Advisory Committee on Fishery Management

ICES CM 1998/Assess:2

REPORT OF THE

ARCTIC FISHERIES WORKING GROUP

ICES, Headquarters
20 - 28 August 1997

PART 1 OF 2

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

TABLE OF CONTENTS

Section		Page

Section	Page

1 PARTICIPANTS

Ole Thomas Albert	Norway
Erik Berg	Norway
Bjarte Bogstad	Norway
W. Ray Bowering	Canada
Konstantin V. Drevetnyak	Russia
Åge Fotland	Norway
Tore Jakobsen	Norway
C. Tara Marshall	Norway
Sigbjørn Mehl	Norway
Lorenzo Motos	Spain
Kjell H. Nedreaas	Norway
Xabier Paz Canalejo	Spain
Rüdiger Schöne	Germany
Knut Sunnanå (Chairman)	Norway
Victor Tretyak	Russia
Natalia A. Yaragina	Russia

2 INTRODUCTION

2.1 Terms of reference

Compared to last year, the terms of reference is somewhat changed, as stated by The ICES Statutory Meeting in 1996:

"2:14:3 The **Arctic Fisheries Working Group** [AFWG] (Chairman: Mr. K. Sunnanå, Norway) will meet at ICES Headquarters from 20-28 August 1997 to:

a) assess the status of and provide catch options for 1998 for the stocks of cod, haddock, saithe, and Greenland halibut in Sub-areas I and II, taking into account interactions with other species;

b) assess the status and provide catch options for redfish in Sub-areas I and II; alternative methods to conventional catch-at-age analysis should also be attempted, such as the use of stock-production models;

c) propose a definition of safe biological limits using target reference points based, where appropriate, on biomass, fishing mortality, maturity, growth, age structure, exploitation pattern, geographical distribution and other relevant parameters; based on the above parameters, propose limit reference pints to be avoided with high probability;

d) prepare medium-term forecasts of yield and SSB, taking into account uncertainties in data and assessments and assuming a stock recruitment relationship, to indicate the probability of attaining target reference points and avoiding limit reference points;

e) provide information on quantities of discards by gear type and area for the stocks of fish and fisheries considered by this group [OSPAR 1997/5.3] and report to WGECO.

The above terms of reference are set up to provide ACFM with the information required to respond to the requests for advice from the NEAFC, the EC and OSPAR."

No major changes in the structure of the report is necessary to address the Terms of Reference set up for the WG this year. However, the WG have treated the terms of reference points c) and e) in separate subsections in the introduction (Sections 2.3 and 2.4).

2.2 General comments to the work

At the October-November 1996 meeting, ACFM provided some comments on the work of the Arctic Fisheries WG in 1996. Once again, we appreciate the positive comments on the quality of our work.

This year the WG have put a lot of effort into developing risk models for both cod and haddock in addition to saithe as an answer to comments from ACFM. The result of this work is described later in the section on Northeast Arctic Cod.

The WG this year has faced considerable problems with the methods available, especially concerning the evaluation of the strength of recruiting year classes. The WG, however, did not manage to apply any *ad hoc* programs to investigate the consistency of the surveys as proposed by ACFM. The WG feels that such work should be done by the relevant institutes providing the survey data to the WG. Before the meeting of the WG considerable concern was expressed for the observed increase in mortality of Northeast Arctic cod seen in some of the surveys, however, no useful analysis of this was available to the WG.

The WG last year presented an assessment that changed the perception of the stock size of Northeast Arctic cod considerably upwards compared to earlier years. Despite warnings given by scientists and others on the significance of this perception of the cod stock, this eventually resulted in an considerable increase in the allocated quota. Members of the WG thus expected, *a priori*, that this change in perception would be reversed this year.

Last year cannibalism was fully implemented in the assessment of Northeast Arctic cod, accounting for the bulk of the discussion on cod at that meeting. The WG regrets that this work may have overshadowed the problem of assessing the size of the potentially strong year classes from 1989 and following. Some considerations on the use of power curve relationship versus linear relationship to describe the relation between survey indices and VPA abundance figures were done last year and probably resulted in an overestimation of the above mentioned year classes. This problem was not solved during the current meeting, but was the focus of long discussions. The WG, at the end of the current meeting, has a clear opinion that the available tools for assessing the stock of Northeast Arctic cod and haddock are not appropriate for the work.

Several suggestions for improving the assessments were also proposed by the Comprehensive Fisheries Evaluation WG at their 1997 meeting, among which specially the problems of time trends in the surveys may have particular influence on the problems that faced the WG this year. However, the WG had no possibility to do any such analysis.

2.3 Biological limits and reference points

The WG has had a thorough discussion on the available information to construct reference points for the stocks included in this WG. It was felt that at the present time, no other useful points were available than F_{med} and MBAL SSB. The use of F_{max} , F_{low} and F_{high} were also discussed and the WG felt that the points could very well be used in projections, but the advice should be focused around F_{med} and MBAL SSB.

The WG was provided with an excellent evaluation of ways to evaluate the quality of the SSB with respect to recruitment and also to evaluate the SSB independently of the VPA-generated stock. This work is described under the cod section in the report.

The WG feels that developing these considerations may give the necessary foundation for managing stocks in relation to observed changes in the spawning stock, and hence, recruitment potential of the stock.

2.4 Information on discards by gear type and area

The WG addressed the request for data on discards and concluded that very little data are available. Some of the members of the WG provided some data. It was also given information on ongoing work in this field in several countries. Several of the members of the WG are involved in projects dealing with discards and bycatch and the chairman will take on the responsibility to collect information from the various projects, as he is also conducting a project in this field.

At the present time, the WG is not able to provide any estimates of discards in Sub-areas I and II to the WG on Ecological Impact of Fisheries. The WG believes that there is some amount of discard in these areas based on observations, but do not have any information as to whether the discarding is increasing or decreasing. From the historical survey data provided for tuning it may, however, be concluded that unaccounted mortality probably have been large in periods.

2.5 Norwegian coastal cod

This year a first attempt to conduct a tuned VPA estimate of Norwegian coastal cod has been conducted. This involves a complete different calculation of catches than the previous one used for this stock, and one result is that some catches of Norwegian coastal cod is contained in both the catch statistic for Northeast Arctic cod and the new one for coastal cod. Before approving this new assessment of Norwegian coastal cod, special considerations should be put into compiling the catches of Northeast Arctic cod and Norwegian coastal cod. The view of the WG is that this should also be seen in connection with the announced revision of the time series of both Northeast Arctic cod and haddock to avoid several revisions of the catch data.

2.6 Quality and coverage of sampling

The members of the WG provided information on the number of samples taken in 1996 to compile the catch and the surveys and this is summarised in the following table. The information is the sum of samples from Germany, Norway, Russia (catch numbers also include survey numbers), Spain and UK.

Species	Catch		Surveys		Predation
	No. age/length readings	No. length measurements	No. age/lengthreadings	No. lengthmeasurements	No. of samples
Cod	35840	659108	8221	173283	8641
Haddock	15678	225428	3779	63842	
Saithe	5824	15954	1137	9984	
Redfish	1620	8997	2688	44566	
Greenland halibut	1675	7886	7729	62598	

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

3.1 Status of the fisheries

3.1.1 Historical development of the fisheries (Table 3.1)

From a level of about 900,000 t in the mid-1970s, landings declined steadily to around 300,000 t in 1983-1985 (Table 3.1). 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, and have been stable around 750,000 t since 1994. This level is the highest since 1977, and is also above the long-term mean for the period 1946-1996.

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.

3.1.2 Landings prior to 1997 (Tables 3.1-3.3 and F1, Figure 3.1A)

Final reported landings for 1995 amount to 739,999 t (Table 3.1), excluding 39,285 t of Norwegian coastal cod (Table F1). The provisional figures for 1996 are 731,852 t excluding 32,422 t of Norwegian coastal cod. This is close to the estimate of 740,000 t used by the Working Group last year. The agreed TAC on North-East Arctic cod was exceeded by 31,852 t and the total quota, including 40,000 t of Norwegian coastal cod, was exceeded by 24,274 t. Catches in excess of the agreed TAC in 1996 are mainly catches by countries without a quota (Iceland and other non-quota countries). The catch by other non-quota countries was estimated to be 6,152 t in 1996 assuming the same ratio between the catches of Iceland and other non-quota countries in 1996 as in 1995. When added to the Icelandic catch this gives a total catch by countries with no quota of 29,157 t, all of which was taken in the international waters (part of Sub-area I) in the Barents Sea. Landings reported to Norwegian authorities were used to determine the catches by some ICES countries which had not reported data on landings to ICES.

The estimates of unreported landings in excess of the quota set in 1990-1994 made by the Working Group last year (Table 3.1) were not changed. The catch by area, split into trawl and other gears, is given in Table 3.2 and the nominal catch by country is given in Table 3.3. From 1995 to 1996, catches increased in ICES Sub-area I, but decreased in the other areas.

3.1.3 Expected landings in 1997

The mixed Norwegian-Russian fisheries commission agreed on a TAC for North-East Arctic cod and Norwegian coastal cod combined for 1997 of 890,000 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 1997, 104,000 t was allocated to third countries and 6,000 t transferred from Russia to Norway, giving a Norwegian TAC of 399,000 t (coastal cod included) and a Russian TAC of 383,000 t. Of the Norwegian TAC, 267,330 t (67%) was allocated to the fishery with conventional gears and 131,670 t (33%) to the trawl fishery.

Based on information about the fishery in 1997, the catches in the international area in the Barents Sea by countries with no quota are expected to be about 10,000 t. The Working Group has no information on the size of expected unreported landings in 1997, but believes this problem may continue. The Working Group assumes that there will be no reported landings in excess of the TAC for countries with a quota. Information from Norwegian authorities indicate that about 20,000 t of the Norwegian quota allocated to fishery with conventional gears will not be taken. The total landings of North-East Arctic cod and Norwegian coastal cod combined in 1996 will thus be 880,000 t. Of this, 40,000 t are expected to be Norwegian coastal cod, giving a catch of North-East Arctic cod of 840,000 t.

The Working Group believes that the catch control and reporting of catches is sufficient to make these predictions based on the assumption of a catch constraint for the current year (1997). The Working Group bases this on information from the Norwegian and Russian authorities. A comprehensive monitoring program by the Norwegian coast guard, including counting of vessels at sea and checkpoints for catch control and reporting, is now fully operational.

3.2 Status of research

3.2.1 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 3.11), but the indices by area in Table A1 has not been updated.

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

The results from the Norwegian survey on demersal fish in the Barents Sea in winter 1997 are described by Mehl (WD, 1997). Tables A2 and A3 shows the time series of abundance estimates (acoustic and bottom trawl, respectively) from these surveys. A substantial part of the stock distribution area (i.e. the Russian EEZ) was not surveyed in winter 1997. The indices for 1997 are, therefore, adjusted by dividing the indices for the Norwegian zone by the corresponding indices for 1996 and multiplying by the total for 1996. The reason for using the 1996 indices for adjustment is that of the years with a complete coverage (1993-1996), 1996 was the year which had oceanographic conditions most similar to 1997. The text table below shows the proportions found in the same area in 1993-1996.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Total
1993	0.90	0.32	0.54	0.85	0.92	0.91	0.86	0.92	0.66
1994	0.38	0.36	0.40	0.54	0.68	0.77	0.67	0.71	0.43
1995	0.50	0.36	0.58	0.89	0.89	0.95	0.92	0.83	0.53
1996	0.30	0.28	0.48	0.75	0.71	0.79	0.83	0.72	0.33

It should be noted that the survey in 1993 and later years covered a larger area than in previous years. 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. The changes in the survey methodology through time are described by Jakobsen *et al.* (1997).

Abundance estimates at age from the Norwegian acoustic survey in the Lofoten area (the main spawning area for this stock) in March/April are given in Table A4. This time series has now been extended back to 1985, and the indices for 1990-1996 have been recalculated, as described by Korsbrekke (1997).

Abundance estimates at age from the Norwegian bottom trawl survey in the Svalbard area in the autumn are given in Table A5. In 1995, the Svalbard survey was included in a new August survey which covers the entire cod stock. Bottom trawl indices from this survey from 1995 and 1996 are given in Table A17, together with indices from 1990-1993, when many bottom trawl stations were taken in the Barents Sea area during the 0-group survey in August/September. No data from this survey were used for this assessment. The Russian EEZ was not covered by this survey in 1997.

The trawl/acoustic estimates from the October-December 1996 Russian survey are given in Table A10 and the bottom trawl abundance estimate in Table A11. ICES Division IIb was not covered during the 1996 survey, and only part of Division IIa was covered, while the coverage in Sub-area I was as in previous years. The reason for this was that only one vessel participated in the survey. Before 1988, trawl catchability coefficients for fish of different size groups were used in the calculations of abundance of fish in the near-bottom layer, while acoustic abundance estimates were used in the pelagic layer. In 1988-1994, the length distributions from trawl catches were used directly to convert acoustic abundance to number of fish. From 1995 onwards, the abundance of cod, haddock and redfish has been assessed taking into account separate echo intensities for three size groups (small, mean and large). Values using both the old and new method are given in Table A10. Methods and history of the Russian trawl and trawl-acoustic surveys of demersal fish are described by Shevelev *et al.* (1996) and Lepesevich and Shevelev (1997).

The abundance of 0-group cod, as estimated in the International 0-group survey (ICES C.M. 1997/G:31) are provided in Tables A14 and A15.

The Norwegian bottom trawl and acoustic surveys in the winter of 1997 both indicated that the abundance of 1-group cod (the 1996 year class) was about the same as last year and that these two year classes are the strongest in the time series (1981-1997). The Russian surveys in late autumn 1996 and the International 0-group survey confirmed that this year class is stronger than average.

The Norwegian acoustic and bottom trawl surveys in the Barents Sea, which were given the highest weight in last year's tuning, both indicate that the mortality on ages 1-6 was higher in 1994-1996 than in the previous years, while the other surveys show more variable results. The 1992-1994 year classes come out somewhat differently in the two surveys, but the general picture is that they are approximately average. The 1990 year class is strong according to all the surveys (strongest or second strongest in all surveys except the Russian trawl/acoustic survey). The 1989 and 1991 year class is also above average according to all the surveys. The Lofoten survey shows a very low abundance of the 1988 and older year classes.

3.2.3 Age reading

The joint Norwegian-Russian work on cod otolith reading has continued, with regular exchanges of otoliths and age readers.

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

Length at age and weight at age from the Norwegian survey of the Barents Sea in winter are given in Tables A6 and A7, respectively. Since the lowest values usually are found in the eastern part of the area, the figures for 1997 have been adjusted in the same way as the abundance indices, using the ratio '1996-total value/1996-Norwegian zone value' as adjusting factor in each age group. The length at age and weight at age from the Lofoten survey are given in Tables A8 and A9, respectively. These numbers have been somewhat changed for those given in last year's report, and data for 1985-1989 have been included, as described in Korsbrekke (1997), while length at age and weight at age from the Russian survey in October-December are given in Tables A12 and A13, respectively. No adjustment for incomplete coverage has been carried out for the Russian survey.

The data on size at age from the autumn 1996 Russian survey and the winter 1997 Norwegian survey were in good agreement with each other. The size at age in 1997 differs little from the 1996 values, and is still at a low level for ages 1-7.

3.2.5 Maturity at age (Table 3.5)

Maturity at age ogives from Russian and Norwegian surveys were compared for a limited time period (1990-97). The Norwegian maturity at age ogives were constructed by combining the Barents Sea survey and the Lofoten survey according to the method described in Marshall *et al.* (submitted ms.). It was noted this year that the Norwegian maturity-at-age ogives tend to give a higher percent mature at age compared to the Russian ogives (Yaragina and Marshall, WD 1997). This difference is consistent with the higher growth rates that are observed for cod sampled in Norwegian surveys relative to the Russian surveys. To give a representative view of the maturity composition of the stock as a whole, the arithmetic average of the Russian and Norwegian ogives (Table 3.5) were used for 1990-97. This approach is consistent with the averaging procedure used to estimate the weight at age in the stock (described in Section 3.3.2). Russian ogives were used for 1984-89 and Norwegian ogives for 1982-83 (Table 3.5). Prior to 1982, knife-edge maturation at age 8 was assumed.

3.3 Data used in the assessment

3.3.1 Catch at age (Table 3.8)

For 1995, revised age compositions in the Norwegian fishery together with final total landings for all countries were used to adjust the number at age in the 1995 landings. For 1996, age compositions for all areas were available from Norway (all gears) and Russia (trawl only). The Russian catches by conventional gears were age distributed using the age distributions from the Norwegian catches for the corresponding gear and area. Age compositions from Divisions IIa and IIb were available from Germany. The UK (England & Wales) and Spain provided age compositions for Division IIb, while Iceland provided age compositions from the fishery in Sub-area I. 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 Icelandic trawl (Sub-area I), by UK trawl (Division IIa) and by Spanish trawl (Division IIb).

A SOP check gave a deviation of < 0.5 % for 1995 and 1996. The number at age was adjusted to make the SOP fit exactly to the nominal catch for these years.

The age composition of the cod catches in 1996 was made up of several year classes, mainly 1989-1991. These year classes (age groups 5-7) together contributed 83 % of the catch in numbers.

3.3.2 Weight at age (Tables 3.4 and 3.9-3.10)

For 1995 and 1996, the mean weight at age in the catch (Table 3.9) was calculated as a weighted average of the weight at age in the catch for Norway, Russia (trawl only), Germany, Spain , the UK and Iceland. The weight at age in the catch for these countries is given in Table 3.4. The weight at age in the catch in 1996 was higher than what was assumed by the Working Group last year for ages 3-7 and lower for age groups 8 and older.

Stock weights at age a (W_a) at the start of year y (Table 3.10) were calculated as follows:

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

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 time series weights were used. As data for the Lofoten survey now are available also for the period 1985-1989, the weight at age in the stock for those years was updated using the formula above.

The stock weights at age in 1997 are in good agreement with the prognosis made by the Working Group last year, but with slightly lower values for ages 8 and younger.

3.3.3 Natural mortality

A natural mortality of 0.2 was used. In addition, cannibalism was taken into account as described in section 3.4.3. The proportion of F and M before spawning was set to zero.

3.3.4 Maturity at age (Tables 3.5 and 3.11)

As mentioned in Section 3.2.5 Norwegian maturity-at-age ogives for 1990-97 indicated higher maturity ogives compared with the Russian ogives (Table 3.5). The differences are consistent with growth differences between the two regions. Consequently, arithmetic averages of the Norwegian and Russian values were used.

3.3.5 Tuning data (Table 3.12)

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	1981-1996
Russian acoustic	Total area	Autumn	1-6	1985-1995
Norwegian bottom trawl	Svalbard	Autumn	1-8	1983-1996
Norwegian trawl fleet	Total area	All year	9-14	1985-1996
Russian trawl fleet	Total area	All year	9-14	1985-1996
Norwegian bottom trawl	Barents Sea	Winter	1-8	1980-1996
Norwegian acoustic	Barents Sea + Lofoten	Winter	1-11	1984-1996

Surveys that were conducted during winter were allocated to the end of the previous year. This was done so that data from the 1997 surveys 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 1.0 is added to the indices before the logarithm is taken.

3.3.6 Recruitment indices (Table 3.6)

There were four indices of recruitment available for the 1996 year class: the Russian bottom trawl index in Sub-area I, the Norwegian Barents Sea trawl and acoustic survey indices as well as an index of recruitment from the International 0-group survey.

3.3.7 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. The method used for calculation of the consumption is described by Bogstad and Mehl (1997).

The cod stomach content data were taken from the joint PINRO-IMR stomach content data base (Mehl and Yaragina 1992). About 6,000 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.

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. For 1996, not all the data collected were available for analysis. Thus, calculations for that year should be considered preliminary.

The number of cod at age was taken from the VPA, and thus an iterative procedure has to be applied (Section 3.4.3). 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 time, 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.

3.3.8 Prediction data

The input data to the short-term prediction with management option table (1997-1999) are given in Table 3.22. The stock number at age in 1997 was taken from the final VPA (Table 3.18) for ages 4 and older. The number at age 3 was taken from the XSA (Table 3.14). The fishing pattern was set to the average of the last 3 years from the final VPA, scaled to the 1996 level, and additional the natural mortality due to cannibalism was set to the 1994-1996 average. The weight at age in the catch in 1997 for ages 3-11 was calculated assuming the same ratio between weight at age in the catch and in the stock as the average ratio for 1994-1996. For age 12 and older the weight in the stock and in the catch in 1997 was set equal to the values used for the period 1946-1981. The average maturity ogive, stock weights and catch weights for the years 1995-1997 was used for 1998 onwards.

The recruitment at age 3 in 1998 (655 million) was calculated by applying the predicted natural mortality at age 2 in 1997 to the XSA estimate of age 2 fish at the beginning of 1997. The recruitment at age 3 in 1999, i.e. the abundance of the 1996 year class at age 3 was estimated using RCT3 (Section 3.5.2).

Both changes in growth and cannibalism in North-East Arctic cod have been associated with fluctuations in the abundance of capelin, i.e. that cod growth is positively correlated with capelin abundance and that cod may switch to preying on cod when the abundance of capelin is low (Bogstad and Mehl, 1997). *Figure* 3.3 shows the development in natural mortality due to cannibalism for cod (prey) age group 1-3, and the abundance of capelin in the period 1984-1996. In Fig 3.4, the individual growth (cm/year) as calculated from the Norwegian winter survey (Table A6) is shown. The predicted abundance of capelin in 1997 and 1998 given by Bogstad *et al.* (WD 1997), based on data presented to the Northern Pelagic and Blue Whiting Fisheries Working Group (ICES C.M. 1997/Assess:14) is also shown. Based on these figures, some decrease in cod cannibalism and some increase in cod growth could be expected in the near future. As for cannibalism, using the 1994-1996 average mortalities is not inconsistent with this, as this indicates a decrease in cannibalism from the very high 1996 level. The growth of age 3 and older fish seem to be close to average level, but age 1 and 2 fish seem to be growing very poorly. These young age groups do not depend so much on capelin as food.

It should be possible to improve the predictions of cod cannibalism and cod growth by taking stock sizes of other major prey species into account using multispecies models.

3.4 Methods used in the assessment

3.4.1 VPA and tuning

Tuning of the VPA was carried out using Extended Survivors Analysis (XSA). It was decided first to carry out the analysis without taking cannibalism into account, using M=0.2 for ages 1 and 2, and then to investigate the effects of cannibalism.

First, last years assessment (excluding cannibalism) was repeated using updated data. In that assessment, 1995 was the last year and 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 5, and age-dependent for ages 13 and older. This gave a reference F (age 5-10, unweighted) in 1995 (F_{95}) of 0.58, which is the same as obtained in last year's assessment with cannibalism (according to last year's report the difference between the reference F in the last year with and without cannibalism was <0.01). Including 1996 data in the assessment, increased F_{95} to 0.70 and gave F_{96} =0.59, compared to the value of 0.41 predicted in last year's assessment. It was decided to remove the Russian acoustic survey for age groups 7 and 8 from the tuning, as the abundance indices at these ages are negatively correlated to the VPA estimates. In view of the work carried out on combining the acoustic abundance estimates from the Lofoten survey with the Norwegian Barents Sea survey, it was decided to combine these two surveys in the tuning. This change in tuning indices used decreased F slightly to F_{95} =0.66 and F_{96} =0.54, nearly all the change was due to the combination of the two Norwegian surveys.

Aglen and Nakken (1997) investigated the relationship between VPA number (converged part (pre 1992) only) and survey indices for age 1-5 for the Norwegian Barents Sea trawl and acoustic surveys. They found that when applying a relationship of the form VPA number = a* survey estimate + b, b was significantly different from zero in (SE b < b), except for age 1 in the acoustic survey. As Aglen and Nakken did not shift their indices, their analysis is valid for ages 1-4 in the tuning. Based on this work, it was decided to investigate the effect of changing the age below which catchability is dependent on stock size (hereafter called q-age). It was decided to compare the results obtained using q-age = 4, 6 and 8, by looking at both the tuning diagnostics, the retrospective analysis and how the trend in mortalities obtained from the XSA in the last years compare to the trend in mortality as calculated from the surveys. Fig 3.5 A-C shows the retrospective analysis for q-age = 4, 6 and 8 , while Figure 3.6 A-C shows the trend in mortalities in recent years for ages 5-7 for these three values, compared to the trend in Z as calculated directly from the surveys.

In order to investigate the effect of the uncertainty in last year's survey indices due to incomplete area coverage, the XSA was run with q-age =6 using indices for the Norwegian bottom trawl survey in the Barents Sea and for the Russian bottom trawl survey corresponding to 'minimum' and 'maximum' adjustment for incomplete area coverage, respectively. For the Norwegian survey, the 1995 area distribution corresponds to the minimum value when adjusted, while the 1994 distribution corresponds to the maximum value, as seen from the text table in section 3.2.2. For the Russian bottom trawl survey, 1990 is used as to the minimum value, while 1992 is used as the maximum value. The whole age range is considered when selecting these years. The indices used for the last tuning year are given in the text table below.

Survey	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
Nor BT min	807.0	201.5	57.4	62.6	46.7	26.8	5.6	0.8
Nor BT 1996	1037.6	243.5	68.1	78.5	56.1	29.7	6.4	1.1
Nor BT max	807.0	292.2	94.6	82.0	57.6	36.8	6.5	0.9
Rus BT min	8.9	6.6	5.1	8.6	12.0	8.6	3.7	0.8
Rus BT 1995	13.6	13.5	7.7	11.8	13.4	11.2	4.2	0.8
Rus BT max	28.7	13.2	7.1	8.8	12.7	12.0	4.1	1.1

The results of the various runs described above is given in the table below. The 1997 fishing mortality is calculated applying the 1997 stock parameters (except for cannibalism, i.e, keeping M=0.2 for all age groups) used in the final prediction, for all the runs.

Number of fish (millions) and fishing mortality for various runs.

Run description	q-age <4	q-age < 6	q-age < 8	q-age < 6, min area	q-age < 6, max area
N97 age 3	606	577	558	514	585
N97 age 4	271	267	265	245	273
N97 age 5	269	254	250	242	253
N97 age 6	269	231	219	224	233
N97 age 7	228	180	142	173	188
N97 age 8	74	58	42	56	59
N97 age 9	13	12	11	11	12
F5-10, 1996	0.54	0.58	0.62	0.59	0.57
F5-10, 1997	0.51	0.64	0.81		

The table above indicates that the uncertainty in the size of the 1989-1991 year classes associated with the choice of q-age is quite large, and makes the assessment very uncertain. For the younger year classes, the uncertainty due to the incomplete area coverage is larger than the uncertainty due to the choice of q-age. It should be kept in mind that the effect of incomplete area coverage is underestimated, as the Norwegian acoustic survey is also affected, and that the assessment of the recruiting year classes will be strongly affected by this.

The tuning diagnostics and the retrospective plots give little indications as to which value of q-age to choose. The Working Group felt, however, that the runs for q-age = 8 and q-age = 4 gave stock sizes that are close to the lower and upper end of the range within which the group feels the stock size is likely to be. In view of this, q-age=6 was chosen as an intermediate option between the two 'extremes'.

3.4.2 Recruitment (Table 3.7)

The only year class which needs to be estimated by the RCT3 program is the 1996 year class. Only the age 1 survey indices and the index from the international 0-group survey were included in the estimation, together with the VPA estimate at age 3. The results are given in Table 3.7.

3.4.3 Including cannibalism in the VPA (Tables 3.13-3.16, Figure 3.2 A-G)

Cannibalism in North-East Arctic cod has been described by Bogstad *et al.* (1994). It may have a significant influence on the recruitment to the fishery, and should thus be taken into account in the assessment. Inclusion of cannibalism into the VPA for North-East Arctic cod has been discussed by Korzhev and Tretyak (1992). Tretyak (1984) discusses the age-dependency of natural mortality in general. A multispecies VPA for the Barents Sea for the period 1980-1996, including cod as predator and cod, herring, capelin, shrimp, polar cod and haddock as prey, was presented by Tretyak *et al.* (1997). This MSVPA was run on a quarterly basis, with stomach data obtained from the joint PINRO-IMR stomach content data base. Possible discrepancies between the VPA with cannibalism presented here and the Barents Sea MSVPA may be due to different aggregation of data, use of different age -length keys and weight at age data, and differences in the stomach evacuation rate model used. Work on unifying Russian and Norwegian methods on consumption calculations is in progress. The VPA for this assessment was run on ages 1-15+, so that predation on 0-group was not considered here, although this was taken into account in the MSVPA.

Consumption of cod by cod was calculated by age group 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 3.13 and the total fishing mortalities (true fishing mortality plus mortality from cannibalism) and population numbers in Tables 3.14 and 3.15. The fit to the surveys for ages 1 and 2 was better (higher R^2) for the VPA which incorporated cannibalism compared to the VPA without cannibalism.

The change in the reference F in 1996 was small (< 0.01). The abundance of age groups 4-6 at the beginning of 1997 decreased, however, when cannibalism is included in the analysis, while the abundance of age groups 3, 7 and 8 increased when cannibalism was included, as seen in the text table below.

N97 (million)	No cannibalism	Cannibalism
Age 3	577	615
Age 4	267	225
Age 5	254	199
Age 6	231	192
Age 7	180	190
Age 8	58	66
Age 9	12	13
F5-10, 1996	0.58	0.58
F5-10, 1997	0.64	0.67

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

Year	Age 0 cons.	Age 1 cons.	Age 2 cons.	Age 3 cons.	Age 4 cons.	Age 5 cons.	Age 6 cons.
1984	0	440	23	+	0	0	0
1985	1475	381	70	+	0	0	0
1986	53	418	392	99	0	0	0
1987	654	175	275	14	0	0	0
1988	29	423	23	2	0	0	0
1989	964	141	+	0	0	0	0
1990	0	64	30	0	0	0	0
1991	132	153	220	2	0	0	0
1992	4125	1044	155	4	0	0	0
1993	4265	21261	553	57	1	+	0
1994	9477	8068	716	133	52	8	+
1995	9739	17674	883	293	99	3	+
1996	38	22587	1775	182	69	22	1

The cannibalism is very variable within this time period, on all prey age groups. Thus, cannibalism will be difficult to predict. Estimates of the numbers consumed of age 1 in 1993-1996 were an order of magnitude higher than what the size of a cod year class at age 1 and 2 was earlier believed to be. This result is not unreasonable when compared to the estimates of 0-group abundance made by Nakken *et al.* (1995). Mortalities induced by cannibalism on age 1 in 1993-1996 are high (1.0-2.5). The mortalities induced by cannibalism in 1996 are higher than predicted in last year's assessment.

Because of the better fit to the survey data for the younger age groups, it was decided to adopt the VPA with cannibalism as the final VPA.

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 3.16) was used together with the new true Fs to run the final VPA on ages 3-15+.

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.

Figure 3.2 A-G shows plots of the indices versus stock numbers from the VPA.

3.5 Results of the assessment

3.5.1 Fishing mortalities and VPA (Tables 3.17-3.21, Figures 3.1A and 3.1B)

The average age 5-10 fishing mortalities for the years 1981-1989 were in the range 0.7 to 1.0. The lowest value occurred during 1989 and the highest in 1987. In 1990, fishing mortality dropped to 0.28 as a result of management measures brought into effect to control the amount of fishing effort. Age 5-10 F then increased, reaching 0.76 in 1994 but dropping again to 0.58 in 1996. F_{5-10} in 1991-1996 was higher than calculated in last year's assessment. The assumed fishing mortality in 1997 is also much higher than predicted last year (0.67 vs. 0.38), and the spawning stock biomass in 1997 is estimated to be 839,000 tonnes, compared to 1,277,000 tonnes in last year's assessment. The reason for this is that the 1989-1991 year classes are considerably weaker than estimated in last year's assessment.

The fishing mortalities and stock numbers are given in Tables 3.17-3.18, while the stock biomass at age and the spawning stock biomass at age are given in Tables 3.19-3.20. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1946 is given in Table 3.21 and Figures 3.1A and 3.1B.

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 will address the problem of SOP discrepancies, but has turned out to be a more complicated task than expected.

3.5.2 Recruitment (Table 3.7)

The results of the RCT3 analysis are given in Table 3.7. The 1996 year class estimate at age 3 is 1079 million individuals.

3.5.3 Biological reference points (Table 3.24, Figure 3.1C)

The yield per recruit analysis using the fishing pattern and stock parameters for 1997 from the management option table gave estimates of $F_{0.1} = 0.13$ and $F_{max} = 0.26$ (Table 3.24) which are very close to the values obtained last year. Jakobsen (1992) calculated the values of F_{low}, F_{med} and F_{high} to be 0.32, 0.46 and 0.78, respectively. The present exploitation level is $F_{96} = 0.57$ (*status quo*) which is above the F_{med} level of 0.46. F_{low}, F_{med} and F_{high} will not be recalculated until the time series on weight at age have been updated.

3.5.4 Catch options (Table 3.23)

The management option table (Table 3.23) shows that the expected catches in 1997 will give an increase in F_{5-10} from 0.57 in 1996 to 0.67 in 1997. This is accordance with the increase in catches from 1997 to 1998. Fishing at F_{max}, F_{low} and F_{med} in 1998 gives catches of 316,000, 381,000 and 514,000 t, respectively, compared to the expected catch in 1997 of 840,000 t.

In Figure 3.1D the catch level in 1998 and spawning stock biomass level in 1999 are plotted against the fishing mortality in 1998.

3.5.5 Consumption by cod (Table A16)

The consumption by cod of various prey species is shown in Table A16. The consumption is calculated using the same method as in Bogstad and Mehl (1997), using stomach content data from the joint PINRO-IMR stomach content data base, a model for the gastric evacuation rate of cod and data on sea temperature and the abundance and geographical distribution of cod. The consumption is calculated for three main areas in the Barents Sea and for the first and second half of the year, for age groups 1-11+ separately. On the average 6000 stomachs have been sampled annually since 1984. The consumption estimates in Table A16 do not include consumption by mature cod in the period when it is outside the Barents Sea (assumed to be 3 months during the first half of the year). During this period it may consume significant amounts of adult herring (Bogstad and Mehl, 1997).

The consumption of capelin decreased from approximately 3 million tonnes in 1991-1993 to about 500 thousand tonnes in 1996. This decrease corresponds well to the observed development of the capelin stock. Amphipods and krill combined accounts for about 35% of the diet in 1995-1996, with krill as the most important of those two in 1996. After a drop in 1993-1994, the consumption of redfish increased in 1995, but decreased again in 1996. The consumption of cod by cod (cannibalism) has increased strongly since 1992, and cod now makes up more than 10 % of the diet. The consumption of haddock by cod has varied around 100 thousand tonnes since 1992. The consumption of herring and polar cod decreased strongly from 1994 to 1996, and those two species combined made up only 3 % of the diet in 1996. The consumption of shrimp has been around 400 thousand tonnes since 1992, except for a higher value in 1994. The consumption of Greenland halibut is very low in all years. Very few of the stomach samples were from pelagic trawl hauls. Thus, consumption of prey which are distributed in the upper layers of the sea, e.g., herring, may be underestimated.

It should be noted that scientists at PINRO get different consumption estimates using the same data (Dolgov, WD 1997). The reason for this is under investigation. Also, the mean ambient winter temperatures of ages 1-3 in 1991-1995 were 1-3 °C lower than those used in the consumption estimates, a difference which would reduce the consumption estimates by 10-30 % (Ottersen *et al.*, 1997). When estimates of ambient temperature become available for more years and other seasons, they should be used in consumption estimates. It is worth noting that today the same temperature is used for all ages in a given area and season.

3.6 Management objectives

3.6.1 Target reference points and safe biological limits (MBAL) (Fig 3.8-3.10)

The terms of reference for the 1997 meeting of the WG included a request for more detailed definitions of safe biological limits. This request coincided with improved knowledge of the magnitude of interannual variation in fecundity of North-East Arctic cod (Kjesbu *et al.* submitted ms.), recent research suggesting that there is considerable interannual variation in total egg production by the North-East Arctic cod stock (Marshall *et al.* submitted ms.) and ongoing efforts to better utilize the Norwegian survey database in stock assessment (Aglen, WD 1997).

A preliminary attempt to develop biological reference points for North-East Arctic cod using the Norwegian survey database was presented at this years WG meeting (Marshall, WD 1997). Data from Norwegian acoustic surveys in the Barents Sea and Lofoten were combined to estimate total abundance and demographic composition of the aggregate stock independently of the VPA estimates of abundance. Refinements to the method of combining acoustic and trawl information from the Barents Sea and Lofoten surveys (e.g., Aglen, WD 1997) are expected in the near future.

The effective spawner biomass (ESB) of mature females was estimated as a proxy for total egg production and was estimated by:

$$ESB = \Sigma_l \, n_{l,fem,mat} \times w_{l,fem,pre}$$

where $n_{l,fem,mat}$ is the total number of mature females of length l and $w_{l,fem,pre}$ is the weight of mature pre-spawning females of length l predicted using the year-specific weight/length relationships for pre-spawning females in the Barents Sea winter survey. Estimates of ESB differ from the estimates of total egg production only in that weight-at-length replaces fecundity-at-length. The relative fecundity of the stock (χ_{stock}, eggs/gram spawner biomass) was estimated as:

χ_{stock} = E/ESB

where E is the total egg production by the stock given in Marshall *et al.* (submitted ms.).

Estimates of ESB were both lower and higher than VPA estimates of spawning stock biomass (multiplied by 0.50 to approximate the biomass of females). The largest discrepancies between ESB and the VPA spawning stock biomass estimate were for 1991, 1996 and 1997 (Figure 3.8). The spawner/recruit relationship was examined using ESB as a measure of the reproductive potential and the acoustic estimate of the abundance of age 1 cod (Table A2) as the recruitment index (Figure 3.9). This relationship: (1) approaches the origin; (2) exhibits two order of magnitude variation in ESB which is closer to the three orders of magnitude variation observed in the recruitment index; and (3) is positive and approximately linear with the exception of the observation for 1993 which is the highest ESB in the time series.

Values of χ_{stock} show a three-fold level of variation (Figure 3.10). Values of χ_{stock} were at a minimum in 1988 then increased to a peak in 1992 when the size composition of the spawning females was dominated by large (>80 cm) females belonging to the strong 1983 year class. Large cod are more fecund per unit body weight than small cod (Kjesbu *et al.* submitted ms.). Thus, higher quality spawners can potentially compensate to a limited degree for lower quantity by being more fecund per unit biomass.

Further research is planned to improve the sensitivity of survey-based biological reference points to changes in stock dynamics. Such reference points have the advantages of being: (1) independent of the catch data; (2) free of assumptions about natural and fishing mortality; and (3) estimated by two surveys per year which permits uncertainty to be quantified. Future assessments will hopefully be able to use both survey-based reference points and traditional reference points. An empirical approach may help to reduce the problems which result when the VPA results are unstable during periods of rapidly changing stock abundance.

3.6.2 Limit reference points

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 3.7.

