76	0.38	0.30	0.48	0.14	0.10	0.20
1990	0.31	0.16	0.50	1.23	1.04	1.34	0.61	0.48	0.75
1991	1.19	0.90	1.52	2.30	1.97	2.65	1.17	0.98	1.37
1992	1.06	0.69	1.50	2.94	2.53	3.39	0.87	0.71	1.06
1993	0.75	0.45	1.14	2.09	1.70	2.51	0.64	0.48	0.82
1994	0.28	0.17	0.42	2.27	1.83	2.76	0.64	0.49	0.81
1995	0.16	0.07	0.29	2.40	1.97	2.88	0.25	0.13	0.40
1996	0.65	0.47	0.85	2.87	2.53	3.24	0.39	0.25	0.56
1997	0.39	0.25	0.54	1.60	1.35	1.86	0.21	0.12	0.31
1998	0.59	0.40	0.82	0.68	0.48	0.91	0.59	0.44	0.76
1999	0.41	0.25	0.59	0.21	0.11	0.34	0.25	0.11	0.44

¹Assessment for 1965–1984 made by Toresen (1985).

Table A16 The North-east arctic COD stock's consumption of various prey species in 1984-1997 (1000 tonnes)

Year	Other	Amphipods	Krill	Shrimp	Capelin	Herring	Polar cod	Cod	Haddock	Redfish	G. halibut	Total
1984	512	27	114	443	735	80	15	22	51	370	0	2369
1985	1173	172	58	157	1640	185	3	32	47	227	0	3695
1986	670	1232	109	143	844	135	142	83	110	316	0	3784
1987	668	1064	66	189	226	32	202	25	4	318	0	2794
1988	408	1228	316	128	334	8	90	9	3	220	0	2743
1989	733	816	243	133	585	3	32	8	11	234	0	2797
1990	1571	137	83	193	1594	7	6	19	15	241	0	3866
1991	1091	66	76	188	2894	8	12	26	20	309	7	4697
1992	1021	103	159	376	2463	331	97	54	106	188	20	4920
1993	788	254	718	316	3056	164	278	285	72	100	2	6035
1994	688	576	720	529	1110	149	598	234	49	79	0	4731
1995	854	974	512	364	632	114	254	390	116	193	1	4405
1996	672	638	1178	349	548	47	105	546	69	97	0	4250
1997	543	420	561	337	964	6	116	355	43	37	1	3383
1998	519	412	547	369	827	106	165	187	37	12	0	3181
1999	602	137	288	251	1363	156	162	94	29	21	1	3103

Table A17. North-east Arctic COD. Results from the Norwegian bottom trawl survey in the Svalbard area and the Barents Sea in August-September. Index of number of fish at each age. Rock-hopper gear. Corrected for length-dependent effective spread of trawl.

Year	Age									Total
	1	2	3	4	5	6	7	8	9+	
1990	197.9	27.4	32.1	25.3	38.1	31.3	58.1	5.5	0.9	416.6
1991	391.4	213.6	105.6	31.0	20.2	22.3	20.7	31.3	3.8	839.9
1992	450.1	449.5	240.2	169.7	33.0	17.8	10.0	6.7	12.2	1389.2
1993	453.7	542.1	448.9	123.2	64.6	13.2	7.2	2.4	9.8	1665.1
1994										
1995	1045.7	257.4	233.4	281.0	180.3	66.9	22.1	4.6	0.0	2091.4
1996	2061.4	710.9	161.2	159.4	142.6	80.5	38.3	6.3	0.0	3360.5
1997*	1168.5	889.5	251.7	69.5	52.5	52.1	30.8	11.0	0.0	2525.7
1998**	1425.2	710.2	468.5	137.8	34.6	19.5	12.0	5.7	0.0	2813.4
1999	339.2	418.2	299.4	191.3	44.9	9.0	5.8	3.6	0.0	1311.5
ratio95	1.40	2.21	1.32	1.58	1.70	1.41	1.22	1.22	1.23	
ratio96	1.57	1.61	1.54	1.81	1.94	1.77	1.53	1.48	1.10	
ratio99	1.69	1.52	1.57	1.31	1.27	1.34	1.13	1.08	1.33	

*raised by the 1996 ratio

**raised by the 1999 ratio