The Comprehensive Fishery Evaluation Working Group (ICES CM 1996/Assess:20) suggested a F_{comfie} =min{F_{med},F_{MSY},F_{max}}. F_{MSY} was not estimated by the present WG. Since F_{MSY} is commonly less than F_{max}, the latter should be considered an upper bound on fishing mortality (ICES CM 1996/Assess:20). F_{max} for cod is presently 0.26, which means that there is a potential for increased yields by lowering the fishing mortality from $F_{status\ quo}$ (0.57) to F_{max} (0.26). The catch corresponding to F_{max} in 1998 is about 316,000 t, which is well below the present catch. Keeping the fishing mortality below F_{med} will keep the stock within safe biological limits.

3.7 Medium-term forecasts and management scenarios

3.7.1 Input data (Table 3.22)

The input data were the same used as for the short term predictions, using the same data for the years after 1999 as for 1998 and 1999 (Table 3.22). The recruitment at age 3 of the 1997 and later year classes was set equal to the long-term average of 613 million, adjusted upwards to account for increased mortality at ages 3-5 due to cannibalism, i.e. 1184 million individuals.

3.7.2 Methods

Single option predictions were run using IFAP and following standard procedures. A RISK analysis model has been developed for cod including a recruitment model taking into account a relation between the numbers at age 1 and the female spawning stock and cannibalism. The data for the RISK analysis were only available on the final day of the WG meeting and it turned out to be to many inconsistencies between the traditional medium term projections and the RISK analysis. The results of the RISK analysis are therefor not presented in this report.

However, the WG felt that the principles used for the RISK analysis were appropriate and encouraged a presentation of the results in a separate Working Document to the ACFM meeting. This would allow for further development and testing of the performance of the RISK analysis. It was especially pointed to the need to include the uncertainty of the assessment both in the way of precision of estimation and in the way of uncertainty of the ability to reflect the level of the different age groups in the stock. The WG chairman will take on the responsibility to prepare such a Working Document and to include the uncertainties in the assessment.

3.7.3 Results (Tables 3.25-3.26 and Figure 3.1D)

Despite the large uncertainty in the assessment, deterministic medium-term projections were carried out, but in view of the uncertainty associated with the initial stock size, the results should not be regarded as particularly accurate.
In Table 3.25, the results of the medium-term prediction are given, for 0.4,0.6, 0.8 (=F_{med}),1.0 and 1.2*$F_{status\ quo}$(=F_{97}) , and for fixed TAC values of 500, 600 and 700 thousand tonnes for the period 1998-2001. Detailed output of the prediction for F_{med} (=0.8* $F_{status\ quo}$) is given in Table 3.26. In the medium term, the stock will increase to a level of about 2 million t in the end of the period when fishing at F_{med} , and the catches will be around 500,000 t which is below the present level. The spawning stock biomass will stabilise at about 750,000 t, which is slightly above MBAL. Fishing at F_{97} will make the SSB fall below MBAL in year 2000. Maintaining a catch of 700,000 tonnes will cause F to raise above 1.0 and drop the SSB to 150,000 tonnes at the end of the period.

3.8 Comments to the assessment and the forecasts

In view of the uncertainty of this assessment with respect to actual level of stock size, and the fact that the large quota for 1997 is going to be taken, the Working Group expresses its concern that the stock may very well fall below safe biological limits if the lowest range indicated for the stock size should be true.

From an average level of about 1 million t in the 1980s, the total stock biomass increased rapidly to 2.5 million tonnes in 1993, then decreased to 2.0 million in 1996. Total biomass is currently slightly below the long-term average value for this stock. The spawning stock in 1997 is 839 thousand tonnes, which is an increase from 1996. Growth rates appear to have stabilised at a low level for the youngest fish (age 1 and 2) and at a medium level for the older ages. Weight at age is at a low level. Cannibalism rates are high.

The assessment has been changed considerably since last year, and does not give as optimistic a view of the stock as presented last year. The stock is inside safe biological limits, but a reduction in catch level and fishing mortality is needed in order to keep it there. The uncertainty in the assessment and the predictions due to the problems with the assessment methodology have been explicitly addressed in the report.

Considering the nature of the methodological problems with estimating the large year classes in the current assessment, it is anticipated that the Working Group will be faced with similar concerns in its 1998 meeting with respect to this stock.

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

4.1 Status of the Fisheries

4.1.1 Historical development of the fisheries

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. About 25% is taken by conventional gears, nearly all by Norway and mostly on long line. Part of the long line catches are from a directed fishery. The fishery is restricted by national quotas. In the Norwegian fishery the quotas are set separately for trawl and other gears. The fishery is also regulated by a minimum landing size, a minimum mesh size in trawls and Danish seine, a maximum by-catch of undersized fish, closure of areas with high density of juveniles and other seasonal and areal restrictions.

Historical landings of the fishery show a cyclical pattern (Figure 4.1A, Table 4.1). The historical high catch level of 320,000 t in 1973 divides the time series into two periods. Formerly, highs were close to 200,000 t around 1956, 1961 and 1968, and lows were between 75,000 and 100,000 t in 1959, 1964 and 1971. The second period showed a steady decline from the peak in 1973 down to the historically low level of 17,300 t in 1984. Afterwards, landings increased to 151,000 t before declining to 26,000 t in 1990. Landings have been increasing since then.

The trawl fishery has been more variable than the fishing by other gears (Table 4.2). In recent years Norway and Russia have accounted for more than 90% of the landings (Table 4.3), but before the introduction of national economical zones in 1977, UK (mainly England) landings made up 10-30% of the total.

The exploitation rate of haddock has been variable. The highest fishing mortalities for haddock have occurred at intermediate stock levels and show little relationship with the exploitation rate of cod, in spite of haddock to a large extent being a by-catch in the cod fishery. The exception is the 1990's where more restrictive quota regulations have resulted in a similar pattern in the exploitation rate for both species. It is expected that good year classes of haddock would attract more directed trawl fishing, but this is not reflected in the fishing mortalities.

The Norwegian coastal haddock catches are defined as those from Norwegian statistical areas 06 and 07, i.e. in the southernmost part of ICES Division IIa (Figure 9.4) (ICES 1971/F:3, 1975/F:6). No reason for this definition has been given in Arctic Fisheries Working Group reports, but it is based mainly on the knowledge about the main spawning grounds of North-East Arctic haddock. These are located north of this area and recruitment to areas 06 and 07 from these grounds is unlikely because it would be against the current. The first landings table for coastal haddock (1960-70) was given in ICES 1971/F:3. In the period 1974 to 1996, the reported Norwegian catches of coastal haddock were on average about 4,500 t per year (Table B7).

The USSR data on coastal haddock in Table B7 are taken from ICES 1975/F:6. The average USSR reported catch was approximately 20,000 t of coastal haddock for the period 1960-1974. USSR or Russian catches of coastal haddock have not been reported in later years.

4.1.2 Landings prior to 1997 (Tables 4.1-4.3, Figure 4.1A)

Final reported landings in 1995 are 138,517 t (Table 4.1) which is very close to the figure used in last year's assessment. The provisional landings for 1996 are 173,438 t which is slightly above the agreed TAC of 170,000 t. Catches increased substantially in Sub-area I and decreased in Division IIb.

The catch by area, broken down by trawl and other gears, is given in Table 4.2. The nominal catch by country is given in Table 4.3.

4.1.3 Expected landings in 1997

Based on previous experience and provisional reports, it is expected that the TAC of 210,000 t will be taken.

4.2 Status of Research

4.2.1 Fishing effort and CPUE

After a period of very little trawl fishery for haddock, it has increased in recent years (Table 4.2). The CPUE series of Norwegian trawl fisheries has been updated for tuning of the older ages in the VPA, and the full CPUE series has also been revised this year. However, because of the large proportion taken as by-catch there is work in progress to try to estimate the direct trawl effort on haddock and investigate how trawl CPUE for haddock is best calculated. These data will be available next year.

4.2.2 Survey results (Tables B1-B6)

Norway provided indices from the 1997 Barents Sea bottom trawl and acoustic survey in January-March. The results of this survey are given by Mehl (WD 97). As described in Section 3.2.2 the survey was restricted to the Norwegian economic zone and the adjustments made to the abundance indices followed the same procedure as for cod. The table on the following page shows the proportions of haddock found in the bottom trawl survey in the Norwegian zone in 1993-1996.

	Age (years)								
Year	1	2	3	4	5	6	7	8	Total
1993	0.65	0.34	0.26	0.38	0.70	1.00	0.80	0.68	0.44
1994	1.00	0.76	0.32	0.26	0.53	0.78	1.00	0.63	0.62
1995	0.87	0.75	0.72	0.39	0.56	0.67	1.00	0.90	0.76
1996	0.73	0.63	0.79	0.72	0.59	0.76	0.59	1.00	0.69

Applying the same procedure for adjusting the indices in 1994-1996 as for 1997 would have given an error of no more than 10% on average in each of these years. However, for single age groups the error would have exceeded 20% in ten of the 24 cases and 50% in two cases.

Tables B1 and B3 show the time series of abundance estimates (acoustic and bottom trawl, respectively) from this survey. High indices caused by the good period of recruitment around 1990 can be traced from year to year in both series and the 1990 year class appears as the strongest for age groups 3-7. Although recruitment has been lower in more recent years, the indices are still well above the historical low levels.

Russia provided indices from 1996 trawl and acoustic survey (October-December) in the Barents Sea (Tables B2 and B4). A description of the Russian surveys of demersal fish in the Barents Sea up to 1996 is given in Lepesevich and Shevelev (1997). Also the Russian survey covered a smaller area than normal, but judging from the distribution in earlier years the coverage of the haddock was better than in the Norwegian survey. The bottom trawl indices from Sub-area I and Division IIa were therefore not adjusted. However, the possible effect of this cannot be quantified without a more detailed analysis of the historical survey data. Because there was no coverage in Division IIb, the total indices were adjusted based on the average distribution by area in 1983-1995. The proportion of haddock found in Division IIb in the survey is normally less than 10% of the total. Therefore, this adjustment probably caused little error in the indices. However, the distribution maps show that there evidently were some haddock outside the survey area in Division IIa and the total indices are therefore probably underestimates. There has recently been a substantial change in the routines for calculating acoustic indices and the abundance indices from the acoustic survey in 1996 were therefore excluded from the VPA tuning (see Section 3.2.2). The Russian survey support the main trends in the Norwegian survey.

Estimates of the abundance of 0-group haddock from the International 0-group survey (ICES 1996/G:31) are presented in Tables A14 and A15. The indices show good recruitment for haddock from 1990 to 1994, but average in 1995 and 1996.

4.2.3 Weight at age (Table B6)

Length and weight at age from the surveys are given in Tables B5 and B6, respectively. The weights at age are mostly fairly close to those found in the previous year and confirm that the growth still is relatively slow. For the year classes 1992 and 1993 there is some inconsistency between the Norwegian and the Russian results, but with opposite signs.

4.2.4 Surveys for coastal haddock

The distribution of haddock on the Norwegian coast from the Russian border in Varangerfjord to 62°N (Stadt) has been investigated during the Norwegian coastal surveys in the period 1992-1996 (ICES 1994/Assess: 2, 1995/Assess:3, 1996/Assess:4, 1997/Assess:4) The main purpose is to give estimates of the biomass, find migration patterns and to determine if there is a coastal haddock stock. There have also been joint Russian-Norwegian investigations on the Kola coast concerning the distribution of haddock (Isaev *et al.* 1996, Gavrilov *et al.* 1997).

A tagging experiment on coastal haddock has been performed on cruises in November-December 1993, 1994 and 1995 in Norwegian statistical areas 00, 05 and 06 (Figure 9.1). A total of about 13,500 specimens were tagged. Preliminary results indicate local recaptures which are made throughout the year.

The length and weight at age for the haddock sampled along the coast of Norway are given in Tables B8 and B9, respectively. For haddock caught during the coastal survey the age of 50 % maturity has varied between 4 and 6 years with an estimated average of about 5 years (Table B10). In comparison, the age of 50 % maturity for North-East Arctic haddock in recent years has been more than 6 years.

In 1996 the total biomass of haddock along the coast was calculated to be 244,000 t (331 million fish) and most of this is considered to be North-East Arctic haddock. This is a slight increase from 1995. The corresponding spawning biomass was 120,000 t (83 million fish) (Tables B11 to B14). This represent a doubling of the spawning biomass. However, south of 67° N in areas 06 and 07 the biomass (67,000 t) was nearly the same as in 1995. This is the area where the landings are assumed to be coastal haddock and the proportion of the total increases with decreasing age which could indicate local recruitment in the area.

4.3 Data Used in the Assessment

4.3.1 Catch at age (Table 4.7)

A revised age composition for the Norwegian landings, with final total landings from all countries, were used to revise the number at age in the 1995 landings.

Age compositions of the landings for 1996 were available from Norway and Russia in Sub-area I, from Norway, Russia and UK (England and Wales) in Division IIa, and from Norway and Germany in Division IIb. The catches of the other countries were distributed among ages using the combined Norwegian/Russian age composition in Sub-area I, the UK (England and Wales) age composition in Division IIa and the German age composition in Division IIb.

The SOP check gave a deviation of 0.3 % and 0.2 % from the nominal catch for 1995 and for 1996, respectively. The numbers at age were adjusted to make the SOP fit to the nominal catch for these years.

4.3.2 Weight at age (Tables 4.8-4.9)

The mean weights at age in the catch (Table 4.8) were calculated as weighted averages of the weights in the catch of Norway, Russia, Germany and UK (England & Wales).

The weight at age in the catch in 1996 increased for ages 3-4 and decreased for ages 6-8, but in general continues to be at relatively low levels. The weight at age in the catch in 1996 is higher than the weights used for prediction in last year's report for the dominant age groups 3-6, especially for age 3 (55%) and age 5 (24%). For older age groups the values are closer to those predicted.

Stock weights (Table 4.9) used from 1985 to 1997 for ages 3-7 are averages of values derived from Russian surveys in autumn (mostly October-December) and Norwegian surveys in January-March the following year (Table B6). These averages are assumed to give representative values for the beginning of the year. For the older age groups, the time series' fixed weights have been used, except for the year classes of 1982 and later where the survey weights have been derived in the same way as for ages 3-7 also for ages 8-11. However, for some of the values only Russian data were available. The stock weights in 1997 were lower than those predicted for the younger age groups (10-22% for ages 4-7) and higher for the older age groups.

4.3.3 Natural mortality (Table 4.14)

A natural mortality of 0.2 was used. In addition, estimates of the mortality caused by predation on haddock by cod (based on the cod assessment in this report) were taken into account. The proportion of F and M before spawning was set to zero.

4.3.4 Maturity at age (Table 4.4)

A maturity ogive was available from Russia for 1997. This ogive indicates that there was a shift towards maturation at older age in 1997 and the proportion of mature 5-8 year old fish are the lowest in the time series 1981-1996.

4.3.5 Data for tuning (Table 4.10)

The following surveys and CPUE series are included in the data for tuning:

Name	Place	Season	Age	Year
Russian bottom trawl	Total area	Autumn	1-7	1983-1996
Russian acoustic	Total area	Autumn	1-7	1983-1995
Norwegian bottom trawl	Barents Sea	Winter	1-7	1980-1996
Norwegian acoustic	Barents Sea	Winter	1-7	1980-1996
Norwegian trawl fleet	Total area	All year	8-13	1985-1996

Some of the survey indices have been multiplied by a factor of 10 or 100.

4.3.6 Recruitment indices (Table 4.5).

Four time series of recruitment indices were updated with data from 1996. These are from the Russian bottom trawl survey in autumn (age 0), the International 0-group survey (age 0), and the Norwegian bottom trawl and acoustic survey in winter (age 1 for both indices).

4.3.7 Prediction data (Table 4.21)

The data used for 1997-1999 in the short-term prediction were also used for these years in the medium-term prediction (1997-2001), and the 1999 data were extended forward to 2000 and 2001.

The stock number at age is taken from the final VPA (Table 4.16) and the recruitment of the 1996 year class from the RCT3 analysis (Table 4.6). The recruitment at age 3 of the 1997 and later year classes is set as the long-term geometric mean.

The fishing pattern is the average of the last 5 years from the final VPA, scaled to the 1996 F_{4-7} level. The reasoning for taking such a long time span was to remove some of the noise in the data, especially on the oldest age groups.

The Russian maturity ogive for 1997 (Table 4.4) was used for all the years in the prediction to allow for the decreasing maturity rates currently observed in the population.

The weight at age in the catch in 1997 and the weight at age in the stock in 1998 were both set as the recent three-year-average. However, due to lack of survey data on the oldest fish, the values of weight at age in the stock for ages 12 and older were set equal to the fixed historical values.

The natural mortality on ages 3-6 was set equal to the mean 1994-1996 estimate from the VPA with predation.

4.4 Methods Used in the Assessment

4.4.1 VPA and tuning

The Extended Survivors Analysis (XSA) was used to tune the VPA to the available index series (Table 4.10). The XSA was initially run on the updated 1995 data, including revised estimates of predation, in the same way as last year, i.e., shrinkage to 2 years and 5 ages, using an SE of 1.0 for the mean. Catchability was set to be dependent on stock size for ages younger than 4, and to be independent of age for ages older than 11. The main results were close to those obtained last year. The revised trawl effort data gave somewhat higher fishing mortalities on the oldest age groups, but the year classes most affected by this are of little importance in the present stock.

As for cod, and described in more detail in Section 3.4.1., the choice of ages where catchability is assumed to be dependent on stock size makes a large difference to the results. The $F_{status\ quo}$ catch in 1998 predicted from trial runs with catchability dependent on stock size for ages <4 and <8, respectively, was 190,000 t and 104,000 t, i.e. a difference of 86,000 t. The corresponding (1999) spawning stock biomass estimates were 378,000 t and 134,000 t (below the suggested MBAL). Hence, as basis for management advice and decisions, the two runs represent totally different scenarios.

As for cod, the sensitivity of the XSA seems to be linked to the current stock development with strong year classes in the stock giving historical high abundance indices in the surveys. The stock abundance estimates from these indices are very dependent on the assumption about the relation between catchability and stock size, and the

Working Group has not been able to draw any conclusions from the historical information. In particular this problem concerns the 1990 year class which is one of three outstanding year classes in the time series, the others being 1950 and 1969. The abundance indices from this year class have from age 3 onwards been the highest recorded and have been as much as 8 times higher than for any of the year classes from the converged part of the VPA. Even if the relationship between catchability and stock size were positively identified, the estimate of the strength of this year class would be very uncertain.

The Working Group was unable to find strong arguments in favour of either of the settings in the trial runs and agreed that they represent extremes, at least as far as the use of XSA was concerned, and probably also in reflecting the stock situation. The Working Group therefore chose, as for cod, to use stock size dependent catchability for <6 years as a compromise and try to account for the uncertainty in the RISK analysis.

As in last year's assessment, the estimated consumption of haddock by cod was incorporated into the XSA analysis. A new catch number at age matrix was constructed by adding the numbers of haddock eaten by cod for the years where such data were available (1984-1996) (Table A16). The consumption of haddock by cod for the period 1984-1996 is given below:

Consumption by cod at age (million individuals)

	Age						
Year	0	1	2	3	4	5	6
1984	1,908	1,012	16	+	0	0	0
1985	1,678	1.198	5	0	0	0	0
1986	91	557	242	105	0	0	0
1987	0	756	0	0	0	0	0
1988	0	16	1	9	0	+	0
1989	22	238	0	0	0	0	0
1990	51	144	39	4	0	0	0
1991	0	454	14	0	0	0	0
1992	163	2,153	150	1	0	0	0
1993	907	1,579	170	38	4	3	0
1994	1,552	1,674	84	26	8	1	+
1995	201	3,312	190	14	35	35	+
1996	0	1,607	215	70	9	4	6

In this analysis, the tuning data series was reduced to 1984-1996 to be consistent with the predation data period.

The retrospective analysis showed that levels of fishing mortality tend to be progressively lower in consecutive year's assessment (Figure 4.2).

In order to create a matrix of natural mortality which includes predation, the fishing mortality estimated in the final XSA was split into the mortality caused by the fishing fleet (F) and the mortality caused by predation by cod (M2) by using the proportion of fleet catch and predation catch, respectively, to the total catch. The new natural mortality data set was then prepared by adding 0.2 to the predation mortality. This new M matrix (Table 4.14) was used together with the new Fs to run the final VPA with ages 3 to 14+.

4.4.2 Recruitment (Table 4.13)

The XSA estimate of the strength of the 1994 year class at age 3 was accepted. The strength of the 1995 year class at age 3 was calculated from the XSA estimate at age 2 in the terminal year, applying the average natural mortality (0.2 plus predation mortality) of the 3 last years. The only year class estimated by the RCT3 program was thus the 1996 year class at age 3. The age 0 and 1 survey indices for this year class were used in the estimation, together with estimates of year class strength at age 3 from the final XSA.

4.5 Results of the Assessment

4.5.1 Fishing mortality and VPA (Tables 4.11–4.19 and Figures 4.1A and 4.1B)

The tuning diagnostics of the final XSA (predation included) are given in Table 4.11 and the fishing mortalities and population numbers of this analysis in Tables 4.12 and 4.13, respectively.

Figure 4.3 shows the plots of survey/CPUE abundance indices against VPA numbers for all the tuned ages used in the assessment.

Natural mortalities, fishing mortalities and stock numbers of the final VPA are given in Tables 4.14, 4.15 and 4.16, respectively, while the stock biomass at age and the spawning biomass at age are given in Tables 4.17 and 4.18. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1950 is given in Table 4.19 and Figures 4.1A and 4.1B.

The highest level of fishing mortality (F_{4-7}) from 1980 onwards occurred in 1981 (0.62). F_{4-7} decreased to nearly half of the level in 1984 (0.33) and increased again to 0.53 in 1987. After the historical low (0.18) caused by the severe quota restrictions in 1990, F_{4-7} increased to 0.49 in 1993 before it declined to the current level of 0.33. This is below F_{med} (0.35). However, the levels may be influenced by noise in the values for some of the poorer year classes.

The VPA numbers at age matrix shows a level of the 1990 year class in 1997 of 155 million. This is lower than the predicted value of 203 million in last year's assessment, but is still the highest level at age 7 in the time series.

The spawning stock biomass has been rapidly increasing since 1994 to 187 000 t in 1996, a level exceeded only in five earlier years in the time series, even if it is well below the value of 242 000 t estimated last year. The total stock biomass shows a slow decline in the same period to 548 000 t in 1996.

4.5.2 Recruitment (Tables 4.5–4.6, 4.13, 4.21)

The estimates of the 1993-1995 year classes at age 3, derived from the XSA (Table 4.13), are 130, 110 and 56 million, respectively. The RCT3 estimate of the 1996 year class is 128 million at age 3 (Table 4.6). The long term geometric mean is 96 million individuals.

4.5.3 Biological reference points (Table 4.20, Figure 4.1C)

The yield per recruit analysis using the fishing pattern and stock parameters for 1996 and 1997 from the management option table gave estimates of $F_{0.1}$=0.15 and F_{max}=0.59. The former is lower than the value of 0.19 found in last year's assessment. Jakobsen (1992) gives the values of F_{low}=0.02, F_{med}=0.35 and F_{high}=1.11. The present exploitation level is F_{96} = 0.33 (*status quo*).

4.5.4 Catch options for 1997 (Table 4.24)

The expected catch of 210,000 t in 1997 gives F=0.40. A *status quo* F in 1998 of F = 0.33, which is slightly below F_{med} , corresponds to a catch of 114,000 t, but will not prevent a considerable reduction of the spawning stock. However, considering the dominance of the 1990 year class in the stock, some reduction sooner or later is inevitable.

4.6 MBAL level and advised exploitation rates

4.6.1 Minimum biological acceptable level (MBAL) (Figure 4.4)

From the spawning stock/recruitment plot (Figure 4.4) it is seen that at SSB levels below 140,000 t the probability of very low recruitment increases. Apart from the two points of recruitment above 1 billion and the three points above average at an SSB of 70,000 t, the recruitment seems to be fairly proportional to the SSB up to 140,000 t. Setting the Minimum Biological Acceptable Level of the spawning stock to this value would increase the probability of good recruitment. However, because of the wide natural fluctuation in recruitment for the stock, there might even under responsible management be periods where SSB levels under 140,000 t are impossible to avoid and it is questionable if MBAL is a meaningful concept for this stock, especially if it used as basis for declaring the stock inside or outside safe biological limits.

4.6.2 Advised exploitation rates

For this stock F_{med} is lower than F_{max}. F_{MSY} has not been calculated. It is therefore advised that the level of exploitation be kept well below F_{med}. This will level out some of the fluctuation in the catch and will increase the probability that the spawning stock biomass remains above the indicated MBAL of 140,000 t and that the stock continues to be within safe biological limits.

4.7 Medium-term forecasts and management scenarios

4.7.1 Input data (Table 4.21)

The input data were the same as used for the short term predictions. The recruitment at age 3 of the 1997 and later year classes was set equal to the long-term geometric average of 96 million.

4.7.2 Methods

Single option predictions were run using IFAP and following standard procedures.

4.7.3 Results (Tables 4.23-4.24 and Figure 4.1D)

In Figure 4.1D the catch level in 1998 and spawning stock biomass level in 1999 are plotted against the fishing mortality, F, in 1998.

In Table 4.23, the results of the medium-term prediction are given, for the biological reference points for 0.4,0.6, 0.8 and $1.0*F_{status\ quo}$. Detailed output of the prediction for $F_{status\ quo}$ is also given (Table 4.24). In the medium term, the spawning stock will decrease to a level of approximately 80,000 t when fishing at $F_{status\ quo}$ and the catches will decrease to 50,000 t. Only a very low fishing mortality (0.06) will prevent the spawning stock from declining, but this means that the catch level would be less than 15,000 t.

4.8 Comments to the assessment and forecasts

As already discussed the assessment is presently extremely vulnerable to assumptions about catchability in the surveys and the has found no solution to this problem. In spite of the large uncertainty about the stock level, the Working Group conclude that the stock presently is well inside safe biological limits and it is clear that the 1990 year class is among the three outstanding year classes since 1950. However, the stock will decline as the influence of the 1990 year class is reduced, and the stock situation can quickly change. Reduced growth and delayed maturation are factors which could contribute to a negative trend.

The current problems in the assessment is likely to be gradually reduced as less abundant year classes recruit to the stock, and accumulation of knowledge and any improvement of methods, both in surveys and assessments, will contribute to less uncertain assessments in the future. However, this development can be severely delayed and even completely halted if survey coverage continues to be limited.

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

5.1 Status of the Fishery

5.1.1 Historical development of the fisheries (Tables 5.1-5.2)

Since the early 1960s the fishery has been dominated by purse seine and trawl fisheries, usually accounting for about 75% of the landings (Table 5.2). A traditional gill net fishery for spawning saithe accounts for about 15%. The remaining catches are by-catches or from mixed fisheries. Catches declined sharply after 1976 (Table 5.1). This was partly caused by the introduction of national economical zones in 1977. The stock was accepted as exclusively Norwegian and quota restrictions were put on fishing by other countries while the Norwegian fishery for some years remained unrestricted. However, in recent years the purse seine and trawl fisheries have been regulated by quotas where account has been taken of expected landings from other gears. Quotas can be transferred between purse seine and trawl fisheries if the quota allocated to one of the gears will not be taken.

The target set for the total landings has generally been consistent with the scientific recommendations. Norway presently accounts for about 95% of the landings.

The purse seine fishery is based on schools of immature saithe in coastal areas and fjords. The trawlers operate on the coastal banks and catch both immature and mature fish. Over the years purse seiners and trawlers have taken roughly equal shares of the catches. In the recent years, trawlers have taken a bigger share while purse seine landings have declined. Thus, the purse seine landings were only about 20% of the total in 1992-1995, whereas, trawl landings accounted for more than half of the total. The decline in purse seine landings appears to have been caused predominantly by changing market conditions. However, purse seine landings in 1996 more than doubled and made up 27% of the total, while trawl landings had a corresponding decline and made up less than half (42%) of the total.

5.1.2 Landings prior to 1996 (Table 5.1, Figure 5.1A)

Landings of saithe were highest from 1970-1976 with an average of 238,000 t and a maximum of 265,000 t in 1970. This was followed by a sharp decline to a level of about 160,000 t in the years 1978-1984. Another decline followed and from 1985 to 1992 the landings ranged from 67,000-127,000 t (Table 5.1). An increasing trend is seen after 1990 and in 1995 the revised landings were 169,444 t. Provisional reports of landings in 1996 indicate a slight increase to a total of 171,595 t compared to 163,000 t expected by last years Working Group, which was the target set by Norwegian authorities.

5.1.3 Expected landings in 1997

Norwegian authorities set quotas for other countries and for Norwegian purse seine and trawl fisheries. The goal for 1997 was to limit Norwegian landings to 118,500 t. In addition, about 6,500 t can be expected from other countries, giving a target of 125,000 t for the total fishery. Enforcement of the regulations have gradually improved so that the directed trawl and purse seine fisheries can be stopped when the quota has been taken. Deviations from the target have been relatively small in recent years (+4,400 t in 1995 and +8,500 t in 1996). There is a basis for assuming overfishing of about 15,000 t in the Norwegian saithe fishery in 1997 and therefore the total catch in 1997 is expected to be approximately 140,000 t.

5.2 Status of Research

5.2.1 Fishing Effort and Catch-per-unit-effort (Tables C1-C3)

Table C1 shows the number of vessels of different size categories which have taken part in the purse seine fishery since 1977, with corresponding catches and catch per vessel. On the basis of these data, indices of fishing effort were calculated. The unit of effort is the number of vessels of 20-24.9 m length. This category has in most recent years accounted for approximately half of the purse seine landings, decreasing to about 35% in the two last years, and constitutes most of the specialized saithe purse seiners. The effort of this length category is raised by the catches to represent the total purse seine effort. A decreasing trend in the purse seine effort was observed from 1991 to 1993 with a reduction of about 29% during this period. The 1993 figure was the lowest on record. From 1994 to 1996 fishing effort increased by 35 % (Table C3).

Table C2 gives catch, effort and catch per unit effort for Norwegian trawlers since 1976. This summarizes hauls where the effort has almost certainly been directed towards saithe, i.e., days with more than 50% saithe and only on trips with more than 50% saithe in the catch. The effort estimated for the directed fishery was raised by the catches to give total effort of Norwegian trawlers (Table C3). The index more than doubled from 1991 to maximum recorded level in 1995, and then decreased by 30% in 1996.

Catches from purse seine and trawl fisheries have historically been of the same magnitude. The fleets can therefore be assumed to have represented roughly equal shares of the effort and together they account for a relatively stable proportion of the total landings. Using 1977-1990 as a reference period and multiplying the trawl indices by 2.75 raises them to the same level as the purse seine indices. The indices were then added to give a combined effort index which should reflect the main trends in total effort (Table C3). From 1992 to 1995 the total effort increased with more than 50%, while it decreased by about 20% in 1996.

A group of Norwegian scientists and administrators have recently examined the management of saithe and, in particular, the minimum landing size regulations. Based on the results of this work some additional predictions have been done (Section 5.7).

5.2.2 Survey results (Tables C4)

Since 1985 a Norwegian acoustic survey specially designed for saithe has been conducted annually in October-November. The survey covers the near coastal banks from the Varangerfjord close to the Russian border and southwards to 62° N. The whole area has been covered since 1992, and the major parts since 1988. The aim of conducting an acoustic survey targeting Northeast Arctic saithe has been to support the stock assessment with fishery independent data of the abundance of the youngest saithe. The survey mainly covers the grounds were the trawl fishery takes place, normally dominated by 3-5 year old fish (Table C4). Also 2 year old saithe, mainly inhabiting the fjords and more coastal areas, may recruit to these banks and abundance indices for ages 2-5 from 1988 and onwards are used for tuning.

5.3 Data used in the Assessment

5.3.1 Catch numbers at Age (Table 5.6)

The age composition of Norwegian landings in 1995 was revised, resulting in minor changes compared to last year's assessment. Age composition data for 1996 was available from Norway and Germany, accounting for 98% of the landings. A Russian length composition was also available, but it represented only a minor part of the Russian landings. Therefore Russia, as well as other countries were assumed to have the same age composition as Norwegian trawlers.

The Norwegian sampling in the southern part of Division IIa was poor both in 1994, 1995 and 1996. This may give underestimates of the catch at age 2.

5.3.2 Weight at Age (Tables 5.7)

Constant weight-at-age values were used for the period 1960-1979. For subsequent years, annual estimates of weight-at-age in the catches were used. Weight at age in the stock was assumed to be the same as weight at age in the catch.

5.3.3 Natural mortality

A fixed natural mortality of 0.2 was used both in the assessment and the forecast.

5.3.4 Maturity at age (Table 5.14)

Traditionally, knife-edge maturity at age 6 has been used for this stock. In 1995, the data on spawning zones recorded in otoliths in Norway were investigated. There was no evidence of change in maturation rates over the period in the assessment and it was decided to use the same ogive for all years. This ogive, given in Table 5.14 and below, is based on the distribution of age at first spawning among 8 year and older fish. It represents an approximation of the data from 1973 to 1994, with most weight given to recent observations.

Age	4	5	6	7	8
% mature	1	55	85	98	100

5.3.5 Tuning data (Table 5.3)

The tuning is based on three data series: indices from the Norwegian acoustic survey on saithe and data from the purse seine and trawl fisheries (fishing effort and catch at age). There are some limitations in the data, e.g., low catches of age 2 saithe and relatively crude effort indices. However, the tuning data seem to perform satisfactorily.

5.3.6 Recruitment indices

Reliable recruitment indices are crucial for the predictions. Attempts at establishing year class strength at age 0 or 1 have so far failed. Acoustic survey data show promise for improving the estimate of year class strength at age 2, although there are conflicting results between the catch and survey data in recent years, especially in 1995.

5.3.7 Prediction data (Tables 5.13-14)

The input data to the prediction are given in Table 5.14. The stock number at age in 1997 was taken from the XSA for age 5 and older. The recruitment at age 2 in 1995 and 1996 (1993 and 1994 year classes) was estimated using RCT3 (Section 5.5.2). The corresponding numbers at age 3 and 4 in 1997 was calculated applying a natural mortality of 0.2 and fbars for 1994-1996, scaled to the 1996 level, as fishing mortalities. The long-term geometric mean recruitment of 210 million was used for the 1995 and subsequent year classes. The natural mortality and the maturity ogive are the same as used in the assessment. For the exploitation pattern the average of 1994-1996 has been used, scaled to the 1996 level. For weight-at-age in the catch and stock, the average weight at age for the last three years in the VPA has been used (Table 5.13).

5.4 Methods used in the Assessment

5.4.1 VPA and tuning (Table 5.5, Figure 5.2A-C)

Extended Survivors Analysis (XSA) was used for the assessment with the same settings as last year. Catchability was assumed to be independent of stock size for all ages. Catchability at age 2 was assumed to be dependent on stock size in the 1994-assessment, and the reason for the change in 1995 was the inclusion of purse seine CPUE at that age, which performed badly assuming dependence on catchability. A new trial run this year with catchability at age 2 dependent on stock size and no purse seine CPUE at this age in the tuning series, also gave quite different results and was rejected. The tuning diagnostics are given in Table 5.5. Figures 5.2A-C shows plots of the tuning indices versus stock numbers from the VPA. Trial runs showed that the changes made to the input data gave almost the same results as were obtained last year.

5.4.2 Recruitment (Table 5.4)

Estimates of the recruiting year classes up to the 1992 year class from the XSA were accepted. The high standard error in the tuning diagnostics for age 2 and 3 seems to be caused by the very low and probably underestimated catch figures at age 2 in 1995 and 1996 and to some degree at age 3 in 1996. The retrospective analysis showed that accepting estimates of stock number at age 3 in the last VPA year usually will be better than using the long-term average, whereas, the estimates at age 2 are unreliable (Figures 5.3B-C). The 1993 and 1994 year classes were poorly represented both in the Norwegian acoustic survey and in the purse seine fishery at age 2 in 1995 and 1996, and the 1993 year class was also weakly represented at age 3 in the purse seine fishery in 1996 (Table 5.3). The acoustic indices of the 1993 and 1994 year classes at age 2 were almost the same as the index of the 1992 year class at the same age, while the index of the 1992 year class at age 3 was above the long-term average. It was therefore decided to do a RCT3-run (Table 5.4) to get some guidance whether to use the long-term geometric mean recruitment or a recruitment from the RCT3 for the 1993 and 1994 year classes.

5.5 Results of the Assessment

5.5.1 Fishing mortalities and VPA (Tables 5.8-5.12, Figures 5.1A-B, 5.3A-C)

The XSA-estimates of the 1993-1995 year classes are not considered to be valid and theses estimates are therefore put in brackets (Tables 5.9-10). In Table 5.12 the long-term average recruitment and recalculated total biomass are presented.

The fishing mortality ($F_{3\text{-}6}$) in 1996 was 0.43 which is somewhat lower than the value of 0.49 expected last year (Figure 5.3A).

Also this year there was a change in the exploitation pattern with reduced mortality on the youngest ages. This was caused by more older fish both in the purse seine fishery and trawl fishery compared to previous years. The 1989 and 1990 year classes are still abundant, and the 1991 and 1992 year classes are well represented in the catches, though they seem to be weaker than the two previous year classes.

The spawning stock biomass estimates have on average increased by 13% because of the new maturity ogive. The SOP corrected stock biomass tables are included (Tables 5.10-5.12). There are considerable SOP discrepancies in the early part of the time series which are caused by the fixed weights in the data base prior to 1980. SOP correction should therefore give better estimates of biomass, but it is not advisable to recalculate the weights on this basis because they could be interpreted as observed values. Work is in progress to try to reconstruct the weight at age time series.

5.5.2 Recruitment (Table 5.4)

The XSA estimate of the 1992 year class at age 2 is 174 million individuals. The RCT3 estimates of the 1993 and 1994 year classes are 197 and 176 million individuals, respectively. It was decided to use these estimates and the long-term geometric mean of 210 million individuals for the 1996 and subsequent year classes.

5.5.3 Biological reference points (Figures 5.4 and 5.1C, Table 5.15)

Yield and SSB per recruit were based on the parameters in Table 5.14 and are presented in Table 5.15. $F_{0.1}$ was estimated to be 0.10 which is slightly higher than the value of 0.09 obtained last year. F_{max} was estimated as 0.18 (Figure 5.1C) which is also close to the result from last year (0.16). The plot of SSB versus recruitment is shown in Figure 5.4. The new maturity ogive introduced in 1994 did not change the main pattern in the plot. F_{low}, F_{med} and F_{high} were estimated as 0.21, 0.36 and 0.62, respectively, which are also slightly above the estimates from last year and almost the same as what was obtained two years ago. These minor changes may be caused by the changes in exploitation pattern and growth.

5.5.4 Catch options for 1998 (Table 5.16)

The management option table (Table 5.16) shows that the expected catch of 140,000 t in 1997 will decrease fishing mortality from F_{96} (*status quo*) of 0.43 to 0.41. The *status quo* catch in 1998 is 135,500 t compared to a catch at F_{med} of 117,000 t. SSB will decrease to 205,000 t in 1998 and will continue to decrease in 1999 if fishing mortalities are higher than F_{med} in 1998. A *status quo* catch in 1998 would reduce the SSB to 190,000 t in 1999, while a F_{med} catch gives a small increase in the SSB to about 207,000 t. The F_{max} catch for 1998 is 64,000 t, and the corresponding SSB in 1999 would be 260,000 t.

5.6 Management objectives (Figures 5.4 and 5.1C)

5.6.1 Target reference points and safe biological limits

In the 1994 WG report (ICES 1995/Assess:3) a MBAL of 150,000 t was proposed, based on the frequent occurrence of poor year classes below this level of SSB. The new maturity ogive introduced in 1995 gave somewhat higher historical SSB estimates and 150,000 t was considered to represent a less restrictive MBAL and 170,000 t was found to correspond better with the arguments used in 1994 (ICES. 1996/Assess:4). The updated stock and recruitment plot (Figure 5.4) shows that 65% of the year classes less than the long-term geometric mean of 210 million have been produced by spawning stocks below 200,000 t, while almost 70% of the year classes above the long-term geometric mean are produced by spawning stocks well above 200,000 t. A MBAL of 200,000 t therefore seems to be a more safe biological limit for the saithe SSB.

5.6.2 Limit reference points

The Comprehensive Fishery Evaluation Working Group (ICES 1996/Assess:20) suggested a $F_{comfie} = \min\{F_{med}, F_{MSY}, F_{max}\}$. F_{MSY} for saithe was not estimated by the present WG. Since F_{MSY} is commonly less than F_{max}, the latter should be considered an upper bound on fishing mortality in absence of data on F_{MSY} (Anon. *op. cit.*). F_{max} for saithe is presently 0.18, which means that there is a large potential for increased yields by lowering the fishing mortality from $F_{status\ quo}$ (0.43) to F_{max} (0.18) (Figure 5.1C). The corresponding catch in 1998 is 64,000 t, which would be a drastic reduction from the present TAC. The F_{med} catch of 117,000 t is close to the TAC set for 1997, and with this level of fishing mortality the predictions show stable or slightly increasing catches and spawning stock biomasses.

5.7 Medium-term forecasts and management scenarios (Tables 5.17-5.19, Figs. 5.1D, 5.5A-E, 5.6A-E, 5.7A-B, 5.8A-B)

5.7.1 Input data

The input data were the same as used for the short term predictions (Table 5.14), except for the scenarios on changes in minimum landing size. Here the exploitation pattern and weight-at-age in the catch have been adjusted for 1998 and onwards (Table 5.19). The adjustments are based on a minimum landing size of 40 cm in the purse seine fishery and 45 cm in the other fisheries. This is close to what has been proposed for new minimum landing sizes. For age groups not influenced by these changes (7+), the exploitation pattern is the same as used for 1997. New catch weights were estimated for age groups 2-4.

5.7.2 Methods

Single option predictions were run up to year 2001 using IFAP and following standard procedures.

The risk analyses performed last year were repeated. A spreadsheet reproducing the single option prediction was run under the program @RISK, using 100 iterations and fixed seed for the random number generator. Two probability distribution functions were used to add uncertainty and sample sets of possible values during the simulations. For the initial stock size a lognormal distribution was applied, LOGNORM(mean, standard deviation), with the initial stock numbers by age from the RCT3 and XSA as mean and standard deviation calculated by multiplying the mean by the external standard error from the XSA diagnostics. A truncated lognormal distribution, TLOGNORM(mean, standard deviation, minimum, maximum), was used for the recruitment at age 2. The mean, standard deviation, minimum and maximum were found from the XSA for the years 1962-1994, and the corresponding values were 214, 100, 78 and 459 million, respectively.

5.7.3 Results

Single option predictions for $F_{0.1}$, F_{max}, F_{med}, $F_{status\ quo}$ and F_{high} up to 2001 are given in Table 5.17 and Figures 5.5A-E and 5.6A-E show the corresponding SSB and catch distributions with quantiles from the @RISK simulations. The *status quo* catch in 2001 is 135,000 t, but this level of F would bring the SSB below the most conservative MBAL already in 1999 and down to 183,000 t in 2000. At F_{med} (details in Table 5.18) the catch in 2001 will also be 135,000 t, but the SSB will increase slowly and reach 225,000 t in 2001. The "COMFIE-recommended" $F_{max} = 0.18$ would increase the SSB to 392,000 t in 2001. With this fishing mortality the catch would be reduced to 64,000 t in 1998, increasing to about 113,000 t in 2001 (Table 5.17).

Predictions for the effects of changes of minimum landing size in 1998 are presented in Table 5.19 and Figure 5.7A-B and 5.8A-B show the corresponding SSB and catch distributions with quantiles from the @RISK simulations. A "*status quo*" fishery with changed minimum landing sizes would give a reference F of about 0.33, and the corresponding catch in 2001 is 144,000 t, about 10, 000 t more than the *status quo* catch with the present minimum landing size. The SSB would increase to about 234,000 t, which is 50, 000 t more than at $F_{status\ quo}$ with unchanged minimum landing sizes. If the reference F is increased to todays F_{med} level (0.36) after the introduction of new minimum landing sizes the catch in 2001 would still be about the same (145, 000 t), while the SSB would be somewhat less (216,000 t), actually 10,000 t less than at F_{med} with todays minimum landing sizes. This is because some of the short-term gain from conserving the youngest fish is lost by fishing harder on the mature part of the stock from the start.

In the @RISK simulations the probability of getting below the "old" and the more conservative MBAL for the SSB (170,000 t and 200,000 t, respectively) was analyzed using the "set target value" option. The text table below presents the probability of getting a SSB at or below the MBAL level.

Fishing mortality	MBAL (tonnes) 170,000	200,000
$F_{0.1} = 0.10$	0	0
$F_{max} = 0.18$	0	0
$F_{new\ size} = 0.33$	5	28
$F_{med} = 0.36$	3	32
$F_{status\ quo} = 0.43$	37	68
$F_{high} = 0.62$	100	100

With $F_{status\ quo}$ the chances of getting below both MBAL levels are high. F_{med} seems to be a more appropriate level of fishing mortality, but F_{max} is best with respect to the SSB.

5.8 Comments on the assessment and the forecast

During the 1990s the stock has recovered somewhat after a long period of low stock size and the exploitation patterns are better than in the past. The stock is, however, not considered to be completely within safe biological limits. The fishing mortality increased to a level well above F_{med} in 1995 and was at the same level in 1996. Though the fishing mortality is expected to decrease a little in 1997 a further reduction below F_{med} is advisable to prevent the SSB from being reduced to previous low levels below MBAL. Reduction in the fishing mortality might also improve the stability in the fishery and increase the long-term yield.

The present assessment seems to be quite similar to the previous assessment. Prediction of growth has been a small problem in some periods, especially for abundant year classes. Last years prediction of the 1996 weights at age was, however, very close to the actual weights used in the assessment this year. Uncertainty about recruitment levels will continue be the largest problem in the forecast. Prediction of catches beyond the TAC year will, to a large extent, be dependent on assumptions of average recruitment. In view of this, management advice for longer periods than one year must be considered unreliable. However, if the fishing mortality is further reduced this dependence will be less and multi-year TAC advice should be considered.

6 *SEBASTES MENTELLA* (DEEP-SEA REDFISH) IN SUB-AREAS I AND II

6.1 Status of the Fisheries

6.1.1 Historical development of the fishery

The only directed fisheries for *Sebastes mentella* (deep-sea redfish) are trawl fisheries. By-catches are taken in the cod and especially the shrimp trawl fisheries. It does not yet exist any criteria for legal by-catches of juvenile redfish in the shrimp fishery, but it has been reduced after the invention of the sorting grid. Traditionally the fishery for *S.mentella* was conducted by Russia and other East European countries on grounds from south of Bear Island towards Spitsbergen. The highest landings of *S. mentella* were 269,000 t in 1976, followed by a rapid decline to 80,000 t in 1980-1981 then a second peak of 115,000 t in 1982. The fishery in the Barents Sea decreased in the mid-1980s to the historic low level of 10,500 t in 1987. At this time Norwegian trawlers showed at this time interest in fishing *S.mentella* and started fishing further south, along the continental slope at approximately 500 m depth. These grounds had never been harvested before and were primarily inhabited by mature redfish. After an increase to 49,000 t in 1991 due to this new fishery, landings have been at a level of 10,000-15,000 t until 1996 when they dropped to 8,000 t. Since 1991 the fishery has been dominated by Norway and Russia.

6.1.2 Landings prior to 1997 (Tables 6.1-6.4, D1-D2, and Figure 6.1A)

Nominal catches of *S. mentella* by country for Sub-areas I and II combined are presented in Table 6.1, and for both redfish species in Table D1. The nominal catches by country for Sub-area I and Divisions IIa and IIb are shown in Tables 6.2-6.4. The landings used by the Working Group are those officially reported to ICES except where such reporting are not available at ICES but reportings have been made to Norwegian authorities during the fishery. In such cases the reportings to Norwegian authorities have been used as preliminary figures, which accounts for Canada in 1993, France in 1994-1996 and the Faroe Islands in 1996. For Norway some area adjustments of the official statistics were made prior to the Working Group.

The total landings decreased from 48,727 t in 1991 to 15,590 t in 1992 and have continued to decline. The provisional landings figure in 1996 is 8,086 t which is the lowest on record and 2,086 t less than in 1995. The landings in 1996 are 1,000 t more than the 7,000 t expected by last year's Working Group.

Reliable estimates of species breakdown by area were available to the Working Group back to 1989. The national landings of redfish for Russia and Norway in all areas and Germany in Division IIb are split into species by the respective national laboratories. For other countries (and areas) the Working Group has split the landings into *Sebastes mentella* and *Sebastes marinus* based on reports from different fleets to the Norwegian fisheries authorities. The historical landings (up to 1990) from FRG and GDR have been added and are given under Germany.

Most of the reduction in landings of *S. mentella* during the last four years has occurred in Sub-area I and Division IIb, but a decline is also seen in Division IIa. Landings from Division IIa area in 1996 represent 90% of the total. The large decrease in the Russian landings in 1996 was expected by last years Working Group due to reports of a poor fishery. The increase in the Norwegian landings may be explained by an increased interest in fishing along the continental slope south and west of Bear Island due to a shorter period of less restrictive by-catch regulations of Greenland halibut.

The redfish population in Sub-area IV (North Sea) is believed to belong to the North-East Arctic stock. Since this area is outside the traditional areas handled by this Working Group, the catches are not included in the assessment. The landings from Sub-area IV have been 1,000-2,000 t per year (Table D2). In 1992, however, the landings increased to 2,783 t due to an increase in the French fishery, but decreased again to 1,873 t in 1993. For 1994-1996 there is no information from the French fishery and total landings figures are therefore not available. Historically these landings have been *S. marinus*, but since the mid-1980s trawlers have also caught *S.mentella* in Sub-area IV along the northern slope of the North Sea.

6.1.3 Expected landings in 1997

The only directed Russian fishery for *S. mentella* at present is within the Norwegian EEZ where Russia received a quota of 2,000 t for 1997. In addition to this, and based on reports from the eight first months in 1997, a by-catch of approx. 1,000 t in other fisheries and areas should give an expected total Russian catch in 1997 of about 3,000 t. Strong regulations were enforced in the fishery in 1997. It is now forbidden to fish redfish (both *S.marinus* and *S.mentella*) in the Norwegian EEZ north and west of straight lines through the positions

1. N 7000' E 0521'
2. N 7000' E 1730'
3. N 7330' E 1800'
4. N 7330' E 3556'

and in the Svalbard area (Division IIb). When fishing for other species in these areas, it will be allowed to have maximum 25% by-catch (in weight) of redfish in each trawl haul.

Taking this into account and based on the landings of *S.mentella* by-catches halfway through the year, the total Norwegian landings in 1997 are expected to be around 1,000 t. On this basis, and assuming unchanged catch level for other countries, the landings of *S. mentella* for 1997 are expected to be 5,000 t.

6.2 Status of Research

6.2.1 Fishing effort and catch-per-unit-effort (Table D3)

For 1995, catch-per-hour-trawling data for the *S. mentella* fishery were available from the Russian PST vessels fishing in ICES Division IIa in 1995, accounting for 62% of the total international trawl catch (Table D4). The CPUE has been fluctuating about the 1995-level since 1985 with no clear trend. It is questionable whether this CPUE-series manages to reflect the true stock situation due to changes in the climatic conditions from year to year and a narrower time frame for fishing in recent years. The fishing period is at present limited to the end of April - beginning of May during the "spawning" time. Due to a very low Russian effort in this fishery in 1996 and by other vessel-types, no CPUE value is available for this year. However, the Working Group evaluated some information from the limited Russian fishery to support the conclusion that the CPUE in 1996 most probably had been about the same level as the year before.

Estimates of total effort are based on Russian PST units raised to total international catch. Since 1993 the effort has remained at a low level and was the lowest on record in 1996.

6.2.2 Survey results (Tables A14, D4-D8, Figures 6.2A-D)

The results from the following research vessel survey series were evaluated by the Working Group:

1) The international 0-group survey in the Svalbard and Barents Sea areas in August-September (Table A14).

2) Russian bottom trawl survey in the Svalbard and Barents Sea areas in October-December from 1978-96 in fishing depths of 100-900m (Table D4, Figure 6.2A).

3) Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1986-96 in fishing depths of <100-500m. Data disaggregated on age only for the years 1992-96 (Table D5, Figure 6.2B).

4) Norwegian Barents Sea bottom trawl survey (February) from 1986-96 in fishing depths of <100-500m. Data disaggregated on age only for the years 1992-96 (Tables D6 and D7, Figures 6.2C,D).

5) Russian acoustic survey in April-May from 1992-97 (except 1994 and 1996) on spawning grounds in the western Barents Sea (Table D8).

The international 0-group fish survey carried out in the Barents Sea in August-September since 1965 does not distinguish between the species of redfish (Table A14). The survey design has improved and the indices earlier than 1979 should, therefore, not be directly compared with subsequent years. A considerable reduction in the abundance of 0-group redfish was observed in the 1991 survey: abundance decreased to only 20% of the 1979-1990 average. With the exception of an abundance index of twice the 1991-level in 1994, the indices have remained low. A record low level of less than 10% of the 1991-1995 average was observed for the 1996-year class.

The Norwegian Svalbard groundfish survey in August-September (Table D5, Figure 6.2B), with age disaggregated data from 1992 onwards, was used in the tuning for the first time this year. The survey was in 1995 included in a new survey covering both Svalbard and the Barents Sea and total autumn indices including both areas are therefore expected to be used in future meetings. The Svalbard survey shows some relative good year classes (1988-1990) followed by weak ones (1991-1993).

Since 1981, a stratified random bottom trawl survey, targeted for cod and haddock, has been carried out by Norway in February in the Barents Sea. The results for *S.mentella* are available on length from 1986-1996 and are age disaggregated from 1992 onwards (Tables D6 and D7, Figs. 6.2C,D). Also in this survey the 1988-1990 year classes (possibly also the 1987 year class) are stronger than the adjacent ones. In this survey the 1991-1992 year classes are poor, while the 1993-1994 year classes seem to be at an intermediate level.

In the Russian bottom trawl survey the most recent estimates are among the lowest observed. (Table D4, Figure 6.2A). The area outside Spitsbergen was not properly covered in 1993, and this may account for the generally low values this year. Neither in 1996 this area was covered. The Russian and Norwegian surveys show a very similar picture of the relative strength of the year classes.

Russian acoustic surveys estimating the commercially sized and mature part of the *S.mentella* stock have been conducted in April-May on the Malangen , Kopytov, and Bear Island Banks since 1986. In 1992 the area covered was extended, and data on age are available for the Working Group for 1992, 1993, 1995 and 1997. Table D8 shows a 43% decrease in the estimated spawning stock biomass. This may be explained by the strong 1982-year class migrating west-southwest and out of the surveyed area and the fact that the next year classes expected to contribute significantly to the spawning stock (i.e., the 1987-1990 year classes) are just about to mature.

6.2.3 Age readings

As a result of the process on harmonizing the international age readings on redfish, all catches of redfish in 1992-1996 have been distributed on age according to otolith readings.

6.3 Data used in the Assessment

6.3.1 Catch at age (Table 6.5)

Since 1992, the catch in numbers at age of *S.mentella* from Russia is based on otolith readings. The Norwegian catch-at-age is based on otoliths back to 1990. Before 1990, when the Norwegian catches of *S. mentella* were smaller, Russian scale-based age-length keys were used to convert the Norwegian length distribution to age.

Catch at age for 1989-1993 was revised according to new catch data. Catch-in-numbers-at-age were corrected to make the sum-of-products (SOP) equal to the nominal landings. Catch at age for 1995 were revised according to new catch data and an updated catch at age distribution from Norway. Data on age for 1996 for *S. mentella* were only available from Norway and were based on poorer sampling than in recent years. For Division IIa, Russian and German length distributions were available, and were converted to age using a composite Norwegian age-length key from the fishing area. The landings from other countries in each area were distributed on age according to the available age distribution.

6.3.2 Weight at age (Tables 6.6 and 6.15)

Catch weight-at-age data for 1996 were available from Norway, and were used in the assessment (Table 6.6). In the catch projections, weight at age in the catch has been set equal to the average weight at age from the catches in 1994-1996 (Table 6.15). In previous assessments weight at age in the stock has been set equal to the weight at age in the catch. However, it was noticed that the catch weight-at-age data for 1995 and 1996 deviated from recent previous years and also more than could be expected to happen from one year to another for this redfish stock. The Working Group explained this by the reduced Russian fishery and thus only individual weight data from the Norwegian fishery from other grounds and to some extent also from different times of the year. The Working Group therefore decided to use the 1992-1994 average weight-at-age as weight-at-age in the stock for the years 1995, 1996 and the prediction. It should be further investigated whether it would be better to use a constant weight-at-age series (e.g., based on survey information) instead of catch weight-at-age which may vary due to changes and selections in the fisheries and not due to growth changes in the stock.

6.3.3 Natural mortality (Table 6.15)

A constant natural mortality of 0.1 was used.

6.3.4 Maturity at age (Tables 6.7, 6.15 and D9)

Age-based maturity ogives for *S.mentella* (sexes combined) are available for 1987-1993 and 1995 and 1997 from Russian research vessel observations in spring (Table D9). For 1996 and the catch projections the average for 1995 and 1997 was used.

6.3.5 Tuning data (Table 6.8)

Trawl effort and corresponding catch-at-age data were available for Russian PST-trawlers for the years 1982-1995. A similar CPUE as in 1995 was assumed for the Russian trawl fishery in 1996. For 1994 and 1996 the converted Russian catch-at-length data were used. The data were used as tuning input for ages 9-18.

Two new tuning series have been included in this years assessment. The Norwegian Svalbard groundfish survey in August-September (ages 2-12) and the Norwegian Barents Sea groundfish survey in February (ages 2-14), both with age disaggregated data from 1992 onwards, were used in the tuning for the first time this year.

Catch rates from the Russian bottom trawl survey in October-December are available on age back to 1978, and the whole time series was used for ages 1-10.

The time series of the Russian acoustic survey estimating the commercially sized and mature part of the *S.mentella* stock was considered too short to be included in the assessment this year, but this fishery independent series of adult fish is expected to be included in the future.

6.4 Methods used in the Assessment

6.4.1 VPA and tuning (Tables 6.9, Figures 6.3A-D)

The Extended Survivors Analysis (XSA) was used with the same settings as last year (Table 6.9). The XSA analysis used survivor estimates shrunk towards the mean F of the final 2 years and 5 ages. The standard error of the mean to which the estimates were shrunk was set to 2.0. The catchability was fixed to be constant and equal above age 17. Due to short time series of the two new tuning series no retrospective analysis was conducted. Figures 6.3A-D shows plots of the tuning indices versus stock numbers from the VPA.

The XSA included all ages from age 1 in order to estimate the recruitment at age 6 for recent years. However, since the current assessment aims at estimating the stock of fish age 6 years and older, it was necessary to run a standard VPA to relate all recruitment plots to age 6 and not to age 1. Probably due to slightly different estimation procedures, this caused some minor differences in the resulting stock numbers and SSB when comparing the outputs from the XSA and the summary statistics from the final standard VPA.

6.5 Results of the Assessment

6.5.1 Fishing mortalities and VPA (Tables 6.10-6.14, Figures 6.1A,B)

Fishing mortalities, stock numbers, and stock biomasses from the tuning VPA are given in Tables 6.10-6.14 and Figure 6.1 A and B. The fishing mortality ($F_{10\text{-}16}$) in 1996 is 0.041 and is a further reduction from the low level in the previous four years. The spawning stock biomass has the last 12 years been rather stable but low at a level of 60,000-80,000 t.

The average fishing mortalities for the years 1994-1996, scaled to the 1996 level so that this level corresponds to an F-factor of 1, were used as the input exploitation pattern in the catch projections.

6.5.2 Recruitment

The assessment shows that the year classes 1982 and 1983 are stronger than those just before and after and the 1988-1989 year classes (possibly also the 1987 year class) appear to be at a similar level as the 1982-1983 ones. This confirms what is indicated by the length and age data from Norwegian and Russian surveys and from Russian qualitative observations of young redfish in cod stomachs. The inclusion of the two new tuning survey series caused some reduction of the strength of the 1982-year class compared to last years assessment.

In the catch projection, the VPA results have been used for the year classes up to 1991. The more recent year classes are projected forward to age 6 accounting for natural mortality only (Table 6.15).

6.5.3 Biological reference points (Table 6.15, Figures 6.1C and 6.4)

Yield and SSB per recruit were based on the parameters in Table 6.15. The calculations gave $F_{0.1}$=0.082 while F_{max}=0.36, in spite of being similar to last year, was unrealistically high and clearly cannot be reliably estimated. (Figure 6.1C). From a stock and recruitment plot (Figure 6.4) the reference points F_{low}=0.02, F_{med}=0.07, and F_{high}=0.20 were calculated. F_{96} = 0.041 is about half the value of $F_{0.1}$ and F_{med}.

6.5.4 Catch options for 1998 (Tables 6.16-6.17)

If catches in 1997 are as expected, the fishing mortality will be considerably reduced (Table 6.16). Some increase in SSB from 1997 to 1998 is predicted, and will continue in 1998 for moderate levels of fishing mortality. *Status quo* fishing mortality (=F_{96}) in 1998 will yield a catch of about 8,000 t which is approximately the same as in 1996 and will lead to a slight increase in SSB. Table 6.17 shows predictions up to 2000 with no fishing and the options F_{low} and F_{med}. The catch in 1998 and SSB in 1999 for various levels of F in 1998 are shown in Figure 6.1D.

6.6 MBAL and Advised Exploitation Rates

6.6.1 Minimum Biological Acceptable Level (MBAL) (Figures 6.1B and 6.4)

The plots showing stock and recruitment (Figures 6.1b and 6.4) indicate a fairly close linear relationship between recruitment and SSB. Some deviations from this close relationship seem to have occurred in the 1960s and 1970s, but this may be due to an imprecise maturity ogive as well as inadequate sampling. The plus-group contributes a great deal to the SSB, and the contribution is variable from year to year, up to 30-40% in some years. This variation is probably to a large extent the result of inadequate sampling. If the plus-group is not included in the stock and recruitment plot the relationship between recruitment and SSB will be even closer. In particular, the point to the extreme right in the plot (1967) will fall more into line with the rest of the points.

Considering that the SSB-recruitment relationship appears to be linear within the range of SSBs observed, it is not possible to define a level of SSB where recruitment is largely independent on the SSB. It is also impossible to define a level where there is danger of recruitment failure because the recruitment to some extent will suffer at all levels of SSB.

The only basis for recommending a MBAL seems to be to use the plot without assuming any particular relationship. In that case, the statement made in last years report, that a SSB of about 300,000 t seems to be required to consistently produce average or good recruitment, still appears to be a sensible basis for recommending MBAL.

Using a MBAL of 300,000 t the stock is presently outside safe biological limits and at a level which is only about one third of the lowest level which has produced an average year class. To rebuild the stock to the MBAL, and assuming that there is a linear relationship between SSB and recruitment, it is very important that management measures are taken to ensure that SSB increases significantly each year.

Since the abundance indices of new year classes in recent 0-group and youngfish surveys are lower than ever previously observed it is crucial that the rebuilding of the SSB starts while there is still something to rebuild upon (e.g., the 1982-1983 year classes now within the SSB and the 1988-1990 year classes which are recruiting to the fishable biomass). It is therefore important that these year classes are protected so that they can contribute as much as possible to the stock rebuilding.

6.6.2 Advised exploitation rates

F_{max}=0.36 is too high to be considered as realistic. The values of $F_{0.1}$=0.082 and F_{med}=0.07 are for all practical purposes the same and about twice the current (1996) level of fishing mortality. Fishing mortalities should in general not exceed F_{med} but rebuilding requires that the catches should be kept as close as possible to zero.

6.7 Comments to the assessment and the forecast

The fact that the catch-at-age data are now based on the same age reading method improves the assessment. Strong year classes can be followed through the catch-at-age matrix, although there probably is some "leakage" of strong year classes to adjacent ones. The VPA results are consistent with last years assessment. The inclusion of the two new survey tuning series improved the assessment and should thus encourage continued effort to use research surveys to obtain age disaggregated abundance indices.

7 *SEBASTES MARINUS* (GOLDEN REDFISH) IN SUB-AREAS I AND II

7.1 Status of the Fisheries

7.1.1 Historical development of the fishery

The fishery for *Sebastes marinus* (golden redfish) is mainly conducted by Norway, accounting for 80-90% of the total catch. Germany also has a long tradition of a trawl fishery for this species. The fish are caught mainly by trawl and gillnet, and to a lesser extent by longline and handline. Some of the catches, and most of the catches taken by other countries, are taken in mixed fisheries together with saithe and cod. Important fishing grounds are the Møre area (Svinøy), Halten Bank, the banks outside Lofoten and Vesterålen, and Sleppen outside Finnmark. Traditionally, this has been the most popular and best paid redfish species.

7.1.2 Landings prior to 1997 (Tables 7.1-7.4, D1 and D2)

Nominal catches of *S. marinus* by country for Sub-areas I and II combined are presented in Table 7.1 and the total for both redfish species in Tables D1 and D2. Landings of *S. marinus* showed a decrease in 1991-1992 from a level of 23,000-30,000 t in 1984-1990 to about 16,000 t in 1992-1995. The provisional total landings figure for *S. marinus* in 1996 is 16,517 t. This is 2,483 t less than expected by last year's Working Group, but an increase of about 1,500 t from 1995.

Regarding splitting of the redfish landings on species and area, see chapter 6.

7.1.3 Expected landings in 1997

On the basis of reports of landings from the first half of 1997, Norwegian landings of redfish have been at the same level as in the first half of 1996. Species breakdown is yet not available, but it is assumed that the area closure in 1997 (see chapter 6.1.3) will influence *S.mentella* landings and to a lesser extent *S.marinus*. The Russian catches are expected to increase to 1,500 t. On this basis landings of 18,000 t are expected in 1997 which is approximately 1,500 t more than in 1996.

7.2 Status of Research

7.2.1 Fishing effort and catch-per-unit-effort (Tables D10-D11, Figure 7.1)

Data for *S. marinus* were available for Norwegian freshfish trawlers (ISSCFV-code 07, 250-499.9 GRT) since 1981 (Table D10-D11) from which the total international effort was estimated. This series which is based on GLM analysis on monthly data from five Norwegian statistical areas along the Norwegian coast was revised prior to this year's Working Group. Although typical *S. mentella* grounds have been sorted out, difficulties related to the splitting of the redfish species in the catches may be the reason for still some fluctuations in the series. A lower effort is observed since 1991, but no significant year effect was observed in the standardized CPUEs (Tables D10-D11, Figure 7.1). The provisional figure for 1996 of 1.42 t/hour is close to the long-term average of 1.38 t/hour. The CPUEs have been standardized and scaled to a certain area (3) and month (2) (Table D10).

7.2.2 Survey results (Tables D12-D14, Figures 7.2-7.4)

The results from the following research vessel survey series were evaluated by the Working Group:

1) Norwegian Barents Sea bottom trawl survey (February) from 1986-96 in fishing depths of <100-500m. Data on length for the years 1986-1997 are shown in Table D12 and Figure 7.2. Data disaggregated on age for the years 1992-96 are shown in Table D13 and Figure 7.3. This survey covers important nursery areas for the stock.

2) Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1986-96 in fishing depths of <100-500m. Data disaggregated on age only for the years 1992-96 (Table D14 and Figure 7.4). This survey covers the northernmost part of the species' distribution.

These surveys were also described in chapter 6. Acoustic abundance estimation have also been done in the same areas, usually as combined acoustic - bottom trawl surveys. The acoustic estimates were not available to this meeting.

Both surveys show that the abundance indices over the commercial size range (> 30 cm) appear to be relatively stable at least during the 1990's. An apparent lack of pre-recruit size-groups may be a first sign of poorer recruitment to the future fishery. This should be carefully monitored in the future since a.o. the about ten times more abundant *S.mentella* may obscure significant changes in *S.marinus* indices especially of smaller fish less than 12-15 cm where the species identification is sometimes difficult.

7.2.2 Age readings

For *S.marinus* it is still difficult to follow any strong year classes through the survey time series and from the catch-at-age data. This may be related to lack of samples. However, one should expect to be able to follow certain cohorts through a youngfish survey series. It may then be more difficult to do that in the catch-at-age array where the bulk of the catch is composed of 12-18 year old fish. The consequences of improper survey coverage and the possible improvement by adding surveys in different areas together should be investigated to improve understanding of the causes behind the lack of cohorts to follow through the time series. The effort to harmonize the age readings between readers should continue.

7.3 Data Used in the Assessment

7.3.1 Catch at Age (Table 7.5)

Catch at age for 1989-1993 was revised according to new catch data. Catch-in-numbers-at-age were corrected to make the sum-of-products (SOP) equal to the nominal landings. Catch at age for 1995 were revised according to new catch data and an updated catch at age distribution from Norway. Age composition data for 1996 were only provided by Norway, accounting for 87% of the total landings. In Sub-area I, Russian catch-at-length were converted to age by using the Norwegian age-length key from the area. In Division IIa, German catch-at-length was converted to age by using a Norwegian age-length key for the northern part of this division. In Division IIb, German and Russian catch-at-length were converted to age by using the Norwegian age-length key for the division. Otherwise other countries were assumed to have the same relative age distribution and mean weight as Norway.

The total catch-at-age data back to 1991 are based on Norwegian otolith readings. In 1989-1990 it is a combination of the German scale readings on the German catches, and Norwegian otolith readings for the rest. In 1984-1989 only German scale readings are available, while in the years prior to 1984 also Russian scale readings exist.

7.3.2 Weight at Age (Table 7.6)

Weight-at-age data for ages 7-24+ were available from the Norwegian landings in 1996.

7.3.3 Maturity at age

A maturity ogive was not available for *S. marinus*, and a knife-edge maturity at age 15 was assumed.

7.3.4 CPUE-data for tuning (Table 7.7)

Two preliminary series of *S.marinus* catch rates from the Norwegian bottom trawl surveys at Svalbard (August-September) and the Barents Sea (February) are available on age back to 1992. For both surveys the whole time series was used for ages 2-15 (Tables D13-D14).

On the basis of catch-per-unit-effort from Norwegian freshfish trawlers since 1981 (Table D11), total Norwegian trawl effort was calculated, and corresponding catch-at-age data were used for ages 9-23.

7.4 Comments on the Stock Assessment

Attempts were made to evaluate the status of the *S.marinus* stock using an Extended Survivors Analysis (XSA) for the period 1989-1996. However, the Working Group concluded that there were too many inconsistencies in the input values to put any reliance in the results.

One of the terms of reference to this Working Group was to look into alternative methods to conventional catch-at-age analyses, such as the use of stock-production models. This was discussed during the meeting but the Working Group did not manage to conduct such alternative analyses at this stage. However, the Working Group was informed about modelling at present going on at the Marine Research Institute at Iceland on the East Greenland-Iceland-Faeroe *S.marinus* stock and will try to use this approach on the Northeast Arctic stock in the future (Sigurdsson and Stefansson, Working paper to the North Western WG 1997).

7.5 State of the stock and management considerations

Available data from both the surveys and commercial CPUE suggest that the abundance indices over the commercial size range (>30 cm) appear to be relatively stable at least during the 1990's. This stability is also associated with a rather constant annual catch of about 16,000 tons during the same period. Nevertheless, concerns were expressed with the apparent lack of pre-recruit size groups in the recent surveys suggesting that future recruitment to the fishery may be poor. If this is truly the case then declines in the stock can be anticipated over the next few years.

8 GREENLAND HALIBUT IN SUB-AREAS I AND II

8.1 Status of the fisheries

8.1.1 Historical development of the fisheries

Before the mid 1960s the fishery for Greenland halibut was mainly a coastal long line fishery off the coasts of eastern Finnmark and Vesterålen in Norway. The annual catch level of this fishery has been about 3,000 t and this level has been maintained in recent years, although now also gillnets are used in the fishery. Following the introduction of international trawlers in the fishery in the mid 1960s, the landings increased to a level of about 80,000 t in the early 1970s. The landings decreased steadily to a level of about 20,000 t during the early 1980s. This level was maintained until 1991, when the catch increased sharply to 30,000 t.

From 1992 this fishery has been regulated by allowing only the long line and gillnet fisheries by vessels smaller than 27.5m to be directed for Greenland halibut. This fishery is also regulated by seasonal closure. Trawl catches were limited to bycatch only. From 1992 up to autumn 1994 bycatch in each haul should not exceed 10% in weight. In autumn 1994 this was changed to 5% bycatch of Greenland halibut onboard at any time. In autumn 1996 it was again changed to 5% bycatch in each haul.

The regulations enforced in 1992 reduced the total landings of Greenland halibut by trawlers from 20,000 to about 6,000 t. Since then annual trawler landings have varied between 5,000 and 8,000 t. without any clear trend attributable to the changes in allowed bycatch. Landings of Greenland halibut from the directed longline fishery have increased gradually in the later years. This is connected to increased difficulties of regulating the fishery which only lasts for a few weeks.

8.1.2 Landings prior to 1997 (Tables 8.1 - 8.5, E7, Figure 8.1A)

Nominal catches by country for Sub-areas I and II combined are presented in Table 8.1, and Tables 8.2-8.4 give the catches for Sub-area I and Divisions IIa and IIb separately. For most countries the catches listed in the tables are similar to those officially reported to ICES. For Norway the values in the tables vary slightly from the official statistics, and Russian catches for 1990-1991 represent those presented to the Working Group by Russian scientists. Landings separated by gear type are presented in Table 8.5.

The revised total catch for 1995 is 11,043 t which is virtually unchanged from that used in the previous assessment. The preliminary estimate of total catch for 1996 is 14,073 t. This is somewhat higher than the projected catch of 13,000 t estimated by the Working Group during its 1996 meeting. The increase was caused by Norwegian trawl and longline catches in Division IIa (Table 8.3). Trawl catches from this division increased by 2,141 t while longline increased by 1,360 t. In Sub-area I and Division IIb total catch of Greenland halibut decreased from 1995 to 1996.

In recent years, some fishing for Greenland halibut has taken place in the northern part of Division IVa. In the period 1973-1990, the annual catch in Division IVa was usually well below 100 t, occasionally reaching 200 t. Since then, catches have increased sharply from 267 t in 1991 to 2,280 t in 1995 (Table E7). The increase up to 1991 was mainly due to a gillnet fishery, but in the recent years most of it has been taken by trawl. This fishery is in another management area and is not restricted by any TAC regulations. Although there is a continuous distribution of this species from the southern part of Division IIa along the continental slope towards the Shetland area, little is known about the stock structure and the catch taken from this area has therefore not been added to the catch from Sub-areas I and II.

Also around Jan Mayen, small catches of Greenland halibut have been taken in some years. In 1992, 56 t were taken, while nothing was reported taken in this area in 1993. 140 t and 270 t were reported in 1994 and 1995, respectively. In 1996 only 19 t were reported from this area. Jan Mayen is within Sub-area IIa, but little is known about the relationship with the stock assessed by the Arctic Fisheries Working Group. Catches from this area have therefore not been included in the catches given for Sub-area II.

8.1.3 Expected landings in 1997

Fishery for Greenland halibut is regulated by TAC of 2,500 t that should be taken by gillnetters and longliners within a restricted time period and by restricting allowed bycatch in the trawl fishery to 5% of each trawl catch. When the gillnet and longline fishery was closed for 1997 the quotas were overfished resulting in a catch of nearly 4,000 t. The bycatch in the trawl fishery has decreased and it is expected that a total of about 8,000 t will be caught by Norway. An additional 1,500 t is expected to be caught by Russian vessels, and 500 t by other countries.

The catches from Division IVa are expected to be maintained at the same level as last year.

8.2 Status of research

8.2.1 Fishing effort and catch-per-unit-effort (Table 8.6 and E5, Figure 8.2E)

The restrictive regulations imposed on the trawl fishery after 1991 disrupted the traditional time series of commercial CPUE data. However, an attempt to continue the series was made through a research programme using two trawlers in a limited commercial fishery (Tables 8.6 and E5, Figure 8.2E). This comprises fishing during two weeks in May-June and October, representing an effort somewhat less than 20% of the 1991 level. Since 1994 the fishery has been restricted to May-June. This fishery was conducted, as much as possible, in the same way as the commercial fishery in the previous years.

The CPUE from this experimental fishery was found , however, to be considerably higher than in the traditional fishery and has exhibited an increasing trend from 1992-1996. In 1997 this trend stopped and a clear reduction in catch was observed especially for age 5-7. Still CPUE was higher in 1997 than in the years before 1996. Although it is difficult to fully reconcile this increasing trend in terms of other stock indicators, all of which suggest a declining stock, there are some possible reasons that could partly explain this increase as pointed out in the 1996 report. They are as follows: 1) less competition in the traditional fishing areas for Greenland halibut as a result of a substantial reduction in directed fishing effort since 1991; 2) increased availability of the fishable stock (mainly ages 6-10) also due to much reduced effort in recent years ; and 3) since the experimental fishery occurs mainly in deeper water (600-800m) the catch rates may be more reflective of higher density if a shift in distribution to deeper water has taken place. The lack of modal progression in the age distributions throughout this series of increasing catch rates also indicate that a year effect rather than a year class effect is operating.

In its previous assessment the Working Group concluded it could not treat the CPUE from this fishery as an extension of the commercial time series, but the new data series might be helpful in stabilizing the VPA in the older ages. Its overall effect on the assessment would still be relatively small as it is the size of the pre-recruit year-classes that is of utmost concern. The Working Group adopted a similar approach this year.

8.2.2 Survey results (Tables A14, E1-E5, Figures 8.2A-G)

The results from the following research vessel survey series were evaluated by the Working Group:

1) Norwegian Svalbard bottom trawl surveys (autumn) from 1984-96 in fishing depths of <100-500m. (Table E1, Figure 8.2B)

2) Russian bottom trawl surveys in the Barents Sea from 1990-95 in fishing depths of 100-900m. This series had been revised substantially prior to its use in the 1996 assessment. The parameters of the 1996 survey, however, were considered too incompatible with previous years for direct comparison and covered only half the survey area. Therefore, the 1996 data were not introduced in the current assessment (Table E3, Figure 8.2C)

3) Norwegian Svalbard shrimp trawl surveys from 1988-96 in fishing depths of 200-600m. (Table E4, Figure 8.2D)

4) Norwegian Barents Sea bottom trawl survey (winter) from 1989-97 in fishing depths of <100-500m. (In order to utilise the 1997 values in VPA calibration, this series was adjusted back by 1 year and 1 age group to reflect sampling as if it occurred in the autumn of the previous year) (Table E2, Figure 8.2F).

5) Norwegian Greenland halibut surveys in autumn along the continental slope from 68N to 80N latitude in depths of 500-1500 M north of 7030'N and 500-1000 M south of this latitude. (Table E5, Figure 8.2G)

6) Norwegian pelagic 0-Group surveys from 1970-96. (Table A14, Figure 8.2A)

The Norwegian Svalbard bottom trawl survey caught Greenland halibut mainly in the range of ages 1-8, although in most years age 1 was poorly represented. The age distribution in the earlier period was highly variable, however, for the period 1984-91 the overall abundance for all age groups in most years was relatively high compared to 1992-96. Starting in 1990, the cohorts at ages 2 and 3 began to decline considerably compared to earlier years. Ages 4-6, nevertheless, remained rather stable until about 1991 after which they also declined annually to very low levels by 1995. Estimated abundance of ages 7-8 varied over the period and it is suggested that the limits of the survey depths may be near the main distribution area of these cohorts which would contribute to this effect. The age composition and relative abundance in the 1996 survey was similar to the low levels of recent years with the exception of age 1. This abundance of this age group (representing the 1995 year-class) was the highest in the time series.

The Russian Barents Sea bottom trawl survey series from 1990-95 had been revised considerably prior to its use in the 1996 assessment but details of the methodology were not made available to the Working Group. The revised survey caught fish mainly in the range of 4-9 years old. The overall abundance declined from about 1991-95 largely as a result of declines in the presence of Greenland halibut in the age range of 4-5. There was a considerable difference in the age distributions and relative abundance between the old series and the revised series especially at ages 7 and 8 which are relatively much more abundant in the revised estimates (Figure 8.4). Because of the significance of these changes the group had recommended that a detailed explanation of the revisions be made available at this year's meeting for review. However, no descriptions of the methods were provided.

The Norwegian Svalbard shrimp survey caught fish mainly in the age range of 1-8, and it appeared to be most effective in measuring the abundance of Greenland halibut younger than age 6. Cohorts at ages 1 and 2 began to decline significantly after 1989. All subsequent year-classes and these cohorts at older ages were estimated to be in extremely low abundance with the 1995 survey estimates among the lowest in the time series. The age composition and relative abundance in the 1996 survey were similar to that of 1995 with the exception of age 1. This abundance of this age group (representing the 1995 year-class) was higher than any year-class at age 1 during the 1990's but considerably lower than age 1 estimates in the 1988 and 1989 surveys.

The Norwegian bottom trawl surveys during winter in the Barents Sea caught Greenland halibut up to 12 years and older, but was not particularly effective in catching fish older than 7 years. This is likely to be caused by the limited depth distribution of the survey area. Nevertheless, the survey appeared very effective at catching Greenland halibut up to age 6. The abundance of fish age 5 and older was highly variable over the time series. Ages 1-4, on the other hand, began to decline in about 1991 and by 1994 had reached very low levels. In the 1997 survey, the abundance of these cohorts were collectively the lowest observed in the time series.

The Norwegian Greenland halibut surveys along the deep continental slope south and west of Spitsbergen were begun in 1994 and this is the first time detailed data from these surveys have been presented to the group. Although Greenland halibut were caught older than 15 years few fish were represented in the catch over age 12 or less that age 5. The scarcity of younger fish is probably a reflection of the minimum depth of 500 m. Most of the abundance indices were dominated by ages 5-8. Recognising the shortness of the time series there was nevertheless no apparent trends in the data set.

The strengths of the Greenland halibut year-class of 1970-96 from the Norwegian pelagic 0-Group surveys in the Barents Sea are shown in Table A14 and Figure E1. The results are highly variable over the time period, however, most of the 1970's and 1980's year-classes are represented in reasonably high numbers. In recent years, on the other hand, the 1988-1992 inclusive and the 1996 year-classes are all well below the long term average. The 1993-95 year-classes are closer to the average.

8.2.3 Age readings

Considerable concern has been raised both in previous meetings of the Working Group regarding the age interpretations of Greenland halibut. It was further noted that the age reading problem with Greenland halibut was not restricted to the North East Arctic stock but is an issue of concern Atlantic-wide. In November of 1996 an ICES/NAFO workshop on Greenland halibut ageing was held at Reykjavik, Iceland to address ongoing problems with age interpretation of the species throughout the North Atlantic. A complete report on the proceedings and recommendations is available through both ICES and NAFO (ICES CM 1997/G:1). The main result of the workshop was the standardisation of procedures for interpretation of ages which has now been implemented in the many national research institutes working on Greenland halibut in the North Atlantic; in addition, otolith samples are being circulated on an ongoing basis throughout the respective laboratories in order to maintain consistency. With respect to the current assessment of Greenland halibut in the NE Arctic, however, the problem of unusually low numbers of cohorts at age 9 in data sets from the 1990's continues into 1996 data and remains unexplained. It is recommended, therefore, that prior to the 1998 assessment a stratified analysis of length frequency data be conducted to determine whether the problem is in fact one of age interpretation or if the size compositions associated with age 9 are also missing from the data sets.

8.3 Data used in the assessment

8.3.1 Catch at age (Table 8.7, Figures 8.3 A and B)

The catch-at-age data for 1995 were updated using revised catch figures and revised Norwegian age composition. Catch-at-age data for 1996 were available from both the Norwegian and Russian fisheries. Russian age data were only available from Sub-area II and the Norwegian age distribution was used to calculate Russian catch-at-age in Sub-area I. No age or length data were available from the Russian longline catches, thus Norwegian age compositions were used. This year length distributions were available from the German catches and these were combined with Norwegian age-length keys. The combined Norwegian and Russian catch-at-age was used to allocate catches from other countries on age groups. Total international catch-at-age is given in Table 8.7 and for the recent years also in Figure 8.3. Greenland halibut are usually caught in the range of 3-16 years old, but the catch is mainly dominated by ages 5-10. In some years (especially 1989-91), 4 year-olds were also caught in significant numbers. Generally, fish older than age 10 have comprised a very low proportion of the catches, although they are proportionately higher in the most recent years up to 1996. In 1996 catches were dominated by a narrow range of age groups with about 80% of the catch at ages 5-8 and 40% of the catch was age 7. The Working Group observed that there is an apparent ageing discrepancy in the data particularly related to age 9 similar to that seen in the survey data.

8.3.2 Weight at age (Table 8.8)

A constant set of weight-at-age data was used for all years in the period 1970-1978. For subsequent years annual estimates were used. The mean weight at age in the catch in 1996 (Table 8.8) was calculated as a weighted average of the weight in the catch from Norway and Russia. The weight at age in the stock is set equal to the weight at age in the catch for all years.

The weights at ages 1 and 2 are set to 0 to indicate that the ages are only used for tuning and are not included in the stock biomass.

8.3.3 Natural mortality

Natural mortality of Greenland halibut was set to 0.15 for all ages and years. This is the same assumption as used in previous years.

8.3.4 Maturity at age (Tables 8.9)

An average maturity ogive derived from Russian data from 1983-1987 was used for 1970-1987. For 1988 and 1989 a three-year running average was used. As no appropriate data were available for 1991 and 1992, the average of the 1989 and 1990 ogives was adopted for 1990-1992. Russian maturity ogives, sampled in November 1993-January 1994 and December 1994-January 1995 were averaged and used to represent both 1993 and 1994. This ogive was also used for 1995 and 1996 as no new maturity data were available for these years.

8.3.5 Tuning data (Table 8.10)

The following abundance indices were used for tuning the VPA:
Fleet 9: Norwegian Svalbard bottom trawl surveys (autumn) from 1984-96 for ages 1-8.
Fleet 11:Norwegian Svalbard shrimp trawl surveys from 1988-96 for ages 1-8.
Fleet 12:Experimental commercial fishery CPUE from 1992-95 for ages 5-14.
Fleet 13:Norwegian bottom trawl surveys in the Barents Sea (conducted in winter and adjusted to the autumn the year before) from 1989-97 for ages 1-12.
Fleet 14:Norwegian Greenland halibut surveys using a commercial vessel along the continental slope for ages 4-14.

8.3.6 Recruitment indices (Tables A12, E1-E5, Fig 8.2A-G

In addition to the indices mentioned in section 8.3.4, the 0-group indices from the International 0-group survey (Table A12) were available for recruitment estimation. All the indices seem to indicate low recruitment in the last few years. All year classes after 1989-1994 show consistently very low abundance at all ages. The 1995 year class may be an exception with catch rates both as 0- and I-group well above the average for the past eight years

(Tables A12 and E2). In the Norwegian bottom trawl survey at Svalbard catch rate of I group was higher in 1996 than in any previous year. The 1995 year class was also very abundant in the Norwegian Barents Sea bottom trawl survey as I-group in 1996 but not as II-group in 1997. In the Svalbard shrimp survey the estimate of this year class at age 1 was considerably higher than in recent years but still well below the estimates of 1988 or previous year classes. However, further observations at older ages are needed before any confidence in the strength of the 1995 year class can be established.

The recruitment indices, except for the 0-group survey, are included in the CPUE data used for tuning.

8.3.7 Prediction data

Input data used in the short-term prediction for 1997-1999 are shown in Table 8.17. Population numbers in 1997 are taken from the VPA. Since there are large uncertainties regarding the strength of the 1995 and 1996 year classes recruitment of 3-year olds in 1998 and 1999 was calculated as the mean of the VPA estimate at age 3 for the last three years.

The exploitation pattern used in the short term prediction is the average of 1994-1996 scaled to give an F-factor of 1.0 corresponding to the 1996 fishing level. The maturity ogive is the average of the 1994-1996 ogives. Weight at age in both the catch and the stock has been set equal to the weight at age in the catch averaged for the years 1994-1996.

8.4 Methods used in the assessment

8.4.1 VPA and tuning (Tables 8.11-8.12)

The Extended Survivors analysis (XSA) was used to tune the VPA to the indices identified above. The analysis used survivor estimates shrunk towards the mean of the final 2 years and 5 ages and the standard error of the mean to which the estimates were shrunk was set at 2.0. These values are similar to those used in the previous assessment and the Working Group considered them still to be most appropriate for this stock.

The catchability was assumed to be independent on stock size for all ages. This was also used in last years assessment and reflects the confidence the Working Group now has to the very clear recruitment failure that is seen in the surveys. This way of increasing the influence of the survey results on the assessment is also in line with recommendations from ACFM.

The catchability was set independent on age for ages above age 10. The diagnostics of the tuning are given in Table 8.11 and the population numbers from the XSA extended to age 1 are given in Table 8.12.

As indicated earlier there were some changes in the input data for tuning compared to last years assessment. Several runs were made in order to evaluate the effect of the various changes: 1) Last years assessment was run with updated catch data (but not including 1996); 2) the same run was made without the Russian groundfish survey tuning fleet; 3) then the 1996 data were added, and 4) the new Norwegian Greenland halibut survey was included in the tuning. Of the XSA runs carried out only adding the 1996 data had any significant influence on the results.

8.5 Results of the Assessment

8.5.1 Fishing mortalities and VPA (Tables 8.13-8.16, Fig 8.1, 8.5

The fishing mortality (F) matrix indicates that Greenland halibut were fully recruited to the fishery historically at about age 6 while in recent years it appears full recruitment is more in the range of age 10. This is likely due to a substantial proportional reduction in trawler effort since 1991. Trawlers catch more young fish compared to gillnetters and longliners. Nevertheless, F on ages 6-10 still represents the average fishing mortality on the major age groups represented in the fishery.

The fishing mortality (F_{6-10} declined from approximately 0.35 in the late 70's to 0.14 in 1981. From that time it increased sharply and peaked in 1991 at 0.68. Following the drop in the catches and effort in 1992, the F_{6-10} dropped to 0.25 and has stayed below 0.35 until 1996 when it increased to 0.44.

The fishing mortality levels of the 1989-1995 year classes estimated in the current assessment are consistently somewhat lower than those presented by the working group in 1995. This corresponds to an increase of estimated stock number at age for these year classes of approximately 100%. For older year classes estimated fishing mortality increased in later years relative to last years assessment. A summary of the historical series of landings, fishing mortalities, stock biomasses and recruitment from 1970-1996 is given in Table 8.16.

Until 1976 the spawning stock was well above 100,000 t, then it was relatively stable at around 75,000 t for several years. In 1992 it dropped from 50-60,000 t to 30,000 t and has stayed at that level since. The lack of recruitment observed in the recent years indicates that the spawning stock biomass is currently below the level required to ensure historic recruitment levels. This may be seen in the stock and recruitment plot in Figure 8.6. Although fishing effort is reduced, it is assumed that the recent very weak year classes will reduce the spawning stock for coming years.

The total biomass of the stock has been relatively stable (around 100,000 t) in the period 1976-1991, but the recent low recruitment has led to a decrease to about 42,000 t in 1996.

8.5.2 Recruitment (Table A12)

By setting catchability independent on stock size for all ages, the assessment reflects the recruitment failure seen in the surveys. Historically, annual recruitment of Greenland halibut at age 3 was quite stable at 25-35 million individuals but has been low in recent years. The figures for the 1989 - 1994 year classes were estimated to be 17.3, 8.2, 5.2, 2.2, 0.5 and 2.4 million three-year-olds, respectively. The 1995 year class was estimated to 83.6 million at age 2. Allowing for natural mortality this gives approximately 70 million at age 3. However, the working group has little confidence in the precision of the estimate at this early stage. Further measurements on the size of this year class will be available in the 1998 assessment for more detailed evaluation of its strength. Another uncertainty regarding the VPA estimates of recruitment is their instability when adding a new year of data. In this years assessment the weak year classes were estimated to be about two times more abundant than the previous estimates but still they are weak compared to year classes before 1989.

8.5.3 Biological reference points

Yield and spawning stock biomass-per-recruit have been calculated using the data which are input to the prediction, and the results have been presented in Figure 8.1. The values of $F_{0.1}$ and F_{max} are 0.05 and 0.10, respectively. Using the stock-recruitment relationship shown in Figure 8.5 the values of F_{low} F_{med} and F_{high} were calculated as 0.01, 0.14 and 0.23, respectively.

8.5.4 Catch options for 1997 (Table 8.18)

The expected catch in 1997 is approximately 10,000 t compared with 14,000 t in 1996. Therefore a F-factor less than 1 is used in the management option table in order to get estimated catch in 1997 to equal expected catch. Expected catches in 1997 will cause the spawning stock biomass to decrease during this year from 23,000 to 16,000 t, and the total stock biomass will decrease from 30,000 to 22,000 t.

If the same fishing mortality is applied in 1998, it is expected a further reduction of total and spawning biomass to 15,000 and 10,000 t respectively. If there is no fishing on this stock in 1998, both total and spawning biomass will increase slightly.

8.6 MBAL level and advised exploitation rates

8.6.1 Minimum biological acceptable level (MBAL) (Figure 8.5)

Considering the spawning stock- recruitment relationship (Figure 8.5) it is clear that a spawning stock below 65,000 t results in recruitment failure. Although there are uncertainties associated with the recruitment estimates of this stock, a Minimum Biological Acceptable Level for this spawning stock should be set to 65,000 t as a conservative measure.

8.6.2 Advised exploitation rates

For managing the stock in consideration of this assessment, only the F_{low} value is advisable for rebuilding of the stock. The F_{low} value has proven to be a good reference measure for rebuilding other stocks, e.g.. North East Arctic Cod. The stock is clearly below safe biological limits and the spawning stock will be further reduced as the series of poor year classes mature. The Working Group advises that no fishing on Greenland halibut should take place in 1998.

8.7 Medium-term forecasts and management scenarios

The Working Group feels that it is at present not possible with reasonable precision, to predict future development of the Greenland halibut stock beyond the short term.

8.8 Comments to the assessment and the forecasts

This assessment relies mainly on observations from the surveys for the younger, recruiting ages, i.e. the upper right corner of the VPA tables. Figures 8.4.A-E show the relationship, as a result of tuning procedures, between the survey indices and the resulting VPA. Also included is the CPUE series for the older ages, and they are mainly included to allow for use of the full age range. It is clear from these plots that the surveys generate the trend in the younger ages. However, some support is also given from the CPUE index and they give the necessary stability in the tuning iterations, thus providing estimates of input F values for the VPA.

The tuning diagnostics (Table 8.11) show that the residuals were generally very high, and in several cases the slope was estimated as negative. This means that the precision of the estimated stock numbers and fishing mortalities are poor. However, this years assessment shows just the same general picture as have been seen in the most recent years: The spawning stock is very low and recruitment has been low for several years. The main difference from last years assessment is that the weak year-classes appear somewhat stronger than previously estimated but still very low in the historic sense. A possible explanation to this increased estimate of recruitment is that some of the recruits are outside the area sampled in their first years of life. There are indications that some 5-7 year-old fish come into the survey and fishing areas from other regions. On the other hand, it could simply be a year effect in the 1996 (or 1995) survey data.

The maturity ogives that have been used are a combined maturity of both sexes. However, for Greenland halibut there is a considerable difference in maturation between the sexes. While 50% of males are mature at an age of about 6 years, females are about 10 years old at 50% maturity. In the future more work should be directed towards giving maturity data for each sex separately. Maturity data on Greenland halibut vary throughout the distribution area and it is therefore important to consider geographical coverage and sample size.

When the sex-specific maturity data is established this may very well alter the level of MBAL set earlier in this report but would not change the conclusions about the overall state of the stock at present.

Although some changes have been made in the 1997 assessment and there are concerns related to certain parameter estimates illustrated in the XSA diagnostics, the main conclusions are consistent with recent assessments. No retrospective analyses have been performed due to the short time series of the tuning data used in the assessment. The WG is confident nevertheless that the assessment is reasonably and consistent and could form the basis of management advice .

9 NORWEGIAN COASTAL COD IN SUB-AREAS I AND II

9.1 Status of the fisheries

9.1.1 Historical development of the fisheries (Table F.1)

The existence of a distinct coastal cod stock in the northern part of Norway, which can be separated from the North-East Arctic cod stock by difference in the otolith structure, was given by Rollefsen (1933). The main background for the introduction of the Norwegian Coastal cod and the Murman cod to the ICES Arctic Fisheries Working Group in the 1960's and 1970's was improved knowledge of the existence of such stocks in Norway and Russia.

The Norwegian catch statistics separates the catch of cod into North-East Arctic and Norwegian Coastal cod. This has been based on where and when the catches are caught, and not based on biological sampling of the catch. The definition of the catches is given as catches in ICES Division IIa, Norwegian statistical areas 05 and 00 (quarter 3 & 4), 06 and 07 (all year) (Figure 9.4) (ICES 1970/F:2; ICES 1975/F:6; ICES 1994/Assess:2; ICES 1996/Assess:4; ICES 1997/Assess:4). The Norwegian coastal surveys from 1992-1996 have also found Coastal cod further north and east (Norwegian statistical areas 03 and 04). None of the catches in these areas have been allocated to the Norwegian Coastal cod. For the period 1960-70, landings of Norwegian Coastal cod are available (ICES (1971/F:3). Landings for the period 1971-79 were unavailable. The average landings for the 28 years of statistics is 36,000 t. (Table F.1).

The fishery is conducted both with trawlers and with smaller coastal vessels using traditional fishing gears like gillnet, longline, jig and purse seine. In addition to quotas, the fishery is regulated by the same minimum catch size, minimum mesh size on the fishing gears (as for the North-East Arctic cod), maximum by-catch of undersized fish, closure of areas having high densities of juveniles and by seasonal and area restrictions.

9.1.2 Landings prior to 1997 (Table F.1)

The official landings of Norwegian Coastal cod in 1995 is 39,285 t and the provisional figure for 1996 is 32,422 t (Table F.1). The quotas for both these years were 40,000 t (exclusive Norwegian quota).

9.1.3 Expected landings in 1997

The added quota of Norwegian Coastal cod in 1997 is 40,000 t. The expected landings is not available (see Section 9.2.5).

9.2 Status of research

9.2.1 Fishing effort and catch per unit effort

There is no available data on the fishing effort and CPUE in the fishery of Norwegian Coastal cod. However it is assumed that the fishing effort is somewhat higher in 1997 compared with 1996 due to higher allocated quotas, assumed constant catchability this could leave higher fishing mortality.

9.2.2 Survey results

A Norwegian standard trawl-acoustic survey was conducted along the coast from Varanger to Stadt in September-October 1996 using RV *Michael Sars*. The survey covered the same areas as the coastal survey in 1995.

The results from the trawl-acoustic coastal survey in 1996 estimated a total biomass of about 106,000 t (77 million fish) for the coastal area from Varanger to Stadt at 62° N (Tables F.5 and F.6). The spawning biomass accounted for 56,000 t (20 million fish) of this total (Tables F.7 and F.8). Thus, spawners make up about 52 % of the total biomass. Eighty percent of the total coastal biomass was distributed from the Russian border to 67° N and 20 % south of 67° N (areas 06 and 07, Table F.6). The bulk of the biomass was comprised of age classes 3-7 (Table F.6).

The data indicated a higher proportion of Norwegian Coastal cod in the fjords and to the South compared with the northern and outer areas. In the Norwegian statistical areas 06 and 07 (south of 67° N) nearly all otoliths collected were of the Norwegian Coastal cod type, which is similar to the results of the 1993, 1994 and 1995 surveys (ICES 1994/Assess:2; 1996/Assess:4; ICES 1997/Assess:4).

The numbers of Norwegian Coastal cod per age-class from all the coastal surveys is given in Table F.9.

The Norwegian 1997 coastal survey (September-October) will be conducted in a similar way as the 1995 and 1996 surveys to build up a time series for Norwegian Coastal cod over its distribution area.

Age readings of the Norwegian Coastal cod both from the surveys and from the catches, are done the same way as for the North-East Arctic cod. Co-operation between the Fiskeriforskning in Tromsø, Institute of Marine Research in Bergen and PINRO in Murmansk regarding the otolith reading is ongoing.

A total of 2396 cod otoliths were sampled during the 1996 survey. These were separated into Norwegian Coastal cod type (1919) and North-East Arctic cod type (477) (ICES 1994/Assess:2). As in previous years, Norwegian Coastal cod were found throughout the survey area. The 1996 survey data shows the same pattern as the 1995 survey. The proportion of the Norwegian Coastal cod increases going from North to south along the Norwegian coast. The Norwegian Coastal cod type otoliths dominate south of 67° N (Norwegian statistical areas 06 and 07). Although the proportion is lower, there is significant biomass of Norwegian Coastal cod North of 67° N. It must be emphasised that the Norwegian Coastal cod surveys are conducted in August-October each year, and therefore there may be North-East Arctic cod in this southern area at other times of the year, especially during the spawning season in the winter time.

Scientists from Norway and Russia are co-operating in the research on the Norwegian Coastal cod and the Murman cod, and two joint surveys have been made to the Northern coast of the Kola Peninsula from the coast out to 50 n.miles in 1994 and 1995 (Gavrilov *et al.* 1997).

9.2.3 Weight at age (Table F.3)

The 1996 data from the trawl-acoustic survey for the Norwegian Coastal cod shows a general tendency for cod age 1-8 to be both longer and heavier when caught further south along the coast (Tables F.2 and F.3). The same tendency was found for the survey in 1995 (ICES 1997/Assess:4). The weight at age in 1996 is slightly higher compared with 1995.

9.2.4 Maturity at age

The maturity at age is estimated from the data collected at the Norwegian coastal survey. This is not an optimal way to do it because the survey is conducted in the early autumn when the stage at the maturity scale is hard to define. Further improvement of maturity ogives is recommended. The age at 50 % maturity (M_{50}) for the Norwegian Coastal cod was estimated to be about 5 years old on average for the surveyed area (Table F.4). There are some variations between the different areas, but the trend is that the cod are a little younger when mature in the southern areas, which is in accordance with a faster growth in those areas. The 1996 data show that the average M_{50} is slightly higher compared to that found in the 1995 survey (ICES 1997/Assess:4). The average M_{50} for the North-East Arctic cod in 1996 is close to 7 years old (ICES 1997/Assess:4).

9.2.5 Catch statistics

A detailed breakdown of the catches of Norwegian Coastal cod for the period 1984 to 1996 have been done to form the basis of a VPA. This was carried out by analysing Norwegian landings of cod by vessel size, area caught, landed as given by the Norwegian Directorate for Fisheries, and cod samplings done by the Institute of Marine Research, Bergen to separate Norwegian Coastal cod and North-East Arctic cod by otolith type.

The separation off the Norwegian catches into North-East Arctic and Norwegian Coastal cod is based on:

- No catches outside the 12 n.mile zone have been allocated to the Norwegian Coastal cod catches.
- The catches inside 12 n.mile zone is separated into quarter, fishing gear and Norwegian statistical areas.
- From the otolith structure, catches inside the 12 n.mile zone have been allocated into Norwegian Coastal cod and North-East Arctic cod. The Institute of Marine Research in Bergen has been taking samples of commercial catches along the coast for a long period.

The method of separating the catches will be described in detail in a working document at the AFWG meeting in 1998.

The expected landings of Norwegian Coastal cod in 1997 using the new method based on separation from the otolith structure, is calculated as following; assuming the fishing effort of the conventional coastal fleet is proportional to this fleets quota of North-East Arctic cod and Norwegian Coastal cod. This quota increased from 224,000 t in 1996 to 267,000 t in 1997 (19%). When assuming a constant catchability the fishing mortality also increased with 19%. This assumption gave an expected landing of Norwegian Coastal cod in 1997of 68,881 tonnes which is about 6,000 tonnes higher that in 1996.

9.3 Data used in the assessment

9.3.1 Catch at age (Table 9.1)

The catches of Norwegian Coastal cod from is calculated in the period 1984-1996, and consists of cod from age 0-10, where age 10 is a plus group. The catches consists mostly of individuals 3-7 year. In 1995 and 1996 the catches of young Norwegian Coastal cod (1-3 years) has increased (Table 9.1).

9.3.2 Weight at age (Tables 9.2, 9.3, F.3)

The weight at age in the catch was calculated as arithmetic mean at each age-group. The weight at age in the catch from 1984-1988 is an arithmetic mean of weight at age from 1989-1996.

The weight at age in the stock in 1995 and 1996 is based on data from the Norwegian Coastal survey, and the weight at age from 1984-1994 is an average of 1995 and 1996.

9.3.3 Natural mortality

A constant natural mortality of 0.2 was used in both the assessment and the forecast. The proportion of F and M before spawning was set to zero.

9.3.4 Maturity at age (Table F.4)

The maturity at age for 1995 and 1996 is data from the Norwegian coastal surveys. Since there are no survey data from the earliest years, data from the samples of the commercial catches are used from 1984-1994. This is likely to cause a too high proportion of mature cod for the youngest individuals because only the largest individuals in an age group is caught due to the selectivity of the fishing gears. Further improvement is recommended.

9.3.5 Tuning data (Table F.10)

In 1995 and 1996 the coastal surveys covered the whole area. In 1992-1994 only parts of the areas was covered. To obtain the minimum of three points for regression, the indexes from the surveys in 1995 and 1996 were divided into 3 different fleets which correspond to the three surveys from 1992-1994. The surveys which are included in the data for the tuning, are given in the table below:

Name	Area[1]	Season	Age	Year
Norwegian coastal survey	03,04	Autumn	All	1992, 1995, 1996
Norwegian coastal survey	00,05	Autumn	All	1993, 1995, 1996
Norwegian coastal survey	06,07	Autumn	All	1994, 1995, 1996

[1]Norwegian statistical areas (Figure 9.4)

The survey indexes used are calculated from the coastal acoustic surveys.

9.3.6 Recruitment indices

The coastal surveys are not designed to give good estimates of 0 and 1 group Coastal cod, because these age groups often settle in very shallow waters. Therefore, recruitment (age <3) indices from the coastal survey are not very reliable. The data on 0 and 1 group of cod is not complete and these age groups are therefore not tuned in the XSA. The recruitment (age 3) is therefore taken from the results of the XSA.

9.3.7 Prediction data (Table 9.10-9.11)

The prediction is based on cod older than 2 years. The input data to the short-term prediction with management option table are given in Table 9.11. The stock number at age in 1997 was taken from the final VPA (Table 9.10) for ages 3 and older. The recruitment at age 3 in 1998 (40 million) is a geometric average from the VPA (1984-1997). The fishing pattern was the average of the last 3 years from the final VPA, scaled to the 1996 level. The average maturity ogive for the years 1994-1996 was used for the 1997 onwards. The weight at age in the catch and in the stock for the prediction period was set as an average of the period 1994-1996. The natural mortality was set to 0.2. Both the natural mortality and the fishing mortality from the start of the year and until spawning season was set to zero.

9.4 Methods used in the assessment

9.4.1 VPA and tuning (Table 9.6)

Tuning of the VPA was carried out using Extended Survivors Analysis (XSA). The default settings for the XSA were used with the following exceptions: (1) the catchability was set to be independent on stock for all ages, and independent of age for ages 7 years and older; (2) the survivor estimates were shrunk to the mean F of the final 2 years or the 4 oldest ages, and (3) only three points were used for regression due to lack of more tuning data. This gave a reference F (age 4-7, unweighted) in 1996 (F_{96}) of 0.48 (Table 9.6).

9.4.2 Recruitment (Table 9.10)

The recruitment at age 3 was used and calculated as the geometric average from the XSA (1984-1997).

9.5 Results of the assessment

9.5.1 Fishing mortalities and VPA (Tables 9.6-9.9, Figure 9.1 A)

The average age 4-7 fishing mortalities in 1996 was 0.48, The highest fishing mortalities for these age groups was estimated from 1984-1988 (0.59-0.84, Table 9.6). In 1990 and 1991 the lowest F-values was estimated (0.27 and 0.23). The fishing mortalities are given in table 9.6, while the stock number at age, stock biomass at age and the spawning stock biomass at age are given in Tables 9.7-9.9. A summary of the landings is given in Table 9.1.

9.5.2 Recruitment (Table 9.10)

The year classes from 1981-1983 was stronger than the long term average (42). The 1989 and the 1993 year class was also stronger than the long term average, while the year classes 1984 and 1985 was weaker.

9.5.3 Biological reference points (Table 9.14, Figure 9.3)

The yield per recruit analysis using the fishing pattern and stock parameters for 1998 from the management option table gave estimates of $F_{0.1} = 0.15$ and $F_{max} = 0.29$ (Table 9.14). F_{low} , F_{med} and F_{high} was estimated to 0.27, 0.39 and 0.69 (Figure 9.3), which is lower than what is estimated for North-East Arctic cod. The present exploitation level is $F_{96} = 0.48$ (*status quo*) which is above the F_{med} level of 0.39.

9.5.4 Catch options for 1997 (Table 9.12)

The management option table (Table 9.12) shows that the expected catches in 1997 will give a increase in F_{4-7} from 0.48 in 1996 to 0.57 in 1997 (Table 9.12). Fishing at F_{max}, F_{low} and F_{med} in 1998 gives catches of 40,000 , 38,000 and 51,000 t, respectively (Table 9.12), compared to the expected catch in 1997 of 68,000 t. All these fishing levels will result in an increase in the spawning stock biomass above the level in 1998, but it will still be slightly above the long time average (124,000 t).

9.5.5 Limit reference points

The Comprehensive Fishery Evaluation Working Group (ICES CM 1996/Assess:20) suggested a $F_{comfie} = \min\{F_{med}, F_{MSY}, F_{max}\}$. F_{MSY} was not estimated by the present WG. Since F_{MSY} is commonly less than F_{max}, the latter should be considered an upper bound on fishing mortality. F_{max} for Norwegian Coastal cod is presently 0.29, which means that there is a potential for increased yields by lowering the fishing mortality from $F_{status\ quo}$ (0.58) to F_{max} (0.29). The catch corresponding to F_{max} in 1998 is about 40,000 t, which is somewhat below the present catch.

9.6 Medium-term forecasts and management scenarios

9.6.1 Input data (Table 9.10-9.11)

The input data were the same used as for the short term predictions (Table 9.11). The recruitment at age 3 of the 1997 and later year classes were set equal to the long-term geometric average of 40 million individuals (Table 9.10, Figure 9.1).

9.6.2 Methods

Single option predictions were run using IFAP , and the prediction was run with F-factors corresponding to F_{low} (0.27), F_{med} (0.39) and F_{high} (0.69). The same natural mortality, maturity ogive, weight in stock and catch and exploitation pattern as in the short term predition was used (Table 9.11).

9.6.3 Results (Table 9.13)

In Table 9.13 the results of the medium-term prediction are given, for F_{low} (close to F_{max}) F_{med} , and F_{high}. In the medium term, the stock will stabilise at a level of about 250,000 t when fished at F_{med} , and the catches will be between 50,000 t and 63,000 t, which is slightly under the present level. The spawning stock biomass will stabilize at about 150,000 tonnes, which is a high level.

9.7 Comments to the assessment

This assessment on Norwegian Coastal cod must be seen as an preliminary assessment, because the tuning data includes only three points. Next year the tuning data will hopefully become better and the input data will be better described in a working document presented to the working group.

Nevertheless, the assessment seems to reflect the Norwegian Coastal cod stock in a fairly good way compared with the results from the coastal surveys.

10 RECOMMENDATIONS

10.1 New chairman from 1998

The present chairman of the working group has his final year as chairman in 1997. ACFM at their May 1997 meeting did not propose any new chairman. Therefore the WG repeats the proposal from last year that W. Ray Bowering, Canada, be elected new chairman from 1998.

10.2 Resolving methodological problems

Concerns were raised in both the cod and haddock assessment sections of the report regarding the serious implications to the assessments associated with the limitations of the methodology in estimating large year-classes. It is recommended , therefore, that ACFM endeavour to address in a timely manner a means to resolve this problem. It has been made clear that the Working Group will be faced with similar problems in the 1998 meeting if current circumstances persist.

10.3 Resolving the serious gap in survey coverage

In addition to methodological problems, the assessments of several stocks, especially cod and haddock were confounded by the lack of survey coverage in the Russian zone of the Barents Sea in the winter of 1997. This area comprises a substantial portion of the stock distribution area for these species particularly the recruiting age groups. This problem will further exacerbate the precision of the respective assessments in 1998 as areal coverage of several more surveys in 1997 has already been compromised. It is strongly recommended, therefore, that ICES make representation to the appropriate authorities regarding this serious gap in survey coverage in an attempt to resolve the problem as soon as possible.

11 REFERENCES

Aglen, A. and Nakken, O. 1997. Improving time series of abundance indices applying new knowledge. Fisheries Research 30: 17-26.

Bogstad, B., Lilly, GR., Mehl, S., Pàlsson, Ò.K. and Stefànsson, G. 1994. Cannibalism and year-class strength in Atlantic cod (*Gadus morhua* L.) in Arcto-boreal ecosystems (Barents Sea, Iceland, and eastern Newfoundland). ICES mar. Sci. Symp., 198:576-599.

Bogstad, B. and Mehl, S. 1997. Interactions Between Cod and Its Prey Species in the Barents Sea. Proceedings of the International Symposium on The Role of Forage Fishes in Marine Ecosystems, Anchorage, Alaska, 13-16 November 1996. Alaska Sea Grant College Program, AK-SG-97-01 (in press).

Gavrilov, E.N., Isaev, N.A, Kovtsova, M.V, Boitsov, V.D, Eliassen, J.E., Berg, E., Sundet, J.H., Ahlquist, I. 1997. Variation in the biomass of cod and haddock along the Kola penninsula in relation to the hydrological regime. -ICES C.M. 1997 CC:11

ICES, 1970. Report of the North-East Arctic Fisheries Working Group. - ICES C.M.1970. F:2. 16 pp.

ICES, 1971. Report of the North-East Arctic Fisheries Working Group. - ICES C.M. 1971 F:3. 25 pp.

ICES, 1975. Report of the North-East Arctic Fisheries Working Group. - ICES C.M. 1975 F:6. 14 pp.

ICES, 1994. Report of the Arctic fisheries working group. -. Assess: 2. 240 pp.

ICES. 1995. Report of the Arctic Fisheries Working Group. - ICES C.M.1995/Assess: 3. 252 pp.

ICES. 1996. Report of the Arctic Fisheries Working Group. - ICES C.M.1996/Assess: 4. 311 pp.

ICES. 1996. Report of the Comprehensive Fishery Evaluation Working Group. -ICES C.M. 1996/Assess:20. 68 pp.

ICES, 1997. Report of the Arctic fisheries working group. - ICES C.M. 1997 Assess: 4. 326 pp

ICES, 1997. Preliminary report of the international 0-group fish survey in the Barents Sea and adjacent waters in August-September 1996. ICES C.M. 1996/G:31, 37 pp.

ICES., 1997. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. ICES C. M. 1997/Assess: 14.

ICES., 1997. Report of the Comprehensive Fishery Evaluation Working Group. ICES C. M. 1997/Assess:15.

Isaev, N.A., Kovtsova, M.V. & E.N. Gavrilov. 1996. Results from research in the coastal zone of the Kola peninsula. -ICES C.M. 1996 G: 7.12 pp.

Jakobsen, T. 1992. Biological reference points for North-East Arctic cod and haddock. ICES J. mar. Sci., 49:155-166.

Jakobsen, T. 1993. Management of North-East Arctic Cod - past, present and future ? Pp. 321-338 in Proceedings of the International Symposium on Management Strategies for exploited fish populations, Alaska Sea Grant College Program, AK-SG-93-02, 1993.

Jakobsen, T., Korsbrekke, K., Mehl, S. and Nakken, O. 1997. Norwegian combined acoustic and bottom trawl surveys for demersal fish in the Barents Sea during winter. ICES C.M. 1997/Y:17.

Kjesbu, O.S., P.R. Witthames, P. Solemdal and M. Greer Walker. submitted ms. Temporal variations in fecundity in Arcto-Norwegian cod (*Gadus morhua*) studied by different methodology. Can. J. Fish. Aquat. Sci.

Korsbrekke, K. 1997. Norwegian acoustic survey of Northeast Arctic cod on the spawning grounds off Lofoten. ICES C.M. 1997/Y:18.

Korzhev, V.A. and Tretyak, V.L. 1992. The effect of cannibalism on recruitment to the North-East Arctic cod stock. In Bogstad, B. and Tjelmeland, S. (eds). Interrelations between fish populations in the Barents Sea. Proceedings of the fifth PINRO-IMR symposium. Murmansk, 12-16 August 1991. Institute of Marine Research, Bergen.

Lepesevich, Yu.M. and Shevelev, M.S. 1996. Evolution of the Russian survey for demersal fish: From ideal to reality. ICES C.M. 1997/Y:09. 10 pp.

Marshall, C.T., O.S. Kjesbu, N.A. Yaragina, P. Solemdal and Ø. Ulltang. submitted ms. Is spawner biomass a sensitive measure of the reproductive and recruitment potential of North-east Arctic cod? Can. J. Fish. Aquat. Sci.

Mehl, S. and Yaragina, N.A., 1992. Methods and results in the joint PINRO-IMR stomach sampling program. Pp. 5-16 in Bogstad, B. and Tjelmeland, S. (eds). Interrelations between fish populations in the Barents Sea. Proceedings of the fifth PINRO-IMR symposium. Murmansk, 12-16 August 1991. Institute of Marine Research, Bergen.

Nakken, O., Hylen, A. and Ona, E. 1995. Acoustic estimates of 0-group fish abundance in the Barents Sea and adjacent waters in 1992 and 1993. Pp. 187- 197 in Hylen, A. (ed.). Precision and relevance of pre-recruit studies for fishery management related to fish stocks in the Barents Sea and adjacent waters. Proceedings of the sixth IMR-PINRO symposium, Bergen, Norway 14-17 June 1994. Institute of Marine Research, Bergen, Norway.

Ottersen, G., Michalsen, K. and Nakken, O. 1997. Ambient temperature and distribution of Northeast Arctic cod. ICES J. mar. Sci., (in press).

Rollefsen, G. 1933, The otoliths of cod. FiskDir. Skr. Ser. HavUnders., 4(3):1-14.

Shevelev, M. S., Mamylov, V. S., Ratushny, S.V. and Gavrilov, E. N. 1996. Technique of the Russian Trawl-acoustic Survey of the Barents Sea Bottom Fish and Mechanisms to Improve it. NAFO SCR. Doc 96/91, 9 pp.

Tretyak, V.L. 1984. A method of estimating the natural mortality rates of fish at different ages (exemplified by the Arcto-Norwegian cod stock). Pp. 238-271 in Proceedings of the Soviet-Norwegian symposium on reproduction and recruitment of Arctic cod. Leningrad 26-30 September 1983. Institute of Marine Research, Bergen.

Tretyak, V.L., V.A. Korsev, A.V. Dolgov, V.N. Shleinik, and A.A. Filin. 1997. Experience of applying MSVPA method for modelling the commercial part of the Barents Sea community. Paper presented at the Fisheries Management under Uncertainty Symposium, Bergen, June 3-5 1997,

12 WORKING DOCUMENTS

Dolgov, A. Consumption by cod in 1984-1996.

Aglen, A. Combined annual cod stock estimates from Norwegian surveys.

Bogstad, B., H. Gjøsæter and S. Mehl. Multispecies considerations.

Dolgov, A. Food consumption by cod in 1984-1996.

Drevetnyak. K. Russian investigations of redfish (Sebastes mentella Travin) from the Norwegian-Barents Sea stock in 1997.

Lepesevich, Y. Catch per unit effort on direct haddock fishery, kg per hr fishing.

Marshall, C.T. Survey-based assessment of resource status and reproductive potential: a case study using acoustic and trawl data for Northeast Arctic cod.

Mehl, S. Distribution, abundance and adjusted indices for cod, haddock, redfish and Greenland halibut in the Barents Sea Winter 1997.

Shevelev, M.S., V.S. Mamylov, S.V. Tatushny, and E.N. Gavrilov. Technique of Russian trawl-acoustic survey of the Barents Sea bottom fish and mechanisms to improve it.

Yaragina, N.A. and C.T. Marshall. Sex ratios and maturity ogives for Northeast Arctic cod.

Table 3.1 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	Unreportedcatches	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	172,792	86,483	130,000	513,494
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 [1]	273,512	308,712	149,628		731,852

[1] Provisional figures.

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

	Sub-area I		Division IIa		Division IIb	
Year	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	80.0	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 [1]	240.9	32.6	149.7	159.0	143.3	6.3

[1] Provisional.

Table 3.3 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	262	3,337	3,911	168,460	6,217	6,120	182,315	**Iceland**	1,209	383,494
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 [1]	17,749	5,373	6,529	8,326	318,770	15,871	16,061	305,317	23,005	14,851	731,852

[1] Provisional figures.
[2] USSR prior to 1991.
[3] Includes Baltic countries.

Table 3.4 North-East Arctic COD. Weights at age (kg) in landings from various countries.

Norway

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
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	0.76	1.47	1.90	2.49	3.32	4.21	5.01	5.94	7.10	8.20	8.92	9.73	9.85	9.26
1986	(1.20)	1.24	1.94	2.53	3.36	4.54	5.60	5.94	6.73	8.20	8.76	9.94	7.80	8.23
1987	0.56	0.92	1.45	2.24	3.04	4.17	5.33	6.62	6.99	8.33	8.58	9.58	8.27	10.67
1988	0.54	0.55	0.82	1.36	2.38	3.75	5.84	7.05	8.55	11.28	11.63	14.10	-	-
1989	0.36	0.86	1.06	1.34	1.96	3.22	5.07	8.09	9.45	11.60	10.54	-	18.61	17.11
1990	1.19	1.62	1.73	1.95	2.54	3.42	5.07	8.18	10.48	14.16	17.85	-	14.34	-
1991	1.05	1.47	1.86	2.34	3.00	3.66	4.60	6.02	8.97	11.75	17.32	-	-	-
1992	0.39	1.25	1.85	2.54	3.29	4.35	5.29	6.20	8.27	12.21	11.72	-	14.66	20.58
1993	0.53	0.87	1.73	2.44	3.39	4.30	5.47	6.29	7.10	7.78	10.00	16.14	18.99	17.41
1994	0.63	0.86	1.40	2.23	3.34	4.27	5.56	6.88	7.43	8.01	9.61	11.39	7.79	19.89
1995	0.49	0.81	1.29	1.87	2.80	4.12	5.11	5.91	7.90	8.69	9.23	11.52	17.46	21.11
1996	0.85	1.01	1.21	1.54	2.58	4.00	5.74	6.22	7.90	8.86	9.78	10.85	10.65	22.71

Russia (trawl only)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1984	0.22	0.76	1.30	2.04	2.90	4.12	5.56	8.76	13.55	14.95	14.85	19.52	19.31	22.37
1985	0.29	0.77	1.23	1.75	2.64	3.93	5.35	6.72	9.87	9.00	13.72	15.10	15.20	19.25
1986	0.22	0.63	1.15	1.75	2.44	4.09	6.19	8.15	10.31	11.73	17.29	-	27.30	-
1987	0.24	0.41	0.92	1.51	2.14	2.95	5.62	7.13	11.17	10.90	12.29	-	-	-
1988	0.11	0.48	0.82	1.33	2.07	3.04	4.93	7.08	9.68	-	17.50	22.10	-	-
1989	0.22	0.46	0.87	1.25	1.84	2.71	4.34	6.59	9.14	12.47	14.32	13.60	-	-
1990	0.34	0.77	1.33	1.86	2.27	3.31	4.36	7.20	9.34	8.53	12.87	-	-	-
1991	0.26	0.55	0.93	1.59	2.45	3.37	4.78	6.74	11.61	17.63	9.45	19.20	15.40	19.40
1992	0.26	0.92	1.40	2.14	3.24	4.62	5.81	7.49	10.16	17.45	19.00	-	23.00	-
1993	0.20	0.65	1.30	2.03	2.76	4.36	5.97	6.94	8.15	11.12	15.24	17.28	-	22.30
1994	0.17	0.35	1.09	1.85	2.82	3.67	5.95	7.82	8.58	11.12	17.90	23.35	-	-
1995	0.16	0.29	0.75	1.69	2.53	3.99	5.71	7.92	9.33	10.50	12.14	18.80	-	-
1996	0.19	0.45	0.93	1.50	2.47	3.63	6.03	8.91	10.16	11.77	17.54	20.12	-	-

Germany (Division IIa and IIb)

Year	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	15.26	-
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	-	-

Spain (Division IIb)

Year	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	-	8.67	-

Iceland (Sub-area I)

Year	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	-

UK (England & Wales)

Year	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	10.17	10.08	-	-
1996 [2]	-	-	1.55	1.81	2.42	3.61	6.30	6.47	7.83	7.91	8.93	9.38	10.91	-

[1] Division IIa and IIb
[2] Division IIa

e:\acfm\afwg98\T-31-35.xls

Table 3.5 North-East Arctic COD. Basis for maturity ogives (percent) used in the assessment. Norwegian and Russian data.

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

Table 3.6 NORTHEAST ARCTIC COD: recruits as 3 year-olds (inc. data for ages 0,1), 5,40,2 (No. of surveys, No. of years, VPA Column No.)

1957	790	-11	-11	-11	-11	-11
1958	919	-11	-11	-11	-11	-11
1959	730	-11	-11	-11	-11	-11
1960	473	-11	-11	-11	-11	-11
1961	339	-11	-11	-11	-11	-11
1962	778	-11	-11	-11	-11	-11
1963	1583	-11	-11	-11	-11	-11
1964	1293	-11	-11	-11	-11	-11
1965	170	-11	-11	-11	-11	-11
1966	112	-11	-11	2	-11	-11
1967	197	-11	-11	4	-11	-11
1968	405	-11	-11	2	-11	-11
1969	1016	-11	-11	25	-11	-11
1970	1818	23	64	251	-11	-11
1971	526	7	9	77	-11	-11
1972	622	5	4	52	-11	-11
1973	614	16	5	148	-11	-11
1974	348	1	1	29	-11	-11
1975	640	60	1	90	-11	-11
1976	199	1	1	13	-11	-11
1977	140	1	1	49	-11	-11
1978	158	1	2	22	-11	-11
1979	158	1	1	40	-11	-11
1980	169	1	1	13	4.6	8
1981	382	1	1	10	0.8	4
1982	496	1	8	59	341.9	-11
1983	1016	4	9	169	2864.4	1807
1984	267	1	1	155	51.5	108
1985	198	3	10	246	741.8	1302
1986	160	1	2	137	33.4	3
1987	212	1	1	17	5.0	2
1988	429	1	1	33	9.4	9
1989	795	1	1	38	161.0	350
1990	1060	6	1	123	470.8	187
1991	865	3	6	230	131.6	348
1992	747	10	60	294	534.1	1686
1993	474	2	5	209	861.8	1083
1994	-11	16	3	227	4892.4	2644
1995	-11	25	36	240	5788.8	2404
1996	-11	10	-11	287	5036.7	1453

R-1-1 Russian Bottom trawl survey, area I, age 1
R-2B-1 Russian IIb, age 1
INTOGP International 0-group survey
N-BST1 Norwegian Barents Sea, Bottom trawl survey, age 1
N-BSA1 Norwegian Barents Sea Acoustic survey age 1

Table 3.7

Analysis by RCT3 ver3.1 of data from file :

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

Data for 5 surveys over 40 years : 1957 - 1996

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 = 1994

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
R-1-1	2.00	3.80	1.02	.343	24	2.83	9.46	1.497	.115
R-2B-1	2.21	2.78	2.35	.089	24	1.39	5.84	2.682	.036
INTOGP	.02	2.84	2.45	.083	28	227.00	8.50	2.905	.031
N-BST1	.60	3.28	1.12	.287	14	8.50	8.37	1.459	.122
N-BSA1	.48	3.84	1.00	.351	13	7.88	7.59	1.237	.169
					VPA Mean =		6.06	.701	.527

Yearclass = 1995

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
R-1-1	1.97	3.83	1.01	.343	24	3.26	10.25	1.698	.094
R-2B-1	2.30	2.62	2.53	.077	24	3.61	10.92	3.379	.024
INTOGP	.03	2.55	2.66	.070	28	240.00	8.92	3.224	.026
N-BST1	.61	3.20	1.14	.282	14	8.66	8.52	1.522	.117
N-BSA1	.48	3.83	1.00	.349	13	7.79	7.54	1.251	.174
					VPA Mean =		6.10	.694	.565

Yearclass = 1996

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
	I-----------Regression			----------I		I-----------Prediction			---------I
R-1-1	1.93	3.86	1.02	.337	24	2.40	8.50	1.411	.134
R-2B-1									
INTOGP	.03	2.23	2.87	.060	28	287.00	10.33	3.726	.019
N-BST1	.63	3.11	1.15	.278	14	8.52	8.48	1.568	.108
N-BSA1	.48	3.82	1.00	.347	13	7.28	7.30	1.248	.171
					VPA Mean =		6.13	.685	.568

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1994	1163	7.06	.51	.56	1.21		
1995	1356	7.21	.52	.66	1.62		
1996	1079	6.98	.52	.55	1.12		

Table 3.8

Run title : Arctic Cod (run: SVPBJA08/V08)

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	34467,	3709,	2307,	7164,	7754,	35536,	294262,	91855,	45282,	85337,
4,	160048,	174585,	24545,	10792,	13739,	45431,	131493,	437377,	59798,	114341,
5,	69235,	267961,	238511,	25813,	11831,	26832,	61000,	203772,	226646,	79993,
6,	22061,	107051,	181239,	137829,	9527,	12089,	20569,	47006,	118567,	118236,
7,	26295,	26701,	79363,	96420,	59290,	7918,	7248,	12630,	29522,	47872,
8,	25139,	16399,	26989,	31920,	52003,	34885,	8328,	4370,	9353,	13962,
9,	11323,	11597,	13463,	8933,	12093,	22315,	19130,	2523,	2617,	4051,
10,	2329,	3657,	5092,	3249,	2434,	4572,	4499,	5607,	1555,	936,
11,	687,	657,	1913,	1232,	762,	1215,	677,	2127,	1928,	558,
12,	316,	122,	414,	260,	418,	353,	195,	322,	575,	442,
13,	225,	124,	121,	106,	149,	315,	81,	151,	231,	139,
14,	40,	70,	23,	39,	42,	121,	59,	83,	15,	26,
+gp,	14,	46,	46,	35,	25,	40,	55,	62,	37,	53,
TOTALNUM,	352179,	612679,	574026,	323792,	170067,	191622,	547596,	807885,	496126,	465946,
TONSLAND,	572605,	1074084,	1197226,	933246,	689048,	565254,	792685,	1102433,	829377,	867463,
SOPCOF %,	88,	96,	87,	97,	112,	108,	114,	103,	90,	102,

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	39594,	78822,	8600,	3911,	3407,	8948,	3108,	7027,	19282,	16942,
4,	168609,	45400,	77484,	17086,	9466,	20933,	19594,	14165,	38322,	55859,
5,	136335,	88495,	43677,	81986,	20803,	19345,	20473,	18839,	27216,	75486,
6,	52925,	56823,	31943,	40061,	63433,	28084,	17656,	20350,	20342,	27772,
7,	61821,	25407,	16815,	17664,	21788,	42496,	17004,	15415,	13588,	13337,
8,	23338,	31821,	8274,	7442,	9933,	8395,	18329,	8359,	4385,	4587,
9,	5659,	9408,	10974,	3508,	4267,	2878,	2545,	6054,	1904,	1082,
10,	1521,	1227,	1785,	3196,	1311,	708,	646,	764,	1062,	559,
11,	610,	913,	427,	678,	882,	271,	229,	221,	163,	455,
12,	271,	446,	103,	79,	109,	260,	74,	153,	59,	124,
13,	122,	748,	59,	24,	37,	27,	58,	56,	51,	29,
14,	92,	48,	38,	26,	3,	5,	20,	12,	45,	32,
+gp,	54,	51,	45,	8,	1,	5,	5,	12,	38,	1,
TOTALNUM,	490951,	339609,	200224,	175669,	135440,	132355,	99741,	91427,	126457,	196265,
TONSLAND,	905301,	698715,	440538,	380434,	399038,	363730,	289992,	277651,	307920,	430113,
SOPCOF %,	99,	100,	107,	97,	110,	108,	98,	95,	99,	94,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	5570,	3988,	3874,	1541,	4927,	23082,	10706,	5848,	2770,	6306,
4,	100391,	21234,	19833,	5171,	8489,	37919,	46750,	63180,	36969,	26803,
5,	97318,	144215,	28126,	10615,	15565,	25781,	63886,	108060,	119167,	80506,
6,	62371,	59397,	83802,	15467,	18995,	21304,	32692,	58302,	98373,	103926,
7,	12901,	21302,	23501,	31161,	20909,	18390,	14562,	23735,	30632,	56189,
8,	3942,	3415,	4943,	6665,	27404,	13199,	9418,	9019,	7182,	10811,
9,	1021,	1200,	917,	830,	4193,	18518,	6359,	6154,	2813,	1965,
10,	435,	320,	321,	163,	410,	2282,	12920,	4040,	1788,	962,
11,	140,	67,	46,	41,	32,	185,	1931,	7822,	1326,	494,
12,	233,	60,	8,	14,	8,	73,	394,	967,	2118,	201,
13,	17,	51,	1,	9,	1,	3,	59,	102,	217,	829,
14,	21,	7,	9,	5,	1,	8,	23,	15,	41,	84,
+gp,	8,	15,	7,	2,	5,	4,	2,	4,	1,	2,
TOTALNUM,	284368,	255271,	165388,	71684,	100939,	160748,	199702,	287248,	303397,	289078,
TONSLAND,	523071,	434939,	332481,	212000,	319158,	513494,	581611,	771086,	739999,	731852,
SOPCOF %,	97,	96,	103,	100,	97,	100,	100,	100,	100,	100,

Table 3.9 Run title : Arctic Cod (run: SVPBJA08/V08)

Table 2 Catch weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
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,
SOPCOFAC,	.8787,	.9561,	.8743,	.9734,	1.1182,	1.0788,	1.1430,	1.0271,	.9007,	1.0236,

Table 2 Catch weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.9000,	1.3500,	1.2500,	.9700,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.4600,	1.8400,	1.5600,	1.6100,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	2.1900,	2.4300,	2.1400,	2.2100,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.7800,	3.1100,	3.1900,	2.9900,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.8400,	4.1800,	4.3100,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	5.0600,	5.7300,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.8200,
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,
SOPCOFAC,	.9928,	1.0037,	1.0713,	.9731,	1.1050,	1.0767,	.9837,	.9538,	.9936,	.9390,

Table 2 Catch weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	.6500,	.5200,	.5200,	1.1000,	.9800,	1.0100,	.7400,	.6400,	.5300,	.8100,
4,	1.1000,	.8200,	.9000,	1.5300,	1.4900,	1.5500,	1.4800,	1.2000,	.9800,	1.0500,
5,	1.9200,	1.3400,	1.2700,	1.8900,	1.9800,	2.3000,	2.1500,	2.0700,	1.7500,	1.5200,
6,	2.5600,	2.2700,	1.9100,	2.3600,	2.6300,	3.2600,	2.9000,	3.0400,	2.6600,	2.5200,
7,	3.4400,	3.4800,	3.0100,	3.3800,	3.4500,	4.5100,	4.2200,	3.8300,	4.0700,	3.8300,
8,	5.4100,	5.3800,	4.8900,	4.7500,	4.6700,	5.6000,	5.6400,	5.5600,	5.3900,	5.7100,
9,	6.6900,	7.0600,	7.6800,	7.8900,	6.3000,	6.5800,	6.5100,	7.0400,	6.4200,	6.5800,
10,	7.7000,	8.9000,	9.3600,	10.1400,	9.6200,	8.8600,	7.3000,	7.7500,	8.3200,	8.1300,
11,	9.2500,	9.2500,	10.5700,	13.2400,	11.7500,	12.2100,	8.3000,	8.2000,	9.1600,	9.4000,
12,	10.8500,	10.8500,	10.8500,	16.9400,	17.3200,	11.7200,	10.3600,	9.4100,	9.6300,	9.6400,
13,	12.5000,	12.5000,	12.5000,	12.5000,	19.2000,	12.5000,	14.7100,	10.8000,	11.2700,	10.6000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	15.4000,	14.6600,	12.8000,	9.5600,	17.2700,	10.6700,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	19.4000,	20.5800,	11.7500,	19.8900,	21.1100,	22.7100,
SOPCOFAC,	.9670,	.9588,	1.0344,	.9984,	.9690,	1.0008,	1.0013,	1.0005,	1.0001,	1.0005,

Table 3.10 Run title : Arctic Cod (run: SVPBJA08/V08)

Table 3 Stock weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
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,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.3600,	.5300,	.4600,	.3180,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0100,	1.2000,	.9080,	.9260,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.6300,	1.9000,	1.7050,	1.5790,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.5300,	2.9100,	2.9240,	2.5290,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.9700,	4.1070,	3.8950,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	5.8990,	5.7670,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	7.7300,	6.4500,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	10.1270,	6.8330,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	14.2800,	11.0040,
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,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	.2110,	.1930,	.3020,	.3930,	.4750,	.4500,	.3520,	.2360,	.2020,	.1930,
4,	.4980,	.3630,	.5130,	.7160,	1.1390,	.9320,	1.1810,	.7570,	.4960,	.4850,
5,	1.2520,	.7340,	.8600,	1.1940,	1.7300,	1.7610,	1.8290,	1.4080,	1.1430,	.9700,
6,	2.0540,	1.7200,	1.4850,	1.6840,	2.4510,	2.7420,	2.8150,	2.4530,	2.1030,	2.0420,
7,	3.4010,	2.8310,	2.7060,	2.4740,	3.2410,	3.8820,	4.0650,	3.8440,	3.4390,	3.5100,
8,	3.7150,	4.8850,	4.6330,	3.5740,	4.5850,	5.0510,	5.4540,	5.5530,	5.1330,	5.5960,
9,	6.5230,	7.8120,	7.0630,	4.7850,	6.9020,	6.7590,	6.8110,	6.7710,	7.2220,	7.7070,
10,	9.3000,	12.1170,	9.9800,	7.9110,	10.2340,	9.3530,	8.5530,	7.6910,	8.8100,	9.6890,
11,	13.1500,	13.1070,	9.2500,	8.9560,	11.1150,	11.7120,	10.6820,	8.0370,	9.4810,	10.6540,
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 3.11 Run title : Arctic Cod (run: SVPBJA08/V08)

Table 5 Proportion mature at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
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,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0500,	.0800,	.0500,	.0100,	.0200,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.1000,	.1000,	.1800,	.1000,	.0900,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.3400,	.3000,	.3100,	.3300,	.1900,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.6500,	.7300,	.5600,	.5900,	.5600,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.8200,	.8800,	.9000,	.8500,	.7600,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9200,	.9700,	.9900,	.9200,	.8900,
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,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,
4,	.0100,	.0100,	.0000,	.0100,	.0400,	.0100,	.0300,	.0100,	.0000,	.0000,
5,	.0900,	.0300,	.0200,	.0500,	.0600,	.1200,	.0900,	.1100,	.0700,	.0200,
6,	.2300,	.2500,	.1500,	.2100,	.2900,	.4300,	.3000,	.3300,	.3300,	.2600,
7,	.2700,	.5300,	.3900,	.5800,	.6500,	.7500,	.6100,	.6000,	.6200,	.6300,
8,	.6100,	.7900,	.5900,	.7700,	.8300,	.9300,	.9200,	.8200,	.7400,	.8300,
9,	.8100,	1.0000,	.8300,	.8600,	.9700,	.9700,	.9700,	.9700,	.9500,	.9700,
10,	.8000,	1.0000,	1.0000,	.9800,	1.0000,	1.0000,	.9900,	.9900,	.9700,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	.9500,	1.0000,	1.0000,	.9900,	.9900,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	.8000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.12

COD-ARCT: Cod in the North-East Arctic (Areas I and II)

FLT43: Russian Trawl/Acoustic survey (ages 1-8)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1982	1	6	181	141	51	13	26	7	2
1983	1	89	43	56	73	47	20	8	11
1984	1	92	142	162	86	50	31	11	4
1985	1	49	430	303	405	188	49	19	6
1986	1	22	91	565	161	106	30	8	3
1987	1	2	40	59	426	54	31	6	1
1988	1	2	25	77	78	190	25	6	1
1989	1	1	6	34	88	111	155	114	26
1990	1	31	78	38	44	66	60	113	18
1991	1	59	98	110	62	68	77	56	46
1992	1	78	395	485	182	69	53	52	40
1993	1	28	131	647	597	334	91	34	33
1994	1	33	120	300	475	500	180	61	14
1995	1	64	46	124	267	287	126	27	8
1996	1	136	135	77	118	134	112	42	8

09:55 Thursday, August 28, 1997

COD-ARCT: Cod in the North-East Arctic (Areas I and II)

FLT45: Norwegian Svalbard Bottom Trawl Survey (ages 1-8)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1983	1	145.0	26.8	10.7	9.5	2.4	1.9	1.0	1.3
1984	1	499.0	113.0	7.3	4.3	4.7	1.8	0.4	0.4
1985	1	239.0	452.0	99.1	28.4	13.6	5.4	1.0	0.4
1986	1	40.9	181.0	297.0	42.8	15.3	2.6	1.0	0.3
1987	1	41.5	108.0	141.0	125.0	17.1	5.4	0.5	0.1
1988	1	3.1	16.6	33.2	31.8	37.1	9.5	0.6	0.6
1989	1	3.6	2.7	15.4	12.8	11.9	19.2	3.2	0.4
1990	1	70.1	9.4	8.6	14.6	23.4	16.5	20.0	2.0
1991	1	116.0	101.0	25.3	8.5	13.9	16.0	13.5	19.0
1992	1	91.8	130.0	105.0	56.0	16.2	7.3	5.7	3.3
1993	1	136.8	131.6	149.9	65.8	30.0	3.4	3.9	2.3
1994	1	68.6	166.5	102.4	56.4	54.1	25.9	5.9	2.3
1995	1	350.8	62.8	115.9	101.5	93.7	47.2	16.0	3.9
1996	1	427.6	178.6	65.1	45.5	46.1	44.2	24.6	3.2

09:55 Thursday, August 28, 1997

COD-ARCT: Cod in the North-East Arctic (Areas I and II)

FLT52: Norwegian trawl, catch and effort, age 9 - 14 (Catch: Thousands)

Year	Fishing effort	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14
1985	0.45	269	84	13	18	25	9
1986	0.58	93	100	44	21	3	0
1987	0.95	277	121	25	70	7	13
1988	1.01	167	73	13	14	33	0
1989	0.76	156	73	20	0	0	4
1990	0.51	34	16	0	0	0	0
1991	0.66	149	5	1	0	0	0
1992	0.42	1506	185	34	17	0	2
1993	0.41	814	2060	466	58	5	1
1994	0.84	744	453	932	138	10	0
1995	0.71	422	55	27	204	0	0
1996	0.68	283	241	32	0	119	0

09:55 Thursday, August 28, 1997

COD-ARCT: Cod in the North-East Arctic (Areas I and II)

FLT53: Russian trawl, catch and effort, ages 9 - 14 (Catch: Thousands)

Year	Fishing effort	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14
1985	0.70	178	99	2	1	0	1
1986	1.52	184	0	29	0	0	0
1987	2.40	174	43	0	0	0	0
1988	2.77	271	78	0	0	0	0
1989	2.12	266	91	15	2	1	0
1990	1.11	346	61	13	3	0	0
1991	1.56	953	56	2	1	2	0
1992	4.35	3871	482	0	0	0	0
1993	2.68	1818	2042	245	33	2	1
1994	2.95	1209	926	454	0	0	0
1995	3.83	518	452	326	386	0	0
1996	3.71	308	123	100	0	0	0

Table 3.12 (Continued)

COD-ARCT: Cod in the North-East Arctic (Areas I and II)

FLT54: Norwegian Barents Sea Trawl survey shifted swept area correction (Catch: Millions)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1980	1	343.0	164.0	233.0	400.0	384.0	48.0	10.0	3.0
1981	1	29.0	283.0	277.0	236.0	155.0	160.0	14.0	2.0
1982	1	190.0	223.0	371.0	333.0	135.0	46.0	30.0	6.0
1983	1	3932.0	1159.0	262.0	189.0	106.0	32.0	5.0	2.0
1984	1	7276.0	1444.0	995.0	157.0	64.0	25.0	2.0	1.0
1985	1	4615.0	6571.0	1371.0	750.0	233.0	55.0	6.0	2.0
1986	1	4574.0	2334.0	3655.0	461.0	113.0	14.0	4.0	1.0
1987	1	729.0	1852.0	953.0	1895.0	191.0	36.0	6.0	1.0
1988	1	136.0	365.0	649.0	352.0	779.0	87.0	8.0	2.0
1989	1	508.0	233.0	301.0	336.0	197.0	239.0	13.0	4.0
1990	1	2247.0	323.0	191.0	175.0	161.0	93.0	97.0	5.0
1991	1	5289.0	1496.0	495.0	184.0	118.0	75.0	40.0	27.0
1992	1	3310.0	3118.0	1526.0	690.0	142.0	69.0	42.0	22.0
1993	1	4968.0	2763.0	2976.0	1459.0	469.0	88.0	23.0	12.0
1994	1	5038.0	2882.0	2312.0	2492.0	704.0	180.0	22.0	7.0
1995	1	7155.0	1776.0	1160.0	1369.0	1075.0	245.0	29.0	4.0
1996	1	10376.0	2435.0	681.0	785.0	561.0	297.0	64.0	11.0

09:55 Thursday, August 28, 1997

COD-ARCT: Cod in the North-East Arctic (Areas I and II)

FLT59: Russian acoustic survey (ages 1-8)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6
1985	1	1050.0	8950.0	4220.0	2550.0	830.0	440.0
1986	1	530.0	1410.0	9800.0	4440.0	1830.0	560.0
1987	1	150.0	1700.0	1700.0	7380.0	990.0	670.0
1988	1	5.0	430.0	1610.0	1060.0	2450.0	340.0
1989	1	10.0	40.0	170.0	440.0	560.0	990.0
1990	1	220.0	570.0	290.0	350.0	520.0	460.0
1991	1	440.0	750.0	890.0	510.0	530.0	610.0
1992	1	610.0	3330.0	3170.0	1100.0	450.0	370.0
1993	1	100.0	450.0	2150.0	2430.0	1360.0	430.0
1994	1	580.0	1100.0	2080.0	2820.0	2770.0	1200.0
1995	1	590.0	470.0	860.0	1600.0	2030.0	1000.0

09:55 Thursday, August 28, 1997

COD-ARCT: Cod in the North-East Arctic (Areas I and II)

FLT61: Norwegian Barents Sea and Lofoten acoustic survey (Catch: Millions)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11
1984	1	7680.0	1790.0	1270.0	217.0	140.8	135.7	15.8	9.7	8.3	2.7	0.0
1985	1	5900.0	5950.0	1240.0	577.8	96.7	72.7	27.8	3.8	0.0	3.6	0.7
1986	1	720.0	960.0	2560.0	540.2	183.5	12.6	20.4	2.8	0.0	0.3	0.3
1987	1	290.0	640.0	420.0	755.7	119.8	36.5	3.0	2.6	0.5	0.0	0.0
1988	1	90.0	200.0	430.0	270.3	674.1	168.1	29.7	5.9	1.0	0.0	0.6
1989	1	450.0	160.0	240.0	270.9	234.4	620.8	70.4	14.1	2.2	0.0	0.0
1990	1	2340.0	550.0	310.0	271.8	291.1	325.7	383.7	35.0	1.4	1.5	0.0
1991	1	5790.0	1820.0	480.0	193.8	168.1	230.2	209.3	604.1	34.6	12.4	1.8
1992	1	4320.0	3000.0	1630.0	842.1	262.7	225.6	223.5	231.2	393.4	36.8	6.2
1993	1	6860.0	3580.0	3430.0	1768.1	663.6	178.6	79.0	78.9	37.0	142.4	24.2
1994	1	2800.0	1810.0	1610.0	2185.7	980.6	280.2	49.6	31.6	33.6	14.2	68.2
1995	1	3350.0	960.0	700.0	875.0	872.1	396.1	61.0	7.8	4.9	6.5	10.4
1996	1	4080.0	1700.0	530.0	513.8	415.2	464.6	186.5	24.7	5.4	0.0	7.2

Table 3.13

```
Lowestoft VPA Version 3.1

  27-Aug-97  10:17:44

Extended Survivors Analysis

Arctic Cod (run: XSABJA23/X23)

CPUE data from file /users/fish/ifad/ifapwork/afwg/cod_arct/FLEET.X23

Catch data for  30 years. 1967 to 1996. Ages  1 to  15.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                     ,  year, year,  age ,  age
FLT43: Russian Trawl,   1982, 1996,   1,     8,   .900,  1.000
FLT45: Norwegian Sva,   1983, 1996,   1,     8,   .750,   .850
FLT52: Norwegian tra,   1985, 1996,   9,    14,   .000,  1.000
FLT53: Russian trawl,   1985, 1996,   9,    14,   .000,  1.000
FLT54: Norwegian Bar,   1980, 1996,   1,     8,   .990,  1.000
FLT59: Russian acous,   1985, 1996,   1,     6,   .900,  1.000
FLT61: Norwegian Bar,   1984, 1996,   1,    11,   .990,  1.000


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 had not converged after   30 iterations


Total absolute residual between iterations
29 and  30 =     .00066

Final year F values
Age          ,      1,      2,      3,      4,      5,      6,      7,      8,      9,     10
Iteration 29, 2.3780, 1.2850,  .5630,  .3617,  .3927,  .4061,  .5712,  .5742,  .8290,  .7121
Iteration 30, 2.3780, 1.2850,  .5630,  .3617,  .3927,  .4061,  .5711,  .5742,  .8289,  .7121


Age          ,     11,     12,     13,     14
Iteration 29,  .4708,  .4957,  .8290,  .7579
Iteration 30,  .4707,  .4956,  .8289,  .7577
```

Table 3.13 (Continued)

Regression weights

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

Fishing mortalities

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	.532	.897	.203	.046	.090	.451	2.505	1.734	1.931	2.378
2	.806	.121	.002	.060	.222	.124	.461	.621	.977	1.285
3	.083	.031	.027	.008	.018	.038	.073	.197	.568	.563
4	.164	.122	.148	.045	.055	.127	.088	.171	.302	.362
5	.506	.374	.235	.110	.185	.236	.331	.315	.276	.393
6	.965	.675	.389	.196	.294	.414	.531	.574	.485	.406
7	1.105	1.132	.627	.243	.443	.517	.560	.973	.717	.571
8	1.038	1.057	.906	.360	.350	.562	.551	.839	1.020	.574
9	.952	1.134	.956	.360	.404	.425	.587	.883	.891	.829
10	1.476	.939	1.168	.427	.303	.402	.601	.967	.793	.712
11	.805	1.009	.319	.424	.137	.217	.717	.939	1.173	.471
12	1.192	1.041	.293	.151	.135	.525	.993	1.025	.827	.496
13	.801	.949	.038	.631	.014	.068	1.142	.771	.831	.829
14	.977	.961	.417	.270	.127	.151	1.084	1.086	1.022	.758

XSA population numbers (Thousands)

	AGE									
YEAR	1	2	3	4	5	6	7	8		
1987	4.68E+05	5.49E+05	2.71E+05	7.35E+05	2.71E+05	1.11E+05	2.13E+04	6.74E+03	1.84E+03	6.23E+02
1988	7.89E+05	2.25E+05	2.01E+05	2.05E+05	5.11E+05	1.34E+05	3.47E+04	5.79E+03	1.96E+03	5.81E+02
1989	8.45E+05	2.64E+05	1.63E+05	1.59E+05	1.48E+05	2.88E+05	5.58E+04	9.17E+03	1.65E+03	5.15E+02
1990	1.57E+06	5.65E+05	2.15E+05	1.30E+05	1.12E+05	9.59E+04	1.60E+05	2.44E+04	3.04E+03	5.18E+02
1991	1.97E+06	1.22E+06	4.36E+05	1.75E+05	1.02E+05	8.25E+04	6.45E+04	1.02E+05	1.39E+04	1.73E+03
1992	3.18E+06	1.48E+06	8.02E+05	3.50E+05	1.36E+05	6.94E+04	5.03E+04	3.39E+04	5.91E+04	7.62E+03
1993	2.56E+07	1.66E+06	1.07E+06	6.32E+05	2.53E+05	8.76E+04	3.75E+04	2.46E+04	1.58E+04	3.16E+04
1994	1.08E+07	1.71E+06	8.56E+05	8.13E+05	4.74E+05	1.49E+05	4.22E+04	1.76E+04	1.16E+04	7.21E+03
1995	2.28E+07	1.57E+06	7.53E+05	5.75E+05	5.61E+05	2.83E+05	6.85E+04	1.31E+04	6.21E+03	3.92E+03
1996	2.75E+07	2.71E+06	4.83E+05	3.49E+05	3.48E+05	3.49E+05	1.43E+05	2.74E+04	3.85E+03	2.09E+03

Estimated population abundance at 1st Jan 1997

.00E+00	2.09E+06	6.15E+05	2.25E+05	1.99E+05	1.92E+05	1.90E+05	6.60E+04	1.26E+04	1.38E+03

Taper weighted geometric mean of the VPA populations:

2.97E+06	8.54E+05	4.32E+05	3.05E+05	2.08E+05	1.17E+05	5.03E+04	1.74E+04	5.87E+03	2.16E+03

Standard error of the weighted Log(VPA populations) :

1.5385	.8350	.6979	.6789	.6817	.6517	.6271	.8029	1.0675	1.2603

	AGE			
YEAR	11	12	13	14
1987	2.80E+02	3.70E+02	3.41E+01	3.72E+01
1988	1.17E+02	1.03E+02	9.20E+01	1.25E+01
1989	1.86E+02	3.48E+01	2.96E+01	2.92E+01
1990	1.31E+02	1.11E+02	2.12E+01	2.34E+01
1991	2.77E+02	7.02E+01	7.80E+01	9.25E+00
1992	1.05E+03	1.98E+02	5.02E+01	6.29E+01
1993	4.17E+03	6.92E+02	9.58E+01	3.84E+01
1994	1.42E+04	1.67E+03	2.10E+02	2.50E+01
1995	2.24E+03	4.54E+03	4.90E+02	7.94E+01
1996	1.45E+03	5.68E+02	1.63E+03	1.75E+02

Estimated population abundance at 1st Jan 1997

8.39E+02	7.44E+02	2.84E+02	5.81E+02

Taper weighted geometric mean of the VPA populations:

7.69E+02	2.97E+02	1.07E+02	3.63E+01

Standard error of the weighted Log(VPA populations) :

1.4357	1.3479	1.2158	.8925

Table 3.13 (Continued)

Log catchability residuals.

Fleet : FLT43: Russian Trawl

Age	1980	1981	1982	1983	1984	1985	1986
1	99.99	99.99	-.21	1.78	1.02	1.02	.64
2	99.99	99.99	1.78	-.23	.50	.70	.57
3	99.99	99.99	.97	.20	.16	.37	.16
4	99.99	99.99	.02	.34	.31	.74	-.21
5	99.99	99.99	-1.43	-.11	-.02	1.24	-.03
6	99.99	99.99	-.43	-.39	.12	.62	.19
7	99.99	99.99	-1.89	-.87	.03	.57	-.21
8	99.99	99.99	-1.23	-.29	-.24	.69	.05
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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.50	-.73	-1.94	.22	.57	.62	-.68	-.30	-.33	.48
2	.20	.16	-1.28	.14	-.32	.57	-.19	-.17	-.60	-.01
3	-.18	.28	-.11	-.32	-.25	.23	.18	-.07	-.33	-.23
4	-.07	-.17	.19	-.23	-.25	-.03	.30	-.08	-.09	-.20
5	-.91	-.37	.17	-.22	-.01	-.23	.87	.65	-.14	-.33
6	-.27	-.95	-.16	-.19	.30	.21	.63	.83	-.26	-.66
7	-.35	-.81	1.18	-.25	.15	.39	.30	1.16	-.38	-.81
8	-1.10	-.93	1.72	-.14	-.65	.52	.64	.39	.30	-.86
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	-6.8076	-6.5863	-6.5390
S.E(Log q)	.5231	.7396	.8129

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	.817	11.38	.74	15	.92	-10.73
2	.83	.703	9.56	.64	15	.63	-8.71
3	.72	2.032	9.18	.85	15	.30	-7.73
4	.80	1.610	8.34	.87	15	.28	-7.24
5	1.04	-.140	6.76	.58	15	.61	-6.96

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	1.52	-1.481	4.30	.46	15	.75	-6.81
7	1.39	-.773	4.94	.29	15	1.05	-6.59
8	1.12	-.332	6.16	.45	15	.95	-6.54

Table 3.13 (Continued)

Fleet : FLT45: Norwegian Sva

Age	1980	1981	1982	1983	1984	1985	1986
1	99.99	99.99	99.99	1.35	1.66	1.52	.21
2	99.99	99.99	99.99	-.08	.51	.62	1.00
3	99.99	99.99	99.99	-.25	-1.35	.29	.41
4	99.99	99.99	99.99	.04	-.71	-.09	.00
5	99.99	99.99	99.99	-1.07	-.45	.36	-.25
6	99.99	99.99	99.99	-.92	-.92	.22	-.48
7	99.99	99.99	99.99	-.99	-1.36	-.44	-.36
8	99.99	99.99	99.99	-.54	-.68	-.15	-.39
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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	1.11	-1.50	-1.93	.03	.29	-.14	-.38	-.70	.17	.49
2	1.00	.43	-.88	-.86	-.12	-.20	-.15	.04	-.29	-.06
3	1.18	.41	.06	-.65	-.57	-.15	-.16	-.14	.29	.32
4	.18	.40	-.02	.21	-.48	.29	-.20	-.52	.35	.28
5	-.34	-.38	-.25	.53	.23	.11	.10	-.02	.27	.20
6	-.27	-.12	-.41	.38	.58	.06	-.84	.70	.58	.24
7	-.92	-1.20	-.41	.07	.74	.19	.13	.76	1.07	.65
8	-1.52	.44	-.55	-.35	.45	-.02	-.07	.50	1.47	.17
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	-8.7318	-8.6984	-8.6066
S.E(Log q)	.5516	.7693	.7177

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	.91	.427	10.26	.69	14	1.05	-9.77
2	.60	1.625	10.90	.64	14	.61	-9.04
3	.72	1.042	9.96	.60	14	.58	-8.77
4	.76	1.427	9.82	.78	14	.37	-8.90
5	.88	.667	9.16	.78	14	.38	-8.75

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	.77	1.150	9.40	.73	14	.42	-8.73
7	.59	2.170	9.57	.75	14	.39	-8.70
8	.82	.795	8.81	.68	14	.60	-8.61

Table 3.13 (Continued)

Fleet : FLT52: Norwegian tra

Age	1980	1981	1982	1983	1984	1985	1986
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	1.00	.17
10	99.99	99.99	99.99	99.99	99.99	.07	1.02
11	99.99	99.99	99.99	99.99	99.99	.20	.36
12	99.99	99.99	99.99	99.99	99.99	.35	.51
13	99.99	99.99	99.99	99.99	99.99	.99	-.86
14	99.99	99.99	99.99	99.99	99.99	.11	99.99

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	.83	.27	.59	-1.40	-1.69	-.36	.44	.07	.30	.39
10	1.32	.61	1.11	-.33	-3.01	-.38	.72	.12	-1.29	.83
11	.55	.79	.75	99.99	-2.59	.09	1.58	.42	-1.02	-.66
12	.39	-.05	99.99	99.99	99.99	.15	.34	-.38	-.90	99.99
13	.43	.99	99.99	99.99	99.99	99.99	.04	-.92	99.99	-.25
14	1.03	99.99	.08	99.99	99.99	-.91	-.68	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	-2.1487	-2.1807	-2.4533	-1.3906	-1.5038	-1.5038
S.E(Log q)	.8302	1.2604	1.1733	.5005	.7777	.8089

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	1.33	-1.069	-.03	.54	12	1.10	-2.15
10	1.13	-.365	1.45	.47	12	1.50	-2.18
11	.89	.426	2.92	.68	11	1.10	-2.45
12	1.39	-2.651	-.50	.91	8	.49	-1.39
13	1.23	-.632	.70	.67	7	1.02	-1.50
14	1.51	-.332	.53	.16	5	1.41	-1.66

Table 3.13 (Continued)

Fleet : FLT53: Russian trawl

Age	1980	1981	1982	1983	1984	1985	1986
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	.76	.50
10	99.99	99.99	99.99	99.99	99.99	.55	99.99
11	99.99	99.99	99.99	99.99	99.99	-1.03	.06
12	99.99	99.99	99.99	99.99	99.99	-.64	99.99
13	99.99	99.99	99.99	99.99	99.99	99.99	99.99
14	99.99	99.99	99.99	99.99	99.99	.06	99.99

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	.05	.37	.71	.76	-.07	-1.13	-.02	-.08	-.56	-.60
10	.12	.43	1.06	.99	-.70	-1.00	-.41	.33	-.11	-.78
11	99.99	99.99	.51	1.42	-1.68	99.99	.14	-.47	.87	-.14
12	99.99	99.99	.36	.19	-.80	99.99	.24	99.99	.40	99.99
13	99.99	99.99	.07	99.99	.10	99.99	-.16	99.99	99.99	99.99
14	99.99	99.99	99.99	99.99	99.99	99.99	.04	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	-2.7660	-2.9406	-3.5348	-3.7347	-4.0986	-4.0986
S.E(Log q)	.6091	.7190	.9566	.5301	.1459	.0804

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	1.62	-2.986	-.88	.73	12	.73	-2.77
10	1.43	-1.956	.87	.73	11	.89	-2.94
11	1.07	-.276	3.29	.71	9	1.10	-3.53
12	.90	.820	3.92	.95	6	.49	-3.73
13	1.15	-.639	4.09	.95	3	.21	-4.10
14	.00	.000	.00	.00	0	.00	.00

Table 3.13 (Continued)

Fleet : FLT54: Norwegian Bar

Age	1980	1981	1982	1983	1984	1985	1986
1	.15	-1.97	-1.22	.99	.72	.88	1.17
2	-.34	.06	-.18	.20	.09	.47	.84
3	-.02	.00	.26	-.12	.12	.14	.27
4	.36	.28	.49	.11	-.19	.16	-.42
5	-.05	.08	.32	.10	-.29	.66	-.64
6	-.31	.18	-.17	-.23	-.40	.43	-.86
7	-.45	.01	.00	-.91	-1.23	-.14	-.46
8	-.53	-.59	.56	-1.30	-.93	.28	-.35
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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	.54	-1.07	-.62	-.13	.38	-.19	-.24	.00	-.30	.19
2	.98	.19	-.38	-.87	-.40	-.13	-.09	.03	.02	-.07
3	.49	.45	.04	-.61	-.55	-.25	.02	.14	.01	.03
4	-.01	.00	.24	-.12	-.37	-.04	-.11	.09	.09	.23
5	-.39	.03	.01	.02	-.08	-.17	.28	-.02	.13	.16
6	-.41	.00	-.04	-.07	-.04	.17	.30	.53	.10	.01
7	.10	-.08	-.57	.01	.23	.60	.33	.58	.12	.03
8	-.41	.46	.54	-.76	-.52	.59	.30	.38	.30	.13
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	-6.4715	-6.9736	-7.1758
S.E(Log q)	.3386	.4650	.5561

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	.83	1.216	7.52	.84	17	.71	-6.01
2	.73	1.519	7.98	.76	17	.49	-5.86
3	.79	1.403	7.34	.82	17	.34	-5.87
4	.73	2.633	7.70	.91	17	.23	-5.90
5	.83	1.292	7.16	.86	17	.30	-6.14

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	.90	.724	7.01	.83	17	.31	-6.47
7	.86	.683	7.49	.72	17	.41	-6.97
8	1.21	-.804	6.64	.60	17	.68	-7.18

Table 3.13 (Continued)

Fleet : FLT59: Russian acous

Age	1980	1981	1982	1983	1984	1985	1986
1	99.99	99.99	99.99	99.99	99.99	2.06	1.68
2	99.99	99.99	99.99	99.99	99.99	1.50	1.06
3	99.99	99.99	99.99	99.99	99.99	.84	.89
4	99.99	99.99	99.99	99.99	99.99	.56	.77
5	99.99	99.99	99.99	99.99	99.99	.62	.70
6	99.99	99.99	99.99	99.99	99.99	.57	.87
7	No data for this fleet at this age						
8	No data for this fleet at this age						
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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	1.27	-2.40	-2.43	-.02	.51	.72	-1.22	.70	.16	99.99
2	1.54	.62	-1.75	-.10	-.49	.57	-1.05	-.15	-.51	99.99
3	.73	.95	-.71	-.56	-.33	.13	-.45	-.16	-.47	99.99
4	.53	.29	-.12	-.17	-.17	-.22	-.23	-.31	-.30	99.99
5	-.08	.05	-.28	-.19	.00	-.40	.14	.19	-.32	99.99
6	.55	-.58	-.55	-.40	.12	-.09	-.06	.48	-.44	99.99
7	No data for this fleet at this age									
8	No data for this fleet at this age									
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
Mean Log q,	-4.5602,
S.E(Log q),	.4915,

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	1.03	-.083	8.45	.49	11	1.55	-8.64
2	.89	.220	7.27	.35	11	1.08	-6.49
3	.83	.534	6.86	.56	11	.67	-5.57
4	.77	1.134	6.92	.76	11	.40	-5.17
5	.97	.156	5.08	.80	11	.36	-4.87

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	1.98	-1.941	-2.36	.34	11	.84	-4.56

Table 3.13 (Continued)

Fleet : FLT61: Norwegian Bar

Age	1980	1981	1982	1983	1984	1985	1986
1	99.99	99.99	99.99	99.99	1.05	1.36	-.17
2	99.99	99.99	99.99	99.99	.42	.53	.36
3	99.99	99.99	99.99	99.99	.45	.19	.12
4	99.99	99.99	99.99	99.99	.04	.07	-.20
5	99.99	99.99	99.99	99.99	.10	-.40	-.42
6	99.99	99.99	99.99	99.99	.58	.00	-1.68
7	99.99	99.99	99.99	99.99	-.41	.15	-.08
8	99.99	99.99	99.99	99.99	-.22	-.64	-.89
9	99.99	99.99	99.99	99.99	.04	99.99	99.99
10	99.99	99.99	99.99	99.99	.14	-.44	-1.70
11	99.99	99.99	99.99	99.99	99.99	-.86	-2.43
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	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.08	-1.30	-.57	.12	.72	.30	.40	-.19	-.61	-.23
2	.39	.01	-.38	-.25	-.09	.00	.23	-.16	-.26	-.21
3	-.02	.26	.00	-.09	-.44	-.07	.26	-.02	-.25	-.03
4	-.55	-.17	.10	.22	-.35	.25	.24	.24	-.07	.03
5	-1.04	-.04	-.02	.35	-.04	.18	.60	.35	.03	-.13
6	-1.11	-.05	.20	.47	.37	.64	.29	.25	-.13	-.26
7	-1.84	-.01	-.12	.14	.64	1.02	.32	.15	-.38	-.15
8	-1.02	-.03	.23	-.38	1.02	1.38	.61	.32	-.60	-.63
9	-1.38	-.57	.22	-1.44	.29	1.29	.41	.92	-.38	.14
10	99.99	99.99	99.99	-.08	.70	.41	.54	.07	-.27	99.99
11	99.99	.62	99.99	99.99	-.01	-.03	.45	.48	.68	.05
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	-5.7564	-5.7270	-5.6076	-5.6842	-5.1423	-4.6882
S.E(Log q)	.6301	.6613	.7635	.8628	.6834	.8963

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	.834	7.39	.83	13	.71	-6.28
2	.69	2.533	8.48	.88	13	.30	-6.07
3	.79	1.815	7.49	.89	13	.24	-6.02
4	.84	1.254	7.09	.87	13	.27	-6.01
5	1.02	-.097	5.88	.73	13	.43	-6.00

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	1.04	-.126	5.51	.50	13	.69	-5.76
7	.78	.873	6.86	.63	13	.52	-5.73
8	.63	2.526	7.14	.84	13	.39	-5.61
9	.64	3.163	6.81	.91	11	.39	-5.68
10	.81	1.200	5.71	.88	9	.54	-5.14
11	.89	.523	4.96	.78	9	.84	-4.69

Table 3.13 (Continued)

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	3380342.,	1.046,	.000,	.00,	1,	.029,	1.952
FLT45: Norwegian Sva,	3404399.,	1.196,	.000,	.00,	1,	.022,	1.946
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	2535241.,	.801,	.000,	.00,	1,	.050,	2.204
FLT59: Russian acous,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT61: Norwegian Bar,	1654419.,	.780,	.000,	.00,	1,	.053,	2.592
P shrinkage mean ,	853870.,	.84,,,,				.498,	3.216
F shrinkage mean ,	7063638.,	1.00,,,,				.347,	1.359

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2089059.,	.55,	.44,	6,	.799,	2.378

Age 2 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	593753.,	.650,	.079,	.12,	2,	.078,	1.310
FLT45: Norwegian Sva,	584819.,	.635,	.048,	.08,	2,	.083,	1.321
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	562291.,	.503,	.055,	.11,	2,	.129,	1.350
FLT59: Russian acous,	723451.,	1.734,	.000,	.00,	1,	.002,	1.170
FLT61: Norwegian Bar,	493502.,	.323,	.065,	.20,	2,	.325,	1.448
P shrinkage mean ,	432098.,	.70,,,,				.258,	1.552
F shrinkage mean ,	2575817.,	1.00,,,,				.126,	.485

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
614510.,	.26,	.18,	11,	.693,	1.285

Age 3 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	173361.,	.294,	.070,	.24,	3,	.243,	.684
FLT45: Norwegian Sva,	261107.,	.476,	.202,	.43,	3,	.081,	.502
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	231732.,	.308,	.004,	.01,	3,	.211,	.550
FLT59: Russian acous,	146671.,	1.060,	.313,	.29,	2,	.007,	.770
FLT61: Norwegian Bar,	205287.,	.237,	.070,	.30,	3,	.333,	.603
P shrinkage mean ,	305089.,	.68,,,,				.085,	.443
F shrinkage mean ,	864117.,	1.00,,,,				.039,	.180

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
224979.,	.15,	.09,	16,	.609,	.563

Table 3.13 (Continued)

Age 4 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	156987.,	.218,	.037,	.17,	4,	.252,	.440
FLT45: Norwegian Sva,	258471.,	.313,	.042,	.14,	4,	.128,	.290
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	233193.,	.225,	.059,	.26,	4,	.240,	.316
FLT59: Russian acous,	130557.,	.613,	.097,	.16,	3,	.020,	.510
FLT61: Norwegian Bar,	183100.,	.194,	.076,	.39,	4,	.295,	.388
P shrinkage mean ,	207551.,	.68,,,,				.045,	.349
F shrinkage mean ,	539137.,	1.00,,,,				.021,	.149

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
199255.,	.11,	.06,	21,	.516,	.362

Age 5 Catchability dependent on age and year class strength

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	172105.,	.201,	.063,	.31,	5,	.196,	.430
FLT45: Norwegian Sva,	230913.,	.249,	.089,	.36,	5,	.146,	.337
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	215482.,	.180,	.036,	.20,	5,	.273,	.357
FLT59: Russian acous,	143505.,	.347,	.127,	.37,	4,	.064,	.498
FLT61: Norwegian Bar,	189124.,	.171,	.061,	.36,	5,	.265,	.398
P shrinkage mean ,	116850.,	.65,,,,				.039,	.583
F shrinkage mean ,	298599.,	1.00,,,,				.017,	.270

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
192454.,	.09,	.04,	26,	.456,	.393

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	178577.,	.194,	.152,	.79,	6,	.188,	.428
FLT45: Norwegian Sva,	180032.,	.225,	.153,	.68,	6,	.147,	.425
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	201740.,	.161,	.039,	.24,	6,	.295,	.387
FLT59: Russian acous,	143083.,	.261,	.102,	.39,	5,	.103,	.510
FLT61: Norwegian Bar,	218221.,	.162,	.089,	.54,	6,	.251,	.362
F shrinkage mean ,	161727.,	1.00,,,,				.015,	.463

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
190232.,	.09,	.05,	30,	.579,	.406

Table 3.13 (Continued)

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	68873.,	.195,	.168,	.86,	7,	.179,	.553
FLT45: Norwegian Sva,	74317.,	.223,	.141,	.63,	7,	.144,	.521
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	62427.,	.157,	.056,	.36,	7,	.305,	.596
FLT59: Russian acous,	58233.,	.239,	.119,	.50,	6,	.111,	.628
FLT61: Norwegian Bar,	68950.,	.164,	.075,	.45,	7,	.237,	.552
F shrinkage mean ,	55772.,	1.00,,,,				.024,	.648

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
66007.,	.09,	.05,	35,	.548,	.571

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	11075.,	.223,	.216,	.97,	8,	.178,	.633
FLT45: Norwegian Sva,	15856.,	.263,	.195,	.74,	8,	.155,	.481
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	13660.,	.182,	.132,	.73,	8,	.311,	.540
FLT59: Russian acous,	13554.,	.234,	.164,	.70,	6,	.090,	.543
FLT61: Norwegian Bar,	10783.,	.194,	.152,	.79,	8,	.223,	.646
F shrinkage mean ,	10238.,	1.00,,,,				.042,	.671

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
12613.,	.10,	.07,	39,	.718,	.574

Age 9 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
FLT43: Russian Trawl,	1461.,	.241,	.205,	.85,	8,	.117,	.796
FLT45: Norwegian Sva,	1858.,	.285,	.348,	1.22,	8,	.103,	.671
FLT52: Norwegian tra,	2042.,	.869,	.000,	.00,	1,	.067,	.626
FLT53: Russian trawl,	755.,	.637,	.000,	.00,	1,	.124,	1.210
FLT54: Norwegian Bar,	1446.,	.193,	.148,	.77,	8,	.207,	.802
FLT59: Russian acous,	1018.,	.248,	.143,	.58,	6,	.055,	1.010
FLT61: Norwegian Bar,	1229.,	.301,	.108,	.36,	9,	.212,	.895
F shrinkage mean ,	1967.,	1.00,,,,				.116,	.644

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1377.,	.17,	.08,	42,	.463,	.829

Table 3.13 (Continued)

Age 10 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
FLT43: Russian Trawl,	858.,	.211,	.091,	.43,	8,	.109,	.700
FLT45: Norwegian Sva,	1085.,	.237,	.067,	.28,	8,	.096,	.589
FLT52: Norwegian tra,	1484.,	.799,	.265,	.33,	2,	.071,	.462
FLT53: Russian trawl,	416.,	.533,	.104,	.19,	2,	.175,	1.129
FLT54: Norwegian Bar,	952.,	.166,	.074,	.45,	8,	.191,	.649
FLT59: Russian acous,	766.,	.252,	.113,	.45,	6,	.057,	.759
FLT61: Norwegian Bar,	894.,	.220,	.095,	.43,	9,	.174,	.680
F shrinkage mean ,	1017.,	1.00,,,,				.129,	.618

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
839.,	.18,	.06,	44,	.346,	.712

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	978.,	.205,	.075,	.37,	8,	.088,	.376
FLT45: Norwegian Sva,	982.,	.236,	.113,	.48,	8,	.074,	.375
FLT52: Norwegian tra,	390.,	.778,	.317,	.41,	3,	.087,	.764
FLT53: Russian trawl,	663.,	.535,	.015,	.03,	3,	.166,	.516
FLT54: Norwegian Bar,	952.,	.165,	.096,	.58,	8,	.149,	.385
FLT59: Russian acous,	778.,	.254,	.170,	.67,	6,	.048,	.454
FLT61: Norwegian Bar,	863.,	.351,	.113,	.32,	11,	.269,	.417
F shrinkage mean ,	496.,	1.00,,,,				.119,	.642

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
744.,	.19,	.06,	48,	.310,	.471

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

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	281.,	.211,	.102,	.48,	8,	.074,	.500
FLT45: Norwegian Sva,	373.,	.240,	.163,	.68,	8,	.063,	.397
FLT52: Norwegian tra,	181.,	.775,	.466,	.60,	3,	.065,	.697
FLT53: Russian trawl,	464.,	.536,	.259,	.48,	3,	.121,	.331
FLT54: Norwegian Bar,	340.,	.167,	.101,	.61,	8,	.130,	.428
FLT59: Russian acous,	266.,	.256,	.179,	.70,	6,	.044,	.521
FLT61: Norwegian Bar,	405.,	.338,	.127,	.37,	11,	.205,	.371
F shrinkage mean ,	177.,	1.00,,,,				.298,	.708

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
284.,	.32,	.08,	48,	.249,	.496

Table 3.13 (Continued)

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

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	508.,	.232,	.118,	.51,	8,	.041,	.907
FLT45: Norwegian Sva,	604.,	.260,	.150,	.58,	8,	.036,	.807
FLT52: Norwegian tra,	343.,	.457,	.199,	.43,	5,	.321,	1.158
FLT53: Russian trawl,	653.,	.443,	.285,	.64,	4,	.180,	.765
FLT54: Norwegian Bar,	554.,	.182,	.093,	.51,	8,	.074,	.856
FLT59: Russian acous,	586.,	.286,	.251,	.88,	5,	.022,	.824
FLT61: Norwegian Bar,	843.,	.269,	.152,	.57,	11,	.095,	.636
F shrinkage mean ,	976.,	1.00,,,,				.232,	.570

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
581.,	.29,	.08,	50,	.285,	.829

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

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	67.,	.294,	.259,	.88,	8,	.031,	.758
FLT45: Norwegian Sva,	54.,	.325,	.099,	.31,	8,	.029,	.877
FLT52: Norwegian tra,	49.,	.456,	.362,	.79,	4,	.169,	.937
FLT53: Russian trawl,	47.,	.470,	.356,	.76,	3,	.061,	.957
FLT54: Norwegian Bar,	45.,	.223,	.127,	.57,	8,	.059,	.993
FLT59: Russian acous,	65.,	.293,	.309,	1.06,	4,	.014,	.778
FLT61: Norwegian Bar,	80.,	.329,	.123,	.38,	10,	.092,	.669
F shrinkage mean ,	79.,	1.00,,,,				.544,	.673

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
67.,	.55,	.07,	46,	.125,	.758

Table 3.14

Run title : Arctic Cod (run: XSABJA23/X23)

At 27-Aug-97 10:18:10

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0001,	.0000,	.0008,
2,	.0008,	.0000,	.0013,	.0013,	.0019,	.0023,	.0140,	.0302,	.0017,	.0049,
3,	.0296,	.0242,	.0228,	.0406,	.0212,	.0390,	.1949,	.2125,	.0829,	.1647,
4,	.1515,	.2057,	.2209,	.1416,	.1022,	.1661,	.1981,	.4952,	.2086,	.3098,
5,	.1797,	.4073,	.4798,	.3821,	.2277,	.2965,	.3516,	.5356,	.5202,	.4763,
6,	.2007,	.4649,	.5367,	.5703,	.2355,	.3844,	.3903,	.5050,	.7002,	.5706,
7,	.4261,	.3984,	.7676,	.6192,	.5174,	.3140,	.4205,	.4432,	.7012,	.6935,
8,	.6729,	.5186,	.9268,	.8375,	.8320,	.6674,	.6424,	.4861,	.7020,	.8843,
9,	.8392,	.7784,	1.1442,	.9598,	.9326,	1.1402,	1.0097,	.4055,	.6122,	.7731,
10,	.8304,	.7309,	.9990,	.9964,	.7684,	1.2436,	.7421,	.9799,	.4724,	.4603,
11,	.9118,	.5904,	1.1652,	.7073,	.6722,	1.2207,	.5912,	1.0088,	1.2006,	.3074,
12,	.9341,	.3900,	.9659,	.4561,	.5555,	.7818,	.6319,	.6318,	.8564,	1.0504,
13,	.8836,	1.3487,	.8623,	.7110,	.5185,	1.1510,	.4038,	1.7923,	1.4780,	.5108,
14,	.8893,	.7754,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,
+gp,	.8893,	.7754,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,
FBAR 5-10,	.5248,	.5497,	.8090,	.7276,	.5856,	.6743,	.5928,	.5592,	.6180,	.6430,
FBAR 5- 8,	.3698,	.4473,	.6777,	.6023,	.4531,	.4156,	.4512,	.4925,	.6559,	.6562,

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	.0000,	.0000,	.0000,	.0001,	.0000,	.0000,	.0000,	.2617,	.3718,	.5231,
2,	.0157,	.0036,	.0014,	.0023,	.0012,	.0005,	.0002,	.0421,	.0616,	.8355,
3,	.1330,	.1449,	.0484,	.0309,	.0238,	.0640,	.0203,	.0209,	.0439,	.1332,
4,	.5658,	.2223,	.2072,	.1282,	.0973,	.1994,	.1945,	.1213,	.1467,	.1711,
5,	.7526,	.6689,	.3460,	.3533,	.2273,	.2945,	.3060,	.2906,	.3605,	.4783,
6,	.6794,	.8474,	.5443,	.6219,	.5115,	.5463,	.4808,	.5703,	.5883,	.7786,
7,	.6759,	.8447,	.6578,	.6706,	.8507,	.7906,	.7711,	1.0742,	.9862,	1.0258,
8,	.9060,	.9344,	.7506,	.6993,	1.0678,	.9975,	1.0068,	1.1965,	1.1078,	1.1812,
9,	1.2159,	1.2944,	1.0530,	.8654,	1.2340,	1.1256,	1.0044,	1.2064,	1.0279,	.9444,
10,	.7656,	.9903,	.9514,	1.0902,	.9891,	.6802,	.8459,	1.0062,	.6965,	1.0321,
11,	.6260,	1.8533,	1.2703,	1.3370,	1.0958,	.5558,	.4860,	.8113,	.6018,	.7482,
12,	.2401,	1.5004,	1.3528,	.8477,	.8014,	1.2624,	.2849,	.7147,	.5240,	1.4565,
13,	.9852,	2.4658,	.8275,	1.6943,	1.4831,	.4647,	1.1724,	.3634,	.5532,	.5336,
14,	.7742,	1.6429,	1.1039,	1.1811,	1.1341,	.8262,	.7663,	.8289,	.5622,	.8353,
+gp,	.7742,	1.6429,	1.1039,	1.1811,	1.1341,	.8262,	.7663,	.8289,	.5622,	.8353,
FBAR 5-10,	.8326,	.9300,	.7172,	.7168,	.8134,	.7391,	.7358,	.8907,	.7945,	.9067,
FBAR 5- 8,	.7535,	.8239,	.5747,	.5862,	.6643,	.6572,	.6412,	.7829,	.7607,	.8660,

Run title : Arctic Cod (run: XSABJA23/X23)

At 27-Aug-97 10:18:10

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	FBAR 94-96
AGE											
1,	.5322,	.8971,	.2034,	.0460,	.0896,	.4513,	2.5047,	1.7340,	1.9307,	2.3780,	2.0142,
2,	.8060,	.1210,	.0018,	.0599,	.2224,	.1240,	.4612,	.6208,	.9770,	1.2850,	.9609,
3,	.0830,	.0313,	.0265,	.0079,	.0176,	.0385,	.0729,	.1973,	.5682,	.5630,	.4428,
4,	.1638,	.1218,	.1480,	.0449,	.0551,	.1274,	.0881,	.1706,	.3024,	.3617,	.2782,
5,	.5058,	.3742,	.2353,	.1102,	.1849,	.2360,	.3308,	.3153,	.2759,	.3927,	.3279,
6,	.9648,	.6749,	.3888,	.1963,	.2938,	.4144,	.5314,	.5745,	.4848,	.4061,	.4885,
7,	1.1045,	1.1320,	.6270,	.2431,	.4432,	.5172,	.5599,	.9728,	.7174,	.5711,	.7538,
8,	1.0383,	1.0567,	.9055,	.3596,	.3505,	.5622,	.5510,	.8389,	1.0200,	.5742,	.8110,
9,	.9518,	1.1343,	.9560,	.3597,	.4043,	.4253,	.5870,	.8835,	.8906,	.8289,	.8677,
10,	1.4765,	.9386,	1.1682,	.4271,	.3028,	.4022,	.6009,	.9667,	.7926,	.7121,	.8238,
11,	.8046,	1.0089,	.3192,	.4243,	.1367,	.2167,	.7170,	.9395,	1.1730,	.4707,	.8611,
12,	1.1916,	1.0410,	.2932,	.1506,	.1346,	.5245,	.9931,	1.0249,	.8271,	.4956,	.7825,
13,	.8009,	.9490,	.0380,	.6314,	.0143,	.0683,	1.1421,	.7710,	.8305,	.8289,	.8101,
14,	.9772,	.9606,	.4173,	.2699,	.1272,	.1514,	1.0838,	1.0859,	1.0216,	.7577,	.9551,
+gp,	.9772,	.9606,	.4173,	.2699,	.1272,	.1514,	1.0838,	1.0859,	1.0216,	.7577,	
FBAR 5-10,	1.0070,	.8851,	.7135,	.2827,	.3299,	.4262,	.5268,	.7586,	.6969,	.5808,	
FBAR 5- 8,	.9034,	.8095,	.5392,	.2273,	.3181,	.4324,	.4933,	.6754,	.6245,	.4860,	

Table 3.15

Run title : Arctic Cod (run: XSABJA23/X23)

At 27-Aug-97 10:18:10

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	16843,	29709,	61125,	153495,	274668,	80225,	96777,	92824,	52661,	97959,
2,	20932,	13789,	24323,	50045,	125671,	224876,	65682,	79234,	75987,	43115,
3,	130560,	17124,	11290,	19889,	40919,	102691,	183687,	53027,	62940,	62106,
4,	125802,	103775,	13684,	9035,	15636,	32800,	80861,	123765,	35104,	47433,
5,	46519,	88517,	69166,	8983,	6420,	11558,	22744,	54305,	61754,	23330,
6,	13407,	31822,	48225,	35047,	5019,	4186,	7035,	13102,	26023,	30052,
7,	8377,	8981,	16367,	23084,	16223,	3247,	2333,	3899,	6473,	10578,
8,	5673,	4479,	4937,	6219,	10175,	7918,	1942,	1255,	2049,	2629,
9,	2203,	2370,	2183,	1600,	2204,	3625,	3326,	836,	632,	832,
10,	456,	779,	891,	569,	502,	710,	949,	992,	456,	280,
11,	127,	163,	307,	269,	172,	190,	168,	370,	305,	233,
12,	58,	42,	74,	78,	108,	72,	46,	76,	110,	75,
13,	42,	19,	23,	23,	41,	51,	27,	20,	33,	38,
14,	8,	14,	4,	8,	9,	20,	13,	15,	3,	6,
+gp,	3,	9,	8,	7,	5,	6,	12,	11,	7,	12,
TOTAL,	371009,	301590,	252608,	308352,	497774,	472176,	465603,	423729,	324538,	318679,

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	30129,	21235,	23932,	23826,	25496,	57765,	77971,	211293,	135440,	113121,
2,	80138,	24667,	17385,	19594,	19504,	20874,	47294,	63836,	133153,	76456,
3,	35127,	64590,	20123,	14213,	16006,	15950,	17082,	38713,	50110,	102500,
4,	43126,	25177,	45750,	15697,	11283,	12796,	12249,	13704,	31039,	39264,
5,	28489,	20052,	16505,	30446,	11306,	8381,	8583,	8256,	9938,	21945,
6,	11863,	10989,	8410,	9561,	17509,	7374,	5112,	5174,	5054,	5674,
7,	13906,	4923,	3855,	3995,	4203,	8595,	3496,	2587,	2395,	2298,
8,	4329,	5792,	1732,	1635,	1673,	1470,	3192,	1324,	724,	731,
9,	889,	1432,	1863,	669,	665,	471,	444,	955,	328,	196,
10,	314,	216,	321,	532,	231,	159,	125,	133,	234,	96,
11,	145,	120,	66,	102,	146,	70,	66,	44,	40,	95,
12,	140,	63,	15,	15,	22,	40,	33,	33,	16,	18,
13,	22,	90,	12,	3,	5,	8,	9,	20,	13,	8,
14,	19,	7,	6,	4,	0,	1,	4,	2,	12,	6,
+gp,	11,	7,	7,	1,	0,	1,	1,	2,	10,	0,
TOTAL,	248647,	179361,	139984,	120296,	108050,	133956,	175661,	346079,	368505,	362408,

Run title : Arctic Cod (run: XSABJA23/X23)

At 27-Aug-97 10:18:10

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	GMST
AGE												
1,	46830,	78930,	84536,	156546,	197306,	318035,	2558804,	1082879,	2284603,	2751382,	0,	901
2,	54894,	22520,	26350,	56474,	122407,	147699,	165809,	171166,	156553,	271310,	208906,	523
3,	27145,	20073,	16335,	21536,	43550,	80231,	106819,	85599,	75328,	48250,	61451,	386
4,	73453,	20454,	15929,	13024,	17493,	35034,	63210,	81304,	57534,	34941,	22498,	303
5,	27092,	51054,	14825,	11247,	10196,	13554,	25253,	47388,	56125,	34811,	19926,	205
6,	11137,	13375,	28750,	9592,	8247,	6939,	8764,	14852,	28306,	34873,	19245,	113
7,	2132,	3474,	5576,	15956,	6454,	5033,	3753,	4217,	6846,	14271,	19023,	55
8,	674,	579,	917,	2439,	10244,	3392,	2457,	1755,	1305,	2735,	6601,	23
9,	184,	196,	165,	304,	1394,	5908,	1583,	1159,	621,	385,	1261,	9
10,	62,	58,	51,	52,	173,	762,	3161,	721,	392,	209,	138,	3
11,	28,	12,	19,	13,	28,	105,	417,	1419,	224,	145,	84,	1
12,	37,	10,	3,	11,	7,	20,	69,	167,	454,	57,	74,	
13,	3,	9,	3,	2,	8,	5,	10,	21,	49,	163,	28,	
14,	4,	1,	3,	2,	1,	6,	4,	3,	8,	17,	58,	
+gp,	1,	3,	2,	1,	5,	4,	0,	1,	0,	0,	7,	
TOTAL,	243677,	210747,	193465,	287199,	417512,	616726,	2940109,	1492651,	2668349,	3193553,	359300,	

Table 3.16

Table 4 Natural Mortality (M) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
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,

Table 4 Natural Mortality (M) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2007,	.2004,	.3137,
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,

Table 4 Natural Mortality (M) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	.2594,	.2090,	.2000,	.2000,	.2050,	.2060,	.2615,	.3890,	.7626,	.7438,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2027,	.2772,	.4401,	.4605,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2024,	.2214,	.2074,	.2836,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2042,	.2001,	.2053,
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,

Table 3.17

Table 8 Fishing mortality (F) at age

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	.0298	.0244	.0230	.0409	.0213	.0393	.1960	.2136	.0836	.1659
4	.1525	.2069	.2218	.1422	.1028	.1672	.1995	.4961	.2099	.3119
5	.1811	.4088	.4809	.3829	.2286	.2977	.3533	.5373	.5215	.4780
6	.2024	.4671	.5384	.5713	.2368	.3853	.3919	.5072	.7015	.5724
7	.4284	.4012	.7688	.6214	.5195	.3159	.4217	.4455	.7036	.6962
8	.6742	.5221	.9271	.8390	.8338	.6701	.6437	.4875	.7042	.8867
9	.8395	.7795	1.1416	.9599	.9343	1.1369	1.0102	.4089	.6136	.7769
10	.8296	.7333	.9966	.9938	.7720	1.2387	.7436	.9818	.4778	.4636
11	.9097	.5924	1.1604	.7081	.6731	1.2199	.5939	1.0065	1.1997	.3136
12	.9372	.3923	.9634	.4587	.5585	.7819	.6391	.6365	.8546	1.0522
13	.8824	1.3452	.8615	.7109	.5224	1.1459	.4069	1.7817	1.4679	.5124
14	.8890	.7750	1.0390	.7740	.6960	1.1210	.6820	.9750	.9340	.6260
+gp	.8890	.7750	1.0390	.7740	.6960	1.1210	.6820	.9750	.9340	.6260
FBAR 5-10	.5259	.5520	.8089	.7281	.5875	.6741	.5941	.5614	.6204	.6456
FBAR 5- 8	.3715	.4498	.6788	.6037	.4547	.4173	.4526	.4944	.6577	.6583

Table 8 Fishing mortality (F) at age

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	.1339	.1458	.0488	.0312	.0240	.0646	.0205	.0205	.0438	.0196
4	.5667	.2237	.2085	.1292	.0982	.2009	.1960	.1225	.1482	.1722
5	.7532	.6694	.3480	.3552	.2292	.2968	.3082	.2929	.3632	.4815
6	.6805	.8467	.5465	.6240	.5140	.5489	.4845	.5734	.5916	.7810
7	.6783	.8442	.6595	.6735	.8520	.7927	.7741	1.0744	.9869	1.0261
8	.9089	.9357	.7513	.7021	1.0673	.9975	1.0075	1.1943	1.1075	1.1772
9	1.2138	1.2915	1.0535	.8648	1.2276	1.1222	1.0043	1.2019	1.0270	.9477
10	.7737	.9911	.9535	1.0907	.9841	.6798	.8450	1.0060	.6980	1.0296
11	.6314	1.8481	1.2627	1.3301	1.0969	.5550	.4874	.8101	.6069	.7506
12	.2469	1.4943	1.3553	.8591	.8000	1.2602	.2857	.7147	.5258	1.4498
13	.9914	2.4485	.8306	1.6875	1.4753	.4665	1.1688	.3643	.5551	.5365
14	.7740	1.6430	1.1040	1.1810	1.1340	.8260	.7660	.8290	.5620	.8350
+gp	.7740	1.6430	1.1040	1.1810	1.1340	.8260	.7660	.8290	.5620	.8350
FBAR 5-10	.8347	.9298	.7187	.7184	.8124	.7397	.7373	.8905	.7957	.9072
FBAR 5- 8	.7552	.8240	.5763	.5887	.6656	.6590	.6436	.7837	.7623	.8665

Table 8 Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	FBAR 94-96
AGE											
3	.0239	.0225	.0271	.0081	.0128	.0326	.0115	.0082	.0053	.0190	.0108
4	.1645	.1233	.1494	.0458	.0560	.1291	.0859	.0938	.0816	.1010	.0921
5	.5070	.3750	.2382	.1114	.1885	.2394	.3324	.2947	.2691	.3090	.2910
6	.9659	.6752	.3898	.1994	.2967	.4238	.5392	.5784	.4852	.4010	.4882
7	1.1032	1.1303	.6281	.2447	.4508	.5225	.5788	.9921	.6987	.5710	.7539
8	1.0389	1.0545	.9071	.3626	.3527	.5767	.5604	.8917	.9866	.5740	.8174
9	.9484	1.1332	.9530	.3647	.4088	.4287	.6139	.9072	.7965	.8290	.8442
10	1.4678	.9304	1.1636	.4291	.3090	.4090	.6066	1.0589	.7458	.7120	.8389
11	.8042	1.0017	.3178	.4269	.1383	.2229	.7329	.9504	1.3906	.4710	.9373
12	1.1865	1.0330	.2933	.1502	.1364	.5284	1.0249	1.0719	.7475	.8290	.8828
13	.8024	.9433	.0382	.6268	.0143	.0694	1.1415	.8362	.7533	.7580	.7825
14	.9770	.9610	.4170	.2700	.1270	.1510	1.0840	1.0860	1.0220	.7580	.9553
+gp	.9770	.9610	.4170	.2700	.1270	.1510	1.0840	1.0860	1.0220	.7580	
FBAR 5-10	1.0052	.8831	.7133	.2853	.3344	.4333	.5386	.7871	.6636	.5660	
FBAR 5- 8	.9038	.8087	.5408	.2295	.3222	.4406	.5027	.6892	.6099	.4638	

Table 3.18

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	1292664	169748	111969	197051	404980	1015584	1818301	525062	622069	614225
4	1245045	1027225	135629	89590	154864	324567	799411	1223749	347203	468459
5	459765	875147	683854	88953	63624	114403	224808	536114	610053	230437
6	132409	314070	476086	346146	49658	41444	69546	129276	256487	296491
7	82674	88545	161181	227518	160064	32085	23081	38479	63735	104118
8	55931	44102	48535	61173	100065	77949	19153	12395	20179	25821
9	21692	23334	21422	15724	21644	35588	32653	8238	6233	8170
10	4496	7671	8762	5600	4930	6962	9348	9735	4481	2763
11	1250	1606	3017	2648	1697	1865	1652	3638	2986	2275
12	564	412	727	774	1068	709	451	747	1089	737
13	417	181	228	227	401	500	266	195	323	379
14	74	141	39	79	91	194	130	145	27	61
+gp	26	93	77	71	54	64	121	108	66	124
TOTAL	3297008	2552275	1651526	1035553	963140	1651915	2998921	2487882	1934931	1754059

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

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	347737	639589	199019	140432	158266	157734	168694	382073	495900	1016142
4	426010	249016	452622	155181	111445	126501	121067	135308	306253	388444
5	280788	197897	163018	300824	111650	82706	84724	81479	98011	216207
6	116975	108249	82961	94240	172668	72691	50325	50967	49774	55807
7	136945	48495	38005	39327	41340	84553	34374	25381	23518	22555
8	42493	56897	17069	16090	16418	14437	31334	12977	7096	7177
9	8710	14020	18275	6592	6528	4623	4359	9367	3218	1920
10	3076	2118	3155	5217	2273	1566	1232	1307	2306	943
11	1423	1162	644	995	1435	696	650	433	391	939
12	1361	620	150	149	216	392	327	327	158	175
13	211	871	114	32	52	79	91	201	131	76
14	186	64	62	41	5	10	41	23	114	62
+gp	109	68	73	12	2	10	10	23	97	2
TOTAL	1366023	1319065	975164	759132	622297	545998	497228	699867	986968	1710449

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	GMST
AGE												
3	267474	198254	159902	211680	428707	795195	1059851	865490	747476	474419	0	4854
4	728118	201484	157278	127419	171917	344807	626382	806611	581789	346817	221249	3770
5	267717	505694	145819	110897	99654	133092	248124	469345	556624	345315	197808	2596
6	109367	132012	284561	94080	81224	67574	85771	145342	280114	345625	190920	1493
7	20924	34082	55020	157766	63101	49426	36215	40953	66455	141167	188492	748
8	6618	5684	9011	24036	101133	32915	23997	16621	12433	27054	65297	347
9	1811	1917	1621	2978	13695	58190	15139	11218	5579	3795	12477	156
10	609	574	505	512	1693	7450	31033	6708	3707	2060	1356	63
11	276	115	185	129	273	1018	4052	13853	1905	1440	827	25
12	363	101	35	110	69	195	667	1594	4385	388	736	9
13	34	91	29	21	78	49	94	196	447	1700	139	3
14	37	12	29	23	9	63	38	25	70	172	652	1
+gp	14	26	22	9	46	31	3	7	2	4	68	
TOTAL	1403361	1080047	814019	729661	961598	1490006	2131365	2377961	2260984	1689956	880020	

Table 3.19

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
AGE										
3	738326	105490	63635	124673	294342	712127	1350917	350526	364191	408657
4	1094041	982109	118586	87204	173164	350133	913733	1256864	312724	479502
5	626205	1296900	926783	134206	110270	191291	398284	853463	851682	365596
6	273421	705648	978220	791785	130487	105065	186806	312020	542888	713178
7	250631	292065	486201	764038	617475	119411	91016	136346	198050	367675
8	230991	198178	199451	279857	525879	395218	102895	59834	85423	124218
9	117605	137648	115564	94433	149321	236875	230278	52204	34636	51595
10	30424	56473	58988	41973	42443	57829	82270	76990	31077	21773
11	10162	14203	24397	23841	17554	18610	17463	34567	24878	21541
12	5382	4275	6898	8173	12956	8296	5591	8321	10640	8181
13	4585	2164	2491	2764	5598	6745	3794	2501	3642	4852
14	902	1879	469	1067	1420	2916	2069	2066	336	868
+gp	341	1333	1013	1033	912	1040	2081	1665	895	1910
TOTALBIO	3383015	3798363	2982694	2355048	2081821	2205558	3387196	3147365	2461062	2569545

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
AGE										
3	224410	417289	138592	88830	113672	110391	59737	193153	226649	303421
4	422958	249948	484914	151014	123144	136204	120279	154876	276292	337758
5	432103	307887	270705	453756	191224	138028	135843	147665	166036	320565
6	272921	255338	208866	215518	448365	183927	125242	141468	144605	132527
7	469075	167934	140470	132034	157593	314082	116653	96112	95970	82491
8	198288	268416	85947	73593	85263	73060	144865	58177	41593	38864
9	53354	86826	120798	39583	44507	30713	26456	55127	24717	11626
10	23514	16372	26026	39094	19340	12983	9334	9601	23198	6053
11	13066	10785	6379	8961	14669	6928	5911	3824	5553	9705
12	14664	6747	1742	1574	2584	4584	3490	3381	1701	1779
13	2613	10925	1524	385	714	1067	1120	2398	1626	897
14	2567	893	917	549	74	145	557	307	1580	803
+gp	1626	1023	1172	182	26	156	150	332	1440	27
TOTALBIO	2131160	1800382	1488053	1205072	1201176	1012269	749636	866422	1010961	1246516

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
3	54576	36687	49953	83054	197321	358108	373556	204350	151000	91606
4	350648	70127	83460	91083	189741	321602	740724	610886	288587	168285
5	324131	355895	129721	132194	167056	234553	454412	661142	636265	335112
6	217234	217710	437118	158171	192906	185427	241760	356688	589119	706096
7	68815	92514	154010	389674	198168	192016	147406	157497	228555	495727
8	23776	26623	43185	85766	449317	166380	131051	92339	63825	151468
9	11421	14361	11845	14228	91590	393606	103244	75992	40294	29265
10	5479	6671	5218	4042	16790	69735	265771	51615	32663	19965
11	3508	1444	1774	1156	2938	11929	43343	111385	18062	15347
12	3809	1051	388	1197	726	2112	7244	17306	47576	4214
13	406	1087	381	263	943	617	1175	2450	5586	21259
14	492	164	416	322	124	874	524	341	966	2395
+gp	202	379	349	139	671	472	49	98	25	62
TOTALBIO	1064497	824713	917817	961288	1508292	1937431	2510258	2342091	2102524	2040800

Table 3.20

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
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,	230991,	198178,	199451,	279857,	525879,	395218,	102895,	59834,	85423,	124218,
9,	117605,	137648,	115564,	94433,	149321,	236875,	230278,	52204,	34636,	51595,
10,	30424,	56473,	58988,	41973,	42443,	57829,	82270,	76990,	31077,	21773,
11,	10162,	14203,	24397,	23841,	17554,	18610,	17463,	34567,	24878,	21541,
12,	5382,	4275,	6898,	8173,	12956,	8296,	5591,	8321,	10640,	8181,
13,	4585,	2164,	2491,	2764,	5598,	6745,	3794,	2501,	3642,	4852,
14,	902,	1879,	469,	1067,	1420,	2916,	2069,	2066,	336,	868,
+gp,	341,	1333,	1013,	1033,	912,	1040,	2081,	1665,	895,	1910,
TOTSPBIO,	400391,	416152,	409271,	453141,	756083,	727531,	446440,	238147,	191528,	234938,

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	0,	0,	0,	0,	0,	0,	597,	0,	0,	0,
4,	0,	0,	0,	0,	0,	6810,	9622,	7744,	2763,	6755,
5,	0,	0,	0,	0,	0,	13803,	13584,	26580,	16604,	28851,
6,	0,	0,	0,	0,	0,	62535,	37573,	43855,	47720,	25180,
7,	0,	0,	0,	0,	0,	204153,	85156,	53823,	56622,	46195,
8,	198288,	268416,	85947,	73593,	85263,	59909,	127481,	52359,	35354,	29537,
9,	53354,	86826,	120798,	39583,	44507,	28256,	25662,	54576,	22740,	10347,
10,	23514,	16372,	26026,	39094,	19340,	12983,	9334,	9601,	23198,	6053,
11,	13066,	10785,	6379,	8961,	14669,	6928,	5911,	3824,	5553,	9705,
12,	14664,	6747,	1742,	1574,	2584,	4584,	3490,	3381,	1701,	1779,
13,	2613,	10925,	1524,	385,	714,	1067,	1120,	2398,	1626,	897,
14,	2567,	893,	917,	549,	74,	145,	557,	307,	1580,	803,
+gp,	1626,	1023,	1172,	182,	26,	156,	150,	332,	1440,	27,
TOTSPBIO,	309692,	401986,	244506,	163921,	167177,	401330,	320238,	258780,	216901,	166129,

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	0,	0,	0,	0,	0,	3581,	0,	0,	0,	0,
4,	3506,	701,	0,	911,	7590,	3216,	22222,	6109,	0,	0,
5,	29172,	10677,	2594,	6610,	10023,	28146,	40897,	72726,	44538,	6702,
6,	49964,	54427,	65568,	33216,	55943,	79734,	72528,	117707,	194409,	183585,
7,	18580,	49032,	60064,	226011,	128809,	144012,	89917,	94498,	141704,	312308,
8,	14503,	21032,	25479,	66040,	372933,	154733,	120567,	75718,	47230,	125718,
9,	9251,	14361,	9831,	12236,	88843,	381798,	100146,	73712,	38279,	28387,
10,	4383,	6671,	5218,	3961,	16790,	69735,	263113,	51099,	31683,	19965,
11,	3508,	1444,	1774,	1156,	2791,	11929,	43343,	110271,	17881,	15347,
12,	3809,	1051,	388,	1197,	581,	2112,	7244,	17306,	47576,	4214,
13,	406,	1087,	381,	263,	943,	617,	1175,	2450,	5586,	21259,
14,	492,	164,	416,	322,	124,	874,	524,	341,	966,	2395,
+gp,	202,	379,	349,	139,	671,	472,	49,	98,	25,	62,
TOTSPBIO,	137775,	161028,	172062,	352061,	686041,	880959,	761726,	622036,	569880,	719942,

Table 3.21

Run title : Arctic Cod (run: SVPBJA08/V08)

At 27-Aug-97 13:36:01

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,	FBAR 5- 8,
1946,	729759,	4231927,	2585409,	706000,	.2731,	.6735,	.1928,	.1344,
1947,	419945,	3410905,	1805121,	882017,	.4886,	.5708,	.3130,	.2505,
1948,	440690,	3129347,	1355197,	774295,	.5714,	.6152,	.3521,	.2906,
1949,	466659,	3007242,	1153489,	800122,	.6937,	.6799,	.3705,	.3531,
1950,	705512,	3106404,	1197239,	731982,	.6114,	.7781,	.3652,	.2918,
1951,	1085887,	3613344,	1271431,	827180,	.6506,	.8813,	.3983,	.3424,
1952,	1190838,	3245128,	876072,	876795,	1.0008,	.7499,	.5386,	.4731,
1953,	1592006,	3918483,	760081,	695546,	.9151,	.8396,	.3605,	.3051,
1954,	644331,	3858692,	643244,	826021,	1.2841,	.7790,	.4006,	.3123,
1955,	272941,	3874768,	708237,	1147841,	1.6207,	.8170,	.5498,	.4785,
1956,	440230,	3463563,	835948,	1343068,	1.6066,	.8448,	.6431,	.6102,
1957,	805056,	2752695,	771019,	792557,	1.0279,	.8346,	.5059,	.4686,
1958,	497100,	2629141,	894000,	769313,	.8605,	.8831,	.5123,	.4741,
1959,	684731,	2418065,	731957,	744607,	1.0173,	.8562,	.5602,	.5104,
1960,	790432,	2410924,	527354,	622042,	1.1796,	.8819,	.4727,	.4315,
1961,	918947,	2667130,	462188,	783221,	1.6946,	.9069,	.6226,	.5559,
1962,	729959,	2651070,	430028,	909266,	2.1144,	.9175,	.7515,	.6837,
1963,	473302,	1960799,	291642,	776337,	2.6620,	.7829,	.9697,	.8952,
1964,	338955,	1605043,	196777,	437695,	2.2243,	.8184,	.6693,	.5319,
1965,	778090,	1959472,	190406,	444930,	2.3367,	.8965,	.5392,	.4390,
1966,	1582377,	2844752,	317618,	483711,	1.5229,	.9415,	.5082,	.4065,
1967,	1292665,	3383014,	400391,	572605,	1.4301,	.8787,	.5259,	.3715,
1968,	169748,	3798364,	416152,	1074084,	2.5810,	.9561,	.5520,	.4498,
1969,	111969,	2982695,	409271,	1197226,	2.9253,	.8743,	.8089,	.6788,
1970,	197051,	2355047,	453141,	933246,	2.0595,	.9734,	.7281,	.6037,
1971,	404980,	2081822,	756084,	689048,	.9113,	1.1182,	.5875,	.4547,
1972,	1015585,	2205559,	727531,	565254,	.7769,	1.0788,	.6741,	.4173,
1973,	1818302,	3387196,	446440,	792685,	1.7756,	1.1430,	.5941,	.4526,
1974,	525062,	3147366,	238147,	1102433,	4.6292,	1.0271,	.5614,	.4944,
1975,	622069,	2461063,	191528,	829377,	4.3303,	.9007,	.6204,	.6577,
1976,	614225,	2569545,	234938,	867463,	3.6923,	1.0236,	.6456,	.6583,
1977,	347737,	2131159,	309692,	905301,	2.9232,	.9928,	.8347,	.7552,
1978,	639589,	1800381,	401986,	698715,	1.7382,	1.0037,	.9298,	.8240,
1979,	199019,	1488053,	244506,	440538,	1.8017,	1.0713,	.7187,	.5763,
1980,	140432,	1205072,	163921,	380434,	2.3208,	.9731,	.7184,	.5887,
1981,	158266,	1201176,	167177,	399038,	2.3869,	1.1050,	.8124,	.6656,
1982,	157734,	1012268,	401330,	363730,	.9063,	1.0767,	.7397,	.6590,
1983,	168694,	749636,	320238,	289992,	.9056,	.9837,	.7373,	.6436,
1984,	382073,	866421,	258780,	277651,	1.0729,	.9538,	.8905,	.7837,
1985,	495900,	1010961,	216901,	307920,	1.4196,	.9936,	.7957,	.7623,
1986,	1016142,	1246516,	166129,	430113,	2.5890,	.9390,	.9072,	.8665,
1987,	267475,	1064496,	137776,	523071,	3.7965,	.9670,	1.0052,	.9038,
1988,	198254,	824713,	161028,	434939,	2.7010,	.9588,	.8831,	.8087,
1989,	159902,	917817,	172062,	332481,	1.9323,	1.0344,	.7133,	.5408,
1990,	211680,	961288,	352061,	212000,	.6022,	.9984,	.2853,	.2295,
1991,	428707,	1508291,	686041,	319158,	.4652,	.9690,	.3344,	.3222,
1992,	795195,	1937431,	880959,	513494,	.5829,	1.0008,	.4333,	.4406,
1993,	1059852,	2510259,	761726,	581611,	.7635,	1.0013,	.5386,	.5027,
1994,	865490,	2342090,	622036,	771086,	1.2396,	1.0005,	.7871,	.6892,
1995,	747476,	2102524,	569880,	739999,	1.2985,	1.0001,	.6636,	.6099,
1996,	474419,	2040801,	719942,	731852,	1.0165,	1.0005,	.5660,	.4638,
Arith. Mean ,	613205,	2353959,	588083,	679433,	1.6457		.6115,	.5316,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),				

Table 3.22

Cod in the North-East Arctic (Areas I and II)

Single option prediction: Input data

Year: 1997								
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	614510.00	0.6318	0.0000	0.0000	0.0000	0.194	0.0091	0.620
4	221249.00	0.3859	0.0000	0.0000	0.0000	0.515	0.0775	0.980
5	197808.00	0.2375	0.0200	0.0000	0.0000	1.067	0.2450	1.620
6	190920.00	0.2032	0.1300	0.0000	0.0000	1.868	0.4110	2.330
7	188492.00	0.2000	0.5600	0.0000	0.0000	3.362	0.6347	3.670
8	65297.000	0.2000	0.8200	0.0000	0.0000	5.261	0.6882	5.390
9	12477.000	0.2000	0.9500	0.0000	0.0000	9.077	0.7107	8.420
10	1356.000	0.2000	0.9500	0.0000	0.0000	11.799	0.7063	10.980
11	827.000	0.2000	0.9500	0.0000	0.0000	11.358	0.7891	10.860
12	736.000	0.2000	1.0000	0.0000	0.0000	10.850	0.7432	10.850
13	139.000	0.2000	1.0000	0.0000	0.0000	12.500	0.6588	12.500
14	652.000	0.2000	1.0000	0.0000	0.0000	13.900	0.8043	13.900
15+	68.000	0.2000	1.0000	0.0000	0.0000	15.000	0.8043	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	654695.00	0.6318	0.0000	0.0000	0.0000	0.196	0.0091	0.652
4	.	0.3859	0.0000	0.0000	0.0000	0.499	0.0775	1.004
5	.	0.2375	0.0400	0.0000	0.0000	1.060	0.2450	1.632
6	.	0.2032	0.2400	0.0000	0.0000	2.004	0.4110	2.503
7	.	0.2000	0.6000	0.0000	0.0000	3.437	0.6347	3.855
8	.	0.2000	0.8000	0.0000	0.0000	5.330	0.6882	5.496
9	.	0.2000	0.9600	0.0000	0.0000	8.002	0.7107	7.140
10	.	0.2000	0.9700	0.0000	0.0000	10.099	0.7063	9.143
11	.	0.2000	0.9800	0.0000	0.0000	10.498	0.7891	9.807
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.7432	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.6588	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	0.8043	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	0.8043	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
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	1079000.0	0.6318	0.0000	0.0000	0.0000	0.196	0.0091	0.652
4	.	0.3859	0.0000	0.0000	0.0000	0.499	0.0775	1.004
5	.	0.2375	0.0400	0.0000	0.0000	1.060	0.2450	1.632
6	.	0.2032	0.2400	0.0000	0.0000	2.004	0.4110	2.503
7	.	0.2000	0.6000	0.0000	0.0000	3.437	0.6347	3.855
8	.	0.2000	0.8000	0.0000	0.0000	5.330	0.6882	5.496
9	.	0.2000	0.9600	0.0000	0.0000	8.002	0.7107	7.140
10	.	0.2000	0.9700	0.0000	0.0000	10.099	0.7063	9.143
11	.	0.2000	0.9800	0.0000	0.0000	10.498	0.7891	9.807
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.7432	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.6588	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	0.8043	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	0.8043	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

(cont.)

Table 3.23

Cod in the North-East Arctic (Areas I and II)

Prediction with management option table

Year: 1997					Year: 1998					Year: 1999	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.1810	0.6684	1936548	838580	840000	0.0000	0.0000	1637067	811290	0	2306237	1292124
.	.	.	.	.	0.0500	0.0283	.	811290	38897	2258063	1253059
.	.	.	.	.	0.1000	0.0566	.	811290	76695	2211318	1215230
.	.	.	.	.	0.1500	0.0849	.	811290	113430	2165958	1178596
.	.	.	.	.	0.2000	0.1132	.	811290	149133	2121938	1143119
.	.	.	.	.	0.2500	0.1415	.	811290	183837	2079217	1108762
.	.	.	.	.	0.3000	0.1698	.	811290	217572	2037753	1075488
.	.	.	.	.	0.3500	0.1981	.	811290	250369	1997508	1043262
.	.	.	.	.	0.4000	0.2264	.	811290	282255	1958443	1012050
.	.	.	.	.	0.4500	0.2547	.	811290	313258	1920521	981820
.	.	.	.	.	0.5000	0.2830	.	811290	343406	1883706	952539
.	.	.	.	.	0.5500	0.3113	.	811290	372726	1847964	924178
.	.	.	.	.	0.6000	0.3396	.	811290	401241	1813261	896706
.	.	.	.	.	0.6500	0.3679	.	811290	428977	1779564	870095
.	.	.	.	.	0.7000	0.3962	.	811290	455957	1746844	844317
.	.	.	.	.	0.7500	0.4245	.	811290	482204	1715068	819346
.	.	.	.	.	0.8000	0.4528	.	811290	507741	1684207	795154
.	.	.	.	.	0.8500	0.4811	.	811290	532589	1654234	771718
.	.	.	.	.	0.9000	0.5094	.	811290	556769	1625120	749013
.	.	.	.	.	0.9500	0.5377	.	811290	580301	1596839	727016
.	.	.	.	.	1.0000	0.5660	.	811290	603205	1569366	705703
.	.	.	.	.	1.0500	0.5943	.	811290	625499	1542674	685053
.	.	.	.	.	1.1000	0.6226	.	811290	647202	1516741	665044
.	.	.	.	.	1.1500	0.6509	.	811290	668332	1491542	645657
.	.	.	.	.	1.2000	0.6792	.	811290	688906	1467055	626870
.	.	.	.	.	1.2500	0.7075	.	811290	708940	1443258	608665
.	.	.	.	.	1.3000	0.7358	.	811290	728451	1420129	591024
.	.	.	.	.	1.3500	0.7641	.	811290	747454	1397649	573928
.	.	.	.	.	1.4000	0.7924	.	811290	765964	1375798	557359
.	.	.	.	.	1.4500	0.8207	.	811290	783997	1354555	541301
.	.	.	.	.	1.5000	0.8490	.	811290	801566	1333903	525738
.	.	.	.	.	1.5500	0.8773	.	811290	818684	1313823	510654
.	.	.	.	.	1.6000	0.9056	.	811290	835366	1294298	496034
.	.	.	.	.	1.6500	0.9339	.	811290	851625	1275311	481862
.	.	.	.	.	1.7000	0.9622	.	811290	867472	1256845	468125
.	.	.	.	.	1.7500	0.9905	.	811290	882920	1238885	454808
.	.	.	.	.	1.8000	1.0188	.	811290	897980	1221416	441899
.	.	.	.	.	1.8500	1.0471	.	811290	912665	1204422	429384
.	.	.	.	.	1.9000	1.0754	.	811290	926984	1187889	417252
.	.	.	.	.	1.9500	1.1037	.	811290	940949	1171804	405489
.	.	.	.	.	2.0000	1.1320	.	811290	954570	1156151	394084
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANBJA01
Date and time : 28AUG97:09:56
Computation of ref. F: Simple mean, age 5 - 10
Basis for 1997 : TAC constraints

Table 3.24

The SAS System 09:55 Thursday, August 28, 1997

Cod in the North-East Arctic (Areas I and II)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	3.461	13351.922	1.223	11455.424	1.223	11455.424
0.0500	0.0283	0.045	321.237	3.239	10709.486	1.013	8860.418	1.013	8860.418
0.1000	0.0566	0.078	511.493	3.076	8881.543	0.862	7076.767	0.862	7076.767
0.1500	0.0849	0.104	627.608	2.950	7553.733	0.748	5790.408	0.748	5790.408
0.2000	0.1132	0.125	699.420	2.849	6553.085	0.658	4828.634	0.658	4828.634
0.2500	0.1415	0.142	743.698	2.767	5776.914	0.587	4088.994	0.587	4088.994
0.3000	0.1698	0.156	770.356	2.697	5160.640	0.528	3507.116	0.528	3507.116
0.3500	0.1981	0.169	785.490	2.638	4661.761	0.478	3040.681	0.478	3040.681
0.4000	0.2264	0.179	792.970	2.587	4251.252	0.437	2660.831	0.437	2660.831
0.4500	0.2547	0.189	795.312	2.542	3908.686	0.401	2347.285	0.401	2347.285
0.5000	0.2830	0.197	794.190	2.502	3619.309	0.370	2085.421	0.370	2085.421
0.5500	0.3113	0.205	790.736	2.466	3372.229	0.343	1864.466	0.343	1864.466
0.6000	0.3396	0.212	785.725	2.434	3159.252	0.319	1676.331	0.319	1676.331
0.6500	0.3679	0.218	779.696	2.405	2974.106	0.298	1514.842	0.298	1514.842
0.7000	0.3962	0.224	773.026	2.378	2811.924	0.279	1375.216	0.279	1375.216
0.7500	0.4245	0.230	765.981	2.353	2668.875	0.262	1253.702	0.262	1253.702
0.8000	0.4528	0.235	758.748	2.331	2541.908	0.247	1147.320	0.247	1147.320
0.8500	0.4811	0.239	751.461	2.310	2428.568	0.233	1053.679	0.233	1053.679
0.9000	0.5094	0.244	744.211	2.290	2326.859	0.221	970.843	0.221	970.843
0.9500	0.5377	0.248	737.066	2.272	2235.145	0.209	897.229	0.209	897.229
1.0000	0.5660	0.252	730.070	2.254	2152.074	0.199	831.532	0.199	831.532
1.0500	0.5943	0.255	723.254	2.238	2076.517	0.189	772.672	0.189	772.672
1.1000	0.6226	0.259	716.636	2.223	2007.530	0.181	719.742	0.181	719.742
1.1500	0.6509	0.262	710.228	2.209	1944.313	0.172	671.983	0.172	671.983
1.2000	0.6792	0.265	704.036	2.195	1886.190	0.165	628.751	0.165	628.751
1.2500	0.7075	0.268	698.061	2.182	1832.579	0.158	589.499	0.158	589.499
1.3000	0.7358	0.271	692.302	2.170	1782.986	0.151	553.760	0.151	553.760
1.3500	0.7641	0.274	686.756	2.158	1736.979	0.145	521.132	0.145	521.132
1.4000	0.7924	0.277	681.417	2.147	1694.188	0.139	491.269	0.139	491.269
1.4500	0.8207	0.279	676.279	2.136	1654.288	0.134	463.870	0.134	463.870
1.5000	0.8490	0.282	671.335	2.125	1616.997	0.129	438.675	0.129	438.675
1.5500	0.8773	0.284	666.578	2.115	1582.068	0.124	415.456	0.124	415.456
1.6000	0.9056	0.287	662.001	2.106	1549.280	0.120	394.014	0.120	394.014
1.6500	0.9339	0.289	657.596	2.097	1518.442	0.115	374.174	0.115	374.174
1.7000	0.9622	0.291	653.356	2.088	1489.383	0.111	355.781	0.111	355.781
1.7500	0.9905	0.293	649.273	2.079	1461.950	0.108	338.699	0.108	338.699
1.8000	1.0188	0.295	645.341	2.071	1436.008	0.104	322.806	0.104	322.806
1.8500	1.0471	0.297	641.552	2.063	1411.436	0.101	307.997	0.101	307.997
1.9000	1.0754	0.299	637.900	2.055	1388.126	0.098	294.174	0.098	294.174
1.9500	1.1037	0.301	634.379	2.048	1365.979	0.095	281.252	0.095	281.252
2.0000	1.1320	0.303	630.982	2.041	1344.909	0.092	269.155	0.092	269.155
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDBJA01
Date and time : 28AUG97:10:15
Computation of ref. F: Simple mean, age 5 - 10
F-0.1 factor : 0.2299
F-max factor : 0.4557
F-0.1 reference F : 0.1301
F-max reference F : 0.2579
Recruitment : Single recruit

Table 3.25

Cod in the North-East Arctic (Areas I and II)

09:55 Thursday, August 28, 1997

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265590	840023	1494531	1936548	203397	838674	203397	838674
1998	0.4000	0.2264	79639	282248	1430187	1637038	177721	811268	177721	811268
1999	0.4000	0.2264	87129	322236	1942179	1958416	190468	1012027	190468	1012027
2000	0.4000	0.2264	100291	361092	2332654	2276053	201944	1123581	201944	1123581
2001	0.4000	0.2264	122128	418656	2579071	2611436	228935	1222291	228935	1222291
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 28AUG97:12:55
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265590	840023	1494531	1936548	203397	838674	203397	838674
1998	0.6000	0.3396	114338	401232	1430187	1637038	177721	811268	177721	811268
1999	0.6000	0.3396	117209	414890	1911703	1813237	171637	896686	171637	896686
2000	0.6000	0.3396	130890	433010	2281739	2003014	168947	896714	168947	896714
2001	0.6000	0.3396	157907	484303	2511306	2238561	184936	909390	184936	909390
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265590	840023	1494531	1936548	203397	838674	203397	838674
1998	0.8000	0.4528	146108	507730	1430187	1637038	177721	811268	177721	811268
1999	0.8000	0.4528	140991	477217	1883940	1684186	154887	795137	154887	795137
2000	0.8000	0.4528	154012	468551	2238744	1785085	142434	719345	142434	719345
2001	0.8000	0.4528	185273	512766	2456760	1965036	152075	687525	152075	687525
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265590	840023	1494531	1936548	203397	838674	203397	838674
1998	1.0000	0.5660	175258	603192	1430187	1637038	177721	811268	177721	811268
1999	1.0000	0.5660	159917	517236	1858599	1569347	139975	705687	139975	705687
2000	1.0000	0.5660	172101	482646	2202105	1610165	121022	580278	121022	580278
2001	1.0000	0.5660	207328	523197	2411933	1761140	127168	528619	127168	528619
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265590	840023	1494531	1936548	203397	838674	203397	838674
1998	1.2000	0.6792	202062	688891	1430187	1637038	177721	811268	177721	811268
1999	1.2000	0.6792	175100	540985	1835419	1467039	126687	626856	126687	626856
2000	1.2000	0.6792	186770	484608	2170596	1468905	103638	470898	103638	470898
2001	1.2000	0.6792	225892	525510	2374356	1606475	107999	413530	107999	413530
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Table 3.25 (Continued)

Cod in the North-East Arctic (Areas I and II)

09:55 Thursday, August 28, 1997

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265582	840000	1494531	1936548	203397	838674	203397	838674
1998	1.2275	0.6948	205584	700000	1430194	1637067	177725	811290	177725	811290
1999	1.7926	1.0146	235737	699999	1832387	1453871	124977	616778	124977	616778
2000	2.8929	1.6374	326472	699999	2116677	1273357	79552	333734	79552	333734
2001	3.8096	2.1562	416083	700000	2215491	1161272	52947	150870	52947	150870
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 28AUG97:12:55
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : TAC constraints

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265582	840000	1494531	1936548	203397	838674	203397	838674
1998	0.9929	0.5620	174270	600000	1430194	1637067	177725	811290	177725	811290
1999	1.2182	0.6895	187761	600000	1859460	1573207	140476	708679	140476	708679
2000	1.5074	0.8532	229291	600000	2178880	1518332	109713	512926	109713	512926
2001	1.5835	0.8962	270279	599999	2344876	1528556	98163	370292	98163	370292
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.1810	0.6684	265582	840000	1494531	1936548	203397	838674	203397	838674
1998	0.7847	0.4441	143776	500000	1430194	1637067	177725	811290	177725	811290
1999	0.8408	0.4759	147720	500000	1885979	1693556	156103	802476	156103	802476
2000	0.8817	0.4990	166058	500000	2234550	1768694	140411	707390	140411	707390
2001	0.8145	0.4610	183993	500000	2443043	1910718	145339	647798	145339	647798
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Table 3.26

Cod in the North-East Arctic (Areas I and II)

Single option prediction: Detailed tables

Year: 1997 F-factor: 1.1810 Reference F: 0.6684

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0107	4872	3021	614510	119215	0	0	0	0
4	0.0915	16102	15780	221249	113943	0	0	0	0
5	0.2893	44491	72075	197808	211061	3956	4221	3956	4221
6	0.4854	66983	156070	190920	356639	24820	46363	24820	46363
7	0.7496	91224	334792	188492	633710	105556	354878	105556	354878
8	0.8128	33369	179859	65297	343528	53544	281693	53544	281693
9	0.8393	6512	54833	12477	113254	11853	107591	11853	107591
10	0.8341	705	7740	1356	15999	1288	15199	1288	15199
11	0.9319	461	5010	827	9393	786	8923	786	8923
12	0.8777	395	4290	736	7986	736	7986	736	7986
13	0.7780	69	862	139	1738	139	1738	139	1738
14	0.9499	368	5116	652	9063	652	9063	652	9063
15+	0.9499	38	576	68	1020	68	1020	68	1020
Total		265590	840023	1494531	1936548	203397	838674	203397	838674
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1998 F-factor: 0.8000 Reference F: 0.4528

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0073	3522	2296	654695	128320	0	0	0	0
4	0.0620	16152	16217	323202	161278	0	0	0	0
5	0.1960	21830	35627	137258	145493	5490	5820	5490	5820
6	0.3288	29782	74545	116799	234065	28032	56175	28032	56175
7	0.5078	34898	134531	95896	329594	57538	197757	57538	197757
8	0.5506	28240	155207	72928	388707	58343	310966	58343	310966
9	0.5686	9410	67186	23717	189781	22768	182190	22768	182190
10	0.5650	1743	15934	4413	44567	4281	43230	4281	43230
11	0.6313	207	2027	482	5061	472	4960	472	4960
12	0.5946	109	1187	267	2893	267	2893	267	2893
13	0.5270	94	1173	251	3131	251	3131	251	3131
14	0.6434	23	316	52	727	52	727	52	727
15+	0.6434	99	1487	228	3420	228	3420	228	3420
Total		146108	507730	1430187	1637038	177721	811268	177721	811268
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1999 F-factor: 0.8000 Reference F: 0.4528

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0073	5804	3784	1079000	211484	0	0	0	0
4	0.0620	17268	17337	345533	172421	0	0	0	0
5	0.1960	32845	53603	206516	218907	8261	8756	8261	8756
6	0.3288	22688	56787	88976	178307	21354	42794	21354	42794
7	0.5078	24968	96253	68611	235816	41167	141489	41167	141489
8	0.5506	18298	100563	47252	251855	37802	201484	37802	201484
9	0.5686	13660	97533	34430	275505	33052	264485	33052	264485
10	0.5650	4343	39706	10997	111059	10667	107727	10667	107727
11	0.6313	880	8633	2053	21557	2012	21126	2012	21126
12	0.5946	86	934	210	2278	210	2278	210	2278
13	0.5270	45	564	120	1506	120	1506	120	1506
14	0.6434	53	732	121	1683	121	1683	121	1683
15+	0.6434	52	786	121	1809	121	1809	121	1809
Total		140991	477217	1883940	1684186	154887	795137	154887	795137
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 3.26 (Continued)

09:55 Thursday, August 28, 1997

Cod in the North-East Arctic (Areas I and II)

Single option prediction: Detailed tables

(cont.)

Year: 2000	F-factor: 0.8000		Reference F: 0.4528			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0073	6369	4153	1184000	232064	0	0	0	0
4	0.0620	28460	28573	569472	284167	0	0	0	0
5	0.1960	35115	57307	220785	234032	8831	9361	8831	9361
6	0.3288	34135	85441	133871	268278	32129	64387	32129	64387
7	0.5078	19021	73324	52267	179641	31360	107785	31360	107785
8	0.5506	13091	71950	33808	180196	27046	144157	27046	144157
9	0.5686	8851	63195	22308	178508	21416	171368	21416	171368
10	0.5650	6304	57641	15964	161223	15485	156387	15485	156387
11	0.6313	2194	21513	5117	53719	5015	52645	5015	52645
12	0.5946	367	3980	894	9703	894	9703	894	9703
13	0.5270	36	444	95	1186	95	1186	95	1186
14	0.6434	25	352	58	809	58	809	58	809
15+	0.6434	45	678	104	1560	104	1560	104	1560
Total		154012	468551	2238744	1785085	142434	719345	142434	719345
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001	F-factor: 0.8000		Reference F: 0.4528			1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0073	6369	4153	1184000	232064	0	0	0	0
4	0.0620	31229	31354	624889	311820	0	0	0	0
5	0.1960	57872	94447	363875	385707	14555	15428	14555	15428
6	0.3288	36494	91345	143121	286814	34349	68835	34349	68835
7	0.5078	28618	110323	78640	270285	47184	162171	47184	162171
8	0.5506	9973	54811	25754	137270	20603	109816	20603	109816
9	0.5686	6333	45214	15961	127718	15322	122609	15322	122609
10	0.5650	4085	37347	10344	104462	10033	101328	10033	101328
11	0.6313	3185	31230	7428	77984	7280	76424	7280	76424
12	0.5946	914	9919	2228	24179	2228	24179	2228	24179
13	0.5270	151	1891	404	5050	404	5050	404	5050
14	0.6434	20	277	46	637	46	637	46	637
15+	0.6434	30	455	70	1047	70	1047	70	1047
Total		185273	512766	2456760	1965036	152075	687525	152075	687525
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 28AUG97:11:37
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

Table 4.1 North-East Arctic HADDOCK. Total nominal catch (t) by fishing areas. (Data provided by Working Group members).

Year	Sub-area I	Division IIa	Division IIb	Total
1960	125,675	27,925	1,854	155,454
1961	165,165	25,642	2,427	193,234
1962	160,972	25,189	1,727	187,888
1963	124,774	21,031	939	146,744
1964	79,056	18,735	1,109	98,900
1965	98,505	18,640	939	118,079
1966	124,115	34,892	1,614	160,621
1967	108,066	27,980	440	136,486
1968	140,970	40,031	725	181,726
1969	89,736	40,211	565	130,512
1970	59,493	26,611	497	86,601
1971	56,991	21,454	463	78,908
1972	221,183	41,979	2,155	265,317
1973	283,728	23,348	2,989	320,065
1974	159,037	47,033	5,068	221,138
1975	121,692	44,337	9,729	175,758
1976	94,065	37,566	5,649	137,280
1977	72,159	28,452	9,547	110,158
1978	63,965	30,478	979	95,422
1979	63,841	39,167	615	103,623
1980	54,205	33,616	68	87,889
1981	36,834	39,864	455	77,153
1982	17,948	29,005	2	46,955
1983	7,550	13,872	185	21,607
1984	4,000	13,247	71	17,318
1985	30,385	10,774	111	41,270
1986	69,865	26,006	714	96,585
1987	109,429	38,182	3,048	150,659
1988	43,990	47,086	668	91,744
1989	31,265	23,502	355	55,122
1990	15,138	10,375	304	25,817
1991	18,772	14,417	416	33,605
1992	30,746	22,177	964	53,887
1993	47,658	26,761	3,037	77,355
1994	70,773	43,707	6,885	121,365
1995	69,643	54,627	14,247	138,517
1996 [1]	110,217	57,974	5,247	173,438

[1] Provisional figures.

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

	Sub-area I		Division IIa		Division IIb
Year	Trawl	Others	Trawl	Others	Trawl
1967	73.8	34.3	20.5	7.5	0.4
1968	98.1	42.9	31.4	8.6	0.7
1969	41.3	47.7	33.1	7.1	1.3
1970	36.7	22.8	20.2	6.4	0.5
1971	27.3	29.0	15.0	6.6	0.4
1972	193.4	27.8	34.4	7.6	2.2
1973	241.2	42.5	13.9	9.4	13.0
1974	133.1	25.9	39.9	7.1	15.1
1975	103.5	18.2	34.6	9.7	9.7
1976	77.7	16.4	28.1	9.5	5.6
1977	57.6	14.6	19.9	8.6	9.5
1978	53.9	10.1	15.7	14.8	1.0
1979	47.8	16.0	20.3	18.9	0.6
1980	30.5	23.7	14.8	18.9	0.1
1981	19.0	17.9	21.8	18.7	0.5
1982	9.0	8.9	18.5	10.5	-
1983	3.7	3.8	7.6	6.3	0.2
1984	1.6	2.4	6.4	6.9	0.1
1985	24.4	6.0	4.5	6.3	0.1
1986	51.7	18.1	12.8	13.2	0.7
1987	77.8	31.6	22.1	16.1	3.0
1988	27.5	16.5	33.6	13.5	0.7
1989	21.5	9.8	11.7	11.8	0.4
1990	5.9	9.2	4.8	5.6	0.3
1991	9.8	9.0	7.8	6.6	0.4
1992	21.2	9.5	9.3	12.9	1.0
1993	38.0	9.7	17.7	9.0	3.0
1994	57.8	13.0	29.6	14.2	6.9
1995	57.3	12.3	33.7	20.9	13.2
1996 [1]	95.5	14.7	35.5	22.5	4.9

[1] Provisional

Table 4.3 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.Rep.	Fed. Rep. Germany	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	**Greenland**	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	1,797	34,700	651	77,619
1994	2,761	678	770	2,412	64,688	22	4,673	44,484	877	121,365
1995	2,674	598	1,351	2,675	72,864	14	2,536	54,515	1,290	138,517
1996 [1]	3,836	568	1,510	942	89,479	678	2,228	73,935	262	173,438

[1] Provisional figures.
[2] USSR prior to 1991.

Table 4.4 North-East Arctic HADDOCK. Maturity at age in percent from Russian data.

	Age									
Year	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

Table 4.5 Input RCT3

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

4	40	2 (No. of s	No. of yea	VPA Column No.)	
1957	243	38	-11	-11	-11
1958	109	2	-11	-11	-11
1959	241	7	-11	-11	-11
1960	275	30	-11	-11	-11
1961	320	32	-11	-11	-11
1962	100	5	-11	-11	-11
1963	240	16	-11	-11	-11
1964	291	11	-11	-11	-11
1965	20	0.3	-11	-11	-11
1966	17	0.3	1	-11	-11
1967	164	3	8	-11	-11
1968	95	0.3	0.3	-11	-11
1969	1018	31	29	-11	-11
1970	270	10	64	-11	-11
1971	54	3	26	-11	-11
1972	49	2	16	-11	-11
1973	56	13	26	-11	-11
1974	114	15	51	-11	-11
1975	170	163	60	-11	-11
1976	134	6	38	-11	-11
1977	19	1	33	-11	-11
1978	6	0.3	12	-11	-11
1979	8	0.3	20	-11	-11
1980	5	0.3	15	3.1	7
1981	9	0.3	3	3.9	9
1982	256	23	38	2776.8	0.3
1983	459	40	62	5382	1685
1984	83	9.7	78	1421.2	1809
1985	42	3.9	27	649	680
1986	16	0.2	39	134.3	111
1987	24	0.4	10	44.6	20
1988	85	1.9	13	80.8	58
1989	223	3.3	14	555.4	493
1990	815	72	61	1526	1938
1991	317	16	117	1282.2	859
1992	94	20	87	717.5	1424
1993	130	5.5	64	587.5	848
1994	109	14	64	1271.8	1380
1995	-11	9.9	25	312.7	249
1996	-11	6	39	1252.6	779

R-T-1 Ru age 0+
INT0GP I (scaled x 100)
N-BST1 N age 1
N-BSA1 N age 1

Table 4.6 Output RCT3

Analysis by RCT3 ver3.1 of data from file :

g:/acfm/afwg/had_arct/hadnew97.rct

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

Data for 4 surveys over 40 years : 1957 - 1996

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 = 1994

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-T-1	1.18	2.23	.82	.767	37	2.71	5.43	.948	.414
INTOGP	.08	.91	2.36	.285	28	64.00	5.79	2.717	.050
N-BST1	.87	-.58	.95	.692	14	7.15	5.62	1.115	.300
N-BSA1	1.17	-1.87	2.30	.279	14	7.23	6.56	2.707	.051
					VPA Mean =		4.48	1.421	.185

Yearclass = 1995

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-T-1	1.16	2.24	.81	.746	38	2.39	5.01	.923	.411
INTOGP	.08	.86	2.31	.265	29	25.00	2.74	2.681	.049
N-BST1	.90	-.84	.97	.654	15	5.75	4.32	1.112	.283
N-BSA1	1.16	-2.05	2.17	.273	15	5.52	4.36	2.488	.057
					VPA Mean =		4.57	1.320	.201

Yearclass = 1996

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-T-1	1.14	2.29	.81	.730	38	1.95	4.51	.940	.408
INTOGP	.07	.84	2.36	.243	29	39.00	3.75	2.739	.048
N-BST1	.94	-1.12	1.00	.629	15	7.13	5.60	1.177	.260
N-BSA1	1.17	-2.16	2.10	.277	15	6.66	5.61	2.451	.060
					VPA Mean =		4.64	1.271	.223

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1994	218	5.39	.61	.25	.17	110	4.70
1995	97	4.58	.59	.26	.19		
1996	128	4.85	.60	.27	.21		

Table 4.7

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:20

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,
AGE							
3,	3189,	65643,	6012,	64528,	6563,	1154,	16437,
4,	37949,	9178,	151996,	13013,	154696,	10689,	5922,
5,	35344,	18014,	13634,	70781,	5885,	176678,	14713,
6,	18849,	13551,	9850,	5431,	27590,	4993,	127879,
7,	28868,	6808,	4693,	2867,	3233,	28273,	3182,
8,	9199,	6850,	3237,	1080,	1302,	1445,	8003,
9,	1979,	3322,	2434,	424,	712,	271,	450,
10,	1093,	1182,	606,	315,	319,	100,	200,
11,	853,	734,	534,	393,	126,	50,	80,
12,	867,	178,	185,	202,	68,	30,	60,
13,	712,	81,	138,	121,	51,	15,	30,
+gp,	545,	355,	23,	289,	298,	5,	15,
TOTALNUM,	139447,	125896,	193342,	159444,	200843,	223703,	176971,
TONSLAND,	132125,	120077,	127660,	123920,	156788,	202286,	213924,
SOPCOF %,	45,	65,	51,	57,	60,	47,	55,

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

YEAR,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,
AGE										
3,	2074,	1727,	20318,	40117,	15430,	39604,	28567,	22305,	5911,	26157,
4,	24704,	5914,	7826,	71280,	56858,	30947,	72995,	49162,	46161,	22469,
5,	7942,	31438,	7243,	13718,	63354,	49028,	19036,	30592,	40032,	62724,
6,	12535,	5820,	14040,	7138,	8706,	33923,	13627,	5800,	12578,	28840,
7,	46619,	12748,	3154,	6268,	3578,	3209,	9290,	3518,	1672,	5711,
8,	1087,	17565,	2237,	1587,	4407,	1344,	1243,	2709,	970,	578,
9,	1971,	822,	5918,	2352,	788,	1778,	561,	831,	893,	435,
10,	356,	1072,	285,	2015,	527,	243,	410,	104,	122,	188,
11,	17,	226,	316,	497,	1287,	247,	80,	206,	204,	186,
12,	0,	79,	71,	70,	67,	483,	84,	235,	123,	25,
13,	33,	89,	4,	30,	60,	20,	168,	121,	14,	8,
+gp,	126,	207,	109,	12,	20,	8,	44,	69,	457,	22,
TOTALNUM,	97464,	77707,	61521,	145084,	155082,	160834,	146105,	115652,	109137,	147343,
TONSLAND,	123583,	112672,	88211,	155454,	193234,	187888,	146744,	98900,	118079,	160621,
SOPCOF %,	57,	61,	80,	84,	80,	74,	74,	62,	69,	66,

Table 4.7 (Continued)

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:20

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	15917,	657,	1520,	23004,	1978,	230217,	70205,	9684,	10037,	13989,
4,	41373,	67632,	1963,	2408,	24359,	22245,	258773,	41702,	14088,	13449,
5,	13505,	41267,	44526,	1870,	1257,	42846,	24018,	88112,	33871,	6808,
6,	25736,	7748,	18956,	21996,	918,	3196,	6873,	5828,	49711,	20789,
7,	8878,	15599,	3611,	7948,	9279,	1606,	419,	4138,	2135,	40044,
8,	1617,	5292,	4925,	1974,	3056,	6737,	423,	382,	1236,	1247,
9,	218,	655,	1624,	1978,	826,	2630,	1681,	618,	92,	1350,
10,	175,	182,	315,	726,	1043,	897,	525,	2043,	131,	193,
11,	155,	101,	43,	166,	369,	989,	147,	935,	500,	280,
12,	75,	115,	43,	26,	130,	538,	339,	276,	147,	652,
13,	27,	18,	14,	52,	27,	53,	68,	457,	53,	332,
+gp,	14,	52,	9,	44,	8,	67,	27,	202,	234,	340,
TOTALNUM,	107690,	139318,	77549,	62192,	43250,	312021,	363498,	154377,	112235,	99473,
TONSLAND,	136486,	181726,	130502,	86601,	78908,	265317,	320065,	221138,	175758,	137218,
SOPCOF %,	79,	79,	80,	75,	101,	86,	83,	86,	81,	62,

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	55967,	47311,	17540,	627,	486,	883,	704,	456,	29548,	25596,
4,	22043,	18812,	35290,	22878,	2561,	900,	1930,	841,	1153,	61470,
5,	7368,	4076,	10645,	21794,	22124,	3372,	884,	836,	546,	1013,
6,	2586,	1389,	1429,	2971,	10685,	12203,	1374,	307,	715,	376,
7,	7781,	1626,	812,	250,	1034,	2625,	3282,	765,	316,	346,
8,	11043,	2596,	546,	504,	162,	344,	906,	2250,	634,	144,
9,	311,	6215,	1466,	230,	162,	75,	52,	499,	1312,	295,
10,	388,	162,	2310,	842,	72,	80,	37,	70,	416,	484,
11,	96,	258,	181,	1299,	330,	91,	29,	25,	50,	112,
12,	101,	3,	87,	111,	564,	320,	21,	36,	5,	35,
13,	84,	74,	2,	35,	27,	204,	21,	44,	1,	3,
+gp,	98,	65,	53,	15,	42,	34,	91,	185,	57,	7,
TOTALNUM,	107866,	82587,	70361,	51556,	38249,	21131,	9331,	6314,	34753,	89881,
TONSLAND,	110158,	95422,	103623,	87889,	77153,	46955,	21607,	17661,	41270,	96585,
SOPCOF %,	77,	95,	112,	103,	98,	93,	91,	91,	97,	90,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	3928,	794,	1050,	518,	3968,	12342,	13398,	3201,	1346,	2220,
4,	88297,	9031,	3951,	1174,	1967,	12652,	25092,	45937,	13510,	5953,
5,	52611,	50868,	12305,	1871,	1886,	2411,	13154,	34253,	74494,	34700,
6,	586,	19465,	23032,	4138,	2876,	1740,	2784,	8749,	21307,	74744,
7,	207,	382,	3423,	6754,	4442,	2070,	973,	1709,	3564,	11461,
8,	123,	65,	247,	851,	4422,	2619,	1297,	693,	386,	2395,
9,	74,	35,	11,	389,	398,	2737,	2131,	1200,	311,	370,
10,	119,	44,	36,	50,	21,	241,	2011,	1843,	470,	191,
11,	175,	142,	12,	3,	1,	12,	314,	1655,	347,	230,
12,	87,	135,	22,	3,	7,	4,	55,	281,	632,	173,
13,	4,	22,	17,	9,	2,	1,	9,	46,	40,	549,
+gp,	19,	11,	15,	15,	7,	1,	6,	2,	2,	8,
TOTALNUM,	146230,	80994,	44121,	15775,	19997,	36830,	61224,	99569,	116409,	132994,
TONSLAND,	150659,	91744,	55122,	25816,	33605,	53886,	77355,	121365,	138509,	173438,

Table 4.8

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:20

Table 2 Catch weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,
SOPCOFAC,	.7910,	.7910,	.8023,	.7531,	1.0074,	.8566,	.8267,	.8597,	.8093,	.6228,

Table 2 Catch weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	1.5200,	1.5700,	.9200,	.8600,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.8600,	1.9900,	1.6600,	1.2500,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	2.1000,	2.4200,	2.3900,	1.8800,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.6800,	2.7100,	2.4100,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.9300,	2.8900,	2.6600,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3700,	3.2200,	3.0400,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,
SOPCOFAC,	.7678,	.9477,	1.1247,	1.0321,	.9828,	.9337,	.9107,	.9105,	.9654,	.9013,

Table 2 Catch weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	.6400,	.5800,	.8000,	.8900,	.7700,	.8400,	.5900,	.5400,	.6300,	.7800,
4,	.8600,	.8400,	.8900,	1.2200,	1.3100,	1.3600,	1.0600,	.8800,	.6600,	.8200,
5,	1.3300,	1.0500,	1.1700,	1.4000,	1.6100,	1.7000,	1.5200,	1.3300,	1.0600,	1.0400,
6,	2.4500,	1.4300,	1.3700,	1.6000,	1.8600,	1.9600,	1.8400,	1.7400,	1.6800,	1.3500,
7,	2.9800,	1.9700,	1.7100,	1.7700,	2.1100,	2.2900,	2.1800,	2.0600,	2.1100,	1.8100,
8,	2.9800,	2.5200,	2.0100,	2.1600,	2.3400,	2.3900,	2.3000,	2.2000,	2.3400,	2.1200,
9,	3.7000,	3.7000,	3.7000,	3.7000,	2.9300,	2.3200,	2.5200,	2.5000,	2.6700,	2.3600,
10,	4.4100,	4.4100,	4.4100,	4.4100,	2.3400,	2.8800,	2.6400,	2.5800,	2.9100,	3.0400,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	3.1400,	3.1100,	2.8900,	3.0200,	2.4900,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	2.9200,	3.8000,	2.8200,	3.0700,	3.3500,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	2.2800,	2.8600,	3.2400,	2.7700,	2.7600,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	3.2900,	4.3100,	.0000,	3.1500,	3.1500,
SOPCOFAC,	.9825,	.9923,	.9617,	.9630,	.9581,	1.0132,	1.0093,	.9992,	1.0019,	.9992,

Table 4.9

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:20

Table 3 Stock weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,

Table 3 Stock weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.4400,	.2800,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	.8200,	.8200,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7800,	1.5300,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.4000,	2.2600,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.6900,	2.2600,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,

Table 3 Stock weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	.2400,	.2730,	.2840,	.2760,	.3890,	.3710,	.3040,	.2340,	.2060,	.2100,
4,	.4800,	.3900,	.4440,	.7170,	.7540,	.8150,	.8190,	.5450,	.3560,	.4510,
5,	.9300,	.6140,	.7040,	.9460,	1.4840,	1.5400,	1.4370,	1.0520,	.7960,	.6870,
6,	2.2200,	1.0980,	1.0190,	1.2670,	1.6220,	2.0720,	2.1150,	1.5360,	1.4400,	1.1260,
7,	2.8600,	1.5600,	1.4360,	1.5060,	1.6890,	2.3580,	2.3440,	1.9540,	1.9530,	1.8460,
8,	3.3300,	3.3300,	3.3300,	2.0040,	2.0470,	2.2450,	3.0450,	2.5090,	2.9130,	2.4300,
9,	3.7000,	3.7000,	3.7000,	3.7000,	2.6060,	2.7740,	3.3910,	2.3740,	2.9340,	2.8150,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.1980,	3.4000,	2.6210,	3.0330,	3.3230,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	4.2000,	3.1600,	3.6230,	3.4790,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,

Table 4.10

The SAS System 19:59 Thursday, August 28, 1997
HAD-ARCT: Haddock in the North-East Arctic (Areas I and II)

FLT23: Russian bottom trawl, total area, Nov-Dec, age 1-7, calendar

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1983	1	592	95	5	4	0	0	0
1984	1	586	584	15	2	1	0	0
1985	1	144	1343	900	4	1	1	0
1986	1	14	107	363	164	1	0	0
1987	1	9	17	83	225	57	0	0
1988	1	3	7	17	40	76	8	0
1989	1	18	24	4	14	41	81	11
1990	1	143	106	73	42	73	74	57
1991	1	429	176	62	9	3	6	18
1992	1	282	1286	346	50	4	6	9
1993	1	48	357	1985	356	48	8	4
1994	1	49	58	442	1014	116	15	1
1995	1	72	42	31	123	370	40	5
1996	1	23	57	28	49	362	334	29

The SAS System 19:59 Thursday, August 28, 1997
HAD-ARCT: Haddock in the North-East Arctic (Areas I and II)

FLT24: Russian acoustic survey, total area, Oct-Dec, age 1-7, calendar

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1985	1	4340	14680	6360	30	10	1	0
1986	1	370	2080	9170	9100	20	1	1
1987	1	160	290	620	1970	610	1	0
1988	1	10	30	180	830	3010	460	0
1989	1	320	940	20	140	350	670	90
1990	1	1760	750	280	170	230	430	440
1991	1	3680	1430	650	110	40	70	210
1992	1	2450	7580	2180	350	30	40	70
1993	1	260	1990	10760	2280	310	50	20
1994	1	510	390	2520	5910	760	90	1
1995	1	1700	790	720	2300	4040	410	50

The SAS System 19:59 Thursday, August 28, 1997
HAD-ARCT: Haddock in the North-East Arctic (Areas I and II)

FLT29: Norwegian trawl, catch and effort, ages 8 -13 (Catch: Thousands)

Year	Fishing effort	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13
1985	0.46	166	365	26	7	3	1
1986	0.60	57	142	236	27	23	2
1987	0.91	28	41	41	69	43	1
1988	1.07	16	1	8	79	54	8
1989	0.76	127	1	9	3	8	1
1990	0.57	149	3	0	0	1	1
1991	0.68	703	58	7	0	1	1
1992	0.46	394	599	96	2	2	0
1993	0.95	200	279	282	36	9	1
1994	1.03	209	214	497	224	64	16
1995	0.83	53	72	120	77	197	0
1996	0.69	160	19	4	12	3	15

Table 4.10 (Continued)

The SAS System 19:59 Thursday, August 28, 1997
HAD-ARCT: Haddock in the North-East Arctic (Areas I and II)

FLT30: Norway bottom trawl survey, Jan-Mar, age 1-7, shifted, reviced94 (Catch: Thousands)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1980	1	73	23	78	18	53	5	2
1981	1	15	17	18	19	48	24	2
1982	1	66	27	27	13	13	28	13
1983	1	6834	149	16	7	2	3	3
1984	1	13622	3848	63	4	2	3	3
1985	1	3602	3398	1268	45	5	1	1
1986	1	952	1741	2723	506	1	20	0
1987	1	161	288	674	1107	157	2	0
1988	1	7	9	154	269	274	29	0
1989	1	514	41	34	52	94	121	17
1990	1	4209	724	126	31	24	30	56
1991	1	11912	2835	599	41	9	13	51
1992	1	5851	4678	1056	103	5	5	22
1993	1	2003	2960	4482	508	32	2	11
1994	1	1820	426	1534	3416	313	20	5
1995	1	2659	532	489	1494	2559	116	10
1996	1	691	789	254	191	498	706	35

The SAS System 19:59 Thursday, August 28, 1997
HAD-ARCT: Haddock in the North-East Arctic (Areas I and II)

FLT31: Norway acoustic surv, Barents sea, Jan-Mar, age 1-7, shift, rev94 (Catch: Number)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1980	1	140	50	210	600	180	10	3
1981	1	20	30	40	40	100	60	3
1982	1	50	20	30	10	10	40	20
1983	1	1730	60	20	10	3	3	3
1984	1	8390	2740	60	3	3	3	10
1985	1	3120	4880	1620	3	3	3	3
1986	1	260	710	1900	470	3	3	3
1987	1	50	80	200	380	60	3	3
1988	1	60	80	100	170	190	20	3
1989	1	440	40	30	40	70	110	10
1990	1	2650	490	70	20	20	20	40
1991	1	6850	1100	190	20	3	3	10
1992	1	6900	5650	990	100	3	3	10
1993	1	2280	2400	5060	770	80	3	3
1994	1	2850	360	1130	3910	400	20	3
1995	1	2290	440	310	760	1500	80	10
1996	1	320	600	200	140	490	460	30

Table 4.11

Lowestoft VPA Version 3.1

27-Aug-97 20:11:41

Extended Survivors Analysis

Arctic Haddock (run: XSALOR10/X10)

CPUE data from file /users/fish/ifad/ifapwork/afwg/had_arct/FLEET.X10

Catch data for 47 years. 1950 to 1996. Ages 1 to 14.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT23: Russian botto,	1983,	1996,	1,	7,	.900,	1.000
FLT24: Russian acous,	1985,	1996,	1,	7,	.900,	1.000
FLT29: Norwegian tra,	1985,	1996,	8,	13,	.000,	1.000
FLT30: Norway bottom,	1980,	1996,	1,	7,	.990,	1.000
FLT31: Norway acoust,	1980,	1996,	1,	7,	.990,	1.000

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 >= 11

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 2 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 29 iterations

Regression weights

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

Fishing mortalities

Age,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996
1,	3.542,	.392,	.898,	.371,	.301,	1.474,	2.059,	1.624,	2.205,	2.342
2,	.003,	.030,	.007,	.347,	.058,	.156,	.395,	.595,	.833,	1.023
3,	.053,	.298,	.074,	.217,	.053,	.069,	.071,	.107,	.202,	.926
4,	.469,	.167,	.184,	.111,	.146,	.236,	.205,	.101,	.257,	.308
5,	.924,	.550,	.359,	.124,	.263,	.269,	.541,	.415,	.304,	.341
6,	.247,	1.161,	.517,	.196,	.284,	.414,	.571,	.640,	.490,	.382
7,	.562,	.252,	.637,	.278,	.333,	.341,	.431,	.862,	.589,	.523
8,	.652,	.341,	.257,	.315,	.296,	.335,	.373,	.633,	.474,	1.075
9,	.534,	.385,	.088,	.828,	.238,	.301,	.503,	.716,	.661,	1.235
10,	.380,	.720,	.893,	.712,	.089,	.221,	.379,	1.170,	.694,	1.214
11,	.577,	1.119,	.432,	.159,	.026,	.067,	.502,	.622,	.715,	.913
12,	.871,	1.329,	.494,	.180,	.674,	.136,	.491,	1.245,	.515,	1.011
13,	.490,	.561,	.557,	.385,	.176,	.184,	.511,	1.043,	.562,	1.256

Table 4.11 (Continued)

XSA population numbers (Thousands)

YEAR ,	1,	AGE 2,	3,	4,	5,	6,	7,	8,		
1987 ,	8.60E+05,	5.25E+04,	8.37E+04,	2.61E+05,	9.64E+04,	2.96E+03,	5.32E+02,	2.84E+02,	1.98E+02,	4.16E+02,
1988 ,	5.39E+04,	2.04E+04,	4.28E+04,	6.50E+04,	1.33E+05,	3.13E+04,	1.89E+03,	2.49E+02,	1.21E+02,	9.48E+01,
1989 ,	4.44E+05,	2.98E+04,	1.62E+04,	2.60E+04,	4.51E+04,	6.31E+04,	8.03E+03,	1.21E+03,	1.45E+02,	6.74E+01,
1990 ,	5.14E+05,	1.48E+05,	2.43E+04,	1.23E+04,	1.77E+04,	2.58E+04,	3.08E+04,	3.48E+03,	7.64E+02,	1.08E+02,
1991 ,	1.93E+06,	2.91E+05,	8.56E+04,	1.60E+04,	9.01E+03,	1.28E+04,	1.73E+04,	1.91E+04,	2.08E+03,	2.73E+02,
1992 ,	3.09E+06,	1.17E+06,	2.25E+05,	6.65E+04,	1.13E+04,	5.67E+03,	7.91E+03,	1.02E+04,	1.16E+04,	1.34E+03,
1993 ,	2.00E+06,	5.79E+05,	8.21E+05,	1.72E+05,	4.30E+04,	7.07E+03,	3.07E+03,	4.60E+03,	5.96E+03,	7.04E+03,
1994 ,	2.30E+06,	2.09E+05,	3.19E+05,	6.26E+05,	1.15E+05,	2.05E+04,	3.27E+03,	1.63E+03,	2.59E+03,	2.95E+03,
1995 ,	4.11E+06,	3.72E+05,	9.44E+04,	2.35E+05,	4.64E+05,	6.20E+04,	8.85E+03,	1.13E+03,	7.11E+02,	1.04E+03,
1996 ,	1.96E+06,	3.71E+05,	1.32E+05,	6.32E+04,	1.49E+05,	2.80E+05,	3.11E+04,	4.02E+03,	5.77E+02,	3.00E+02,

Estimated population abundance at 1st Jan 1997

, .00E+00, 1.55E+05, 1.09E+05, 4.29E+04, 3.80E+04, 8.66E+04, 1.57E+05, 1.51E+04, 1.12E+03, 1.37E+02,

Taper weighted geometric mean of the VPA populations:

, 8.83E+05, 1.65E+05, 8.62E+04, 5.47E+04, 3.22E+04, 1.42E+04, 5.04E+03, 2.04E+03, 9.82E+02, 5.07E+02,

Standard error of the weighted Log(VPA populations) :

, 1.5786, 1.4882, 1.4626, 1.5521, 1.6320, 1.5829, 1.3041, 1.3128, 1.4144, 1.4354,

YEAR ,	11,	AGE 12,	13,
1987 ,	4.41E+02,	1.65E+02,	1.14E+01,
1988 ,	2.33E+02,	2.03E+02,	5.67E+01,
1989 ,	3.78E+01,	6.24E+01,	4.40E+01,
1990 ,	2.26E+01,	2.01E+01,	3.11E+01,
1991 ,	4.36E+01,	1.58E+01,	1.37E+01,
1992 ,	2.05E+02,	3.48E+01,	6.58E+00,
1993 ,	8.80E+02,	1.57E+02,	2.49E+01,
1994 ,	3.95E+03,	4.36E+02,	7.85E+01,
1995 ,	7.50E+02,	1.73E+03,	1.03E+02,
1996 ,	4.25E+02,	3.00E+02,	8.48E+02,

Estimated population abundance at 1st Jan 1997

, 7.31E+01, 1.40E+02, 8.95E+01,

Taper weighted geometric mean of the VPA populations:

, 2.38E+02, 1.12E+02, 3.93E+01,

Standard error of the weighted Log(VPA populations) :

, 1.5124, 1.4489, 1.4443,

Log catchability residuals.

Fleet : FLT23: Russian botto

Age	1980	1981	1982	1983	1984	1985	1986
1	99.99	99.99	99.99	1.87	1.19	.29	-.01
2	99.99	99.99	99.99	2.46	.89	1.13	.28
3	99.99	99.99	99.99	.59	.77	.96	-.20
4	99.99	99.99	99.99	.12	-.06	-.31	.09
5	99.99	99.99	99.99	99.99	-.16	.30	-.70
6	99.99	99.99	99.99	99.99	99.99	-.26	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	No data for this fleet at this age						
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						

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	.37	-.57	-.62	.67	.28	.44	-.23	-.73	-.45	-.63
2	-.76	-.66	.14	.31	-.14	.51	.18	-.39	-1.07	-.59
3	.00	-.48	-.91	1.26	-.27	.24	.42	.12	-.83	-.68
4	.06	-.42	-.47	1.24	-.42	-.18	.67	.25	-.59	-.08
5	-.01	-.39	.06	1.27	-.48	-.47	.37	.00	-.56	.58
6	99.99	-.60	.40	.90	-.83	.11	.32	-.05	-.31	.20
7	99.99	99.99	.52	.48	-.05	.05	.27	-.77	-.41	.02
8	No data for this fleet at this age									
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									

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

Age	6	7
Mean Log q	-6.3758	-6.3141
S.E(Log q)	.5134	.4371

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	.91	.480	8.81	.75	14	.70	-8.30
2	.98	.110	7.14	.74	14	.82	-7.03
3	.85	.956	7.39	.81	14	.72	-6.65
4	.93	.643	6.91	.89	14	.55	-6.60
5	.79	1.770	7.41	.89	13	.60	-6.61

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	.95	.374	6.55	.89	10	.52	-6.38
7	.85	.947	6.75	.87	8	.37	-6.31

Table 4.11 (Continued)

Fleet : FLT24: Russian acous

Age	1980	1981	1982	1983	1984	1985	1986
1	99.99	99.99	99.99	99.99	99.99	.89	.74
2	99.99	99.99	99.99	99.99	99.99	1.17	.92
3	99.99	99.99	99.99	99.99	99.99	.56	.40
4	99.99	99.99	99.99	99.99	99.99	-.36	1.45
5	99.99	99.99	99.99	99.99	99.99	.34	-.10
6	99.99	99.99	99.99	99.99	99.99	-1.92	-1.60
7	99.99	99.99	99.99	99.99	99.99	99.99	-1.05
8	No data for this fleet at this age						
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						

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	.71	-.75	.04	.77	-.06	-.01	-.81	-.76	-.05	99.99
2	-.08	-1.21	1.58	.07	-.27	-.03	-.35	-.67	-.38	99.99
3	-.01	-.05	-.78	.78	.00	-.09	-.26	-.32	.08	99.99
4	-.18	.23	-.36	.50	-.11	-.48	.15	-.42	-.12	99.99
5	.14	.81	.02	.44	-.19	-.64	.11	-.24	-.38	99.99
6	-2.86	1.78	.85	.99	-.04	.34	.49	.08	.35	99.99
7	99.99	99.99	.94	.85	.73	.43	.21	-2.44	.21	99.99
8	No data for this fleet at this age									
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									

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

Age	6	7
Mean Log q	-4.7114	-4.6407
S.E(Log q)	1.3087	1.1820

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	.73	1.423	8.05	.79	11	.68	-5.92
2	.93	.331	5.36	.72	11	.86	-4.81
3	.71	2.360	6.61	.90	11	.46	-4.51
4	.85	1.119	5.29	.88	11	.56	-4.25
5	.81	2.044	5.59	.94	11	.44	-4.41

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	.57	3.157	6.71	.88	11	.52	-4.71
7	.59	1.956	6.35	.81	8	.58	-4.64

Fleet : FLT29: Norwegian tra

Age	1980	1981	1982	1983	1984	1985	1986
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	99.99	99.99	99.99	99.99	99.99	.93	1.04
9	99.99	99.99	99.99	99.99	99.99	1.79	1.67
10	99.99	99.99	99.99	99.99	99.99	-.24	1.44
11	99.99	99.99	99.99	99.99	99.99	.47	.49
12	99.99	99.99	99.99	99.99	99.99	1.34	2.50
13	99.99	99.99	99.99	99.99	99.99	1.79	1.22

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	.32	-.40	.39	-.19	-.53	-.07	-.66	.45	-.41	-.13
9	1.47	-1.98	-1.95	-1.90	-.38	.66	-.07	.51	.90	.20
10	.09	-.08	.79	99.99	-1.10	.38	-.86	.83	.48	-1.29
11	.75	1.59	.19	99.99	99.99	-1.57	-.67	-.37	.48	-.54
12	1.38	1.42	.70	-.11	.18	.23	-.33	.84	.49	-1.54
13	.13	.48	-1.01	-.45	.10	99.99	-.68	1.08	99.99	-.88

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

Age	8	9	10	11	12	13
Mean Log q	-2.1494	-2.6067	-2.0337	-2.1474	-2.1474	-2.1474
S.E(Log q)	.5322	1.3323	.8747	.9083	1.1344	.9293

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
8	1.21	-1.416	1.02	.85	12	.61	-2.15
9	.73	1.290	3.78	.73	12	.94	-2.61
10	.97	.152	2.18	.74	11	.90	-2.03
11	1.13	-.437	1.64	.62	10	1.09	-2.15
12	1.06	-.257	1.48	.65	12	1.14	-1.67
13	1.44	-1.436	1.40	.62	10	1.25	-2.07

Table 4.11 (Continued)

Fleet : FLT30: Norway bottom

Age	1980	1981	1982	1983	1984	1985	1986
1	1.24	.60	1.01	1.05	.77	.12	.82
2	.47	-.11	.77	1.42	.57	-.09	.80
3	-.10	-.18	-.12	-.03	.46	-.07	.26
4	-2.35	-.54	.45	-.22	-.23	.93	-.06
5	-.07	-.41	.34	.32	.14	1.25	-.90
6	-.03	.41	.06	-.88	.38	-.58	2.73
7	.31	-.28	.26	-1.89	-.66	-.30	99.99
8	No data for this fleet at this age						
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						

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	.15	-1.70	-.28	.74	.13	.00	.07	-.46	-.33	-.49
2	.39	-1.30	-.54	.33	.48	-.45	.08	-.24	-.46	-.01
3	.40	-.05	-.66	.26	.27	-.16	-.13	-.13	.13	-.15
4	.28	.21	-.26	-.01	-.01	-.57	-.19	.04	.45	.06
5	.18	-.02	.17	-.05	.03	-.61	-.43	.14	.16	.15
6	-.84	.38	.47	-.35	-.40	-.41	-1.39	-.08	.42	.61
7	99.99	99.99	.37	-.14	.39	.35	.69	.27	-.31	-.38
8	No data for this fleet at this age									
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									

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

Age	6	7
Mean Log q	-6.0143	-5.6916
S.E(Log q)	.9209	.5706

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	.74	1.859	7.33	.83	17	.72	-5.04
2	.77	1.778	6.75	.86	17	.64	-5.17
3	.91	1.393	5.56	.96	17	.30	-5.01
4	.85	1.722	6.23	.93	17	.45	-5.40
5	.72	3.269	7.23	.93	17	.47	-5.98

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	.95	.272	6.18	.77	17	.92	-6.01
7	1.09	-.442	5.40	.76	14	.65	-5.69

Table 4.11 (Continued)

Fleet : FLT31: Norway acoust

Age	1980	1981	1982	1983	1984	1985	1986
1	1.44	.30	.41	.07	.73	.26	-.05
2	.97	.19	.37	.64	.56	.47	.35
3	1.08	.81	.23	.43	.68	.45	.24
4	.77	.47	.73	.56	.12	-.76	.03
5	.93	.23	.20	.63	.44	.90	-.10
6	.91	1.57	.67	-.63	.63	.77	1.08
7	.89	.30	.87	-1.71	.72	.97	1.31
8	No data for this fleet at this age						
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						

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	-.69	-.45	-.42	.52	-.06	.48	.47	.14	-.13	-.95
2	-.65	.32	-.67	.15	-.08	.00	.18	-.25	-.45	-.02
3	-.43	-.18	-.52	-.01	-.50	.08	.29	-.12	-.01	-.08
4	-.46	.08	-.10	.07	-.17	-.30	.29	.16	.01	.07
5	-.40	-.15	.05	-.12	-.74	-.97	.33	.45	-.05	.29
6	-.18	.26	.63	-.50	-1.61	-.67	-.73	.17	.30	.43
7	1.45	-.13	.01	-.30	-1.06	-.27	-.43	-.07	-.13	-.36
8	No data for this fleet at this age									
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									

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

Age	6	7
Mean Log q	-6.2669	-5.8684
S.E(Log q)	.7741	.7714

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	1.373	6.45	.90	17	.54	-5.21
2	.85	1.723	6.31	.93	17	.42	-5.32
3	.92	.956	5.77	.94	17	.38	-5.32
4	.76	3.624	6.96	.96	17	.34	-5.74
5	.74	2.630	7.21	.91	17	.53	-6.10

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	.191	6.36	.82	17	.79	-6.27
7	1.78	-3.525	3.78	.67	17	.96	-5.87

Table 4.11 (Continued)

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	81981.,	.732,	.000,	.00,	1,	.085,	2.930
FLT24: Russian acous,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	94969.,	.755,	.000,	.00,	1,	.080,	2.792
FLT31: Norway acoust,	59577.,	.564,	.000,	.00,	1,	.144,	3.235
P shrinkage mean ,	164955.,	1.49,,,,				.215,	2.284
F shrinkage mean ,	243579.,	1.00,,,,				.476,	1.941

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
154569.,	.59,	.46,	5,	.782,	2.342

Age 2 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	61748.,	.753,	.045,	.06,	2,	.115,	1.424
FLT24: Russian acous,	103629.,	.742,	.000,	.00,	1,	.015,	1.057
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	105560.,	.625,	.087,	.14,	2,	.175,	1.045
FLT31: Norway acoust,	106261.,	.419,	.025,	.06,	2,	.395,	1.041
P shrinkage mean ,	86236.,	1.46,,,,				.096,	1.181
F shrinkage mean ,	184394.,	1.00,,,,				.204,	.721

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
109353.,	.33,	.12,	9,	.365,	1.023

Age 3 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	19886.,	.566,	.116,	.20,	3,	.094,	1.457
FLT24: Russian acous,	26755.,	.706,	.162,	.23,	2,	.026,	1.238
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	35781.,	.289,	.065,	.23,	3,	.421,	1.040
FLT31: Norway acoust,	36181.,	.308,	.119,	.38,	3,	.325,	1.033
P shrinkage mean ,	54699.,	1.55,,,,				.039,	.787
F shrinkage mean ,	390949.,	1.00,,,,				.094,	.155

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
42934.,	.20,	.23,	13,	1.135,	.926

Table 4.11 (Continued)

Age 4 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	27327.,	.410,	.189,	.46,	4,	.126,	.407
FLT24: Russian acous,	36419.,	.422,	.198,	.47,	3,	.103,	.320
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	41154.,	.246,	.053,	.22,	4,	.341,	.288
FLT31: Norway acoust,	38051.,	.232,	.067,	.29,	4,	.385,	.308
P shrinkage mean ,	32163.,	1.63,,,,				.012,	.355
F shrinkage mean ,	69610.,	1.00,,,,				.033,	.180

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
37997.,	.15,	.06,	17,	.417,	.308

Age 5 Catchability dependent on age and year class strength

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	90976.,	.350,	.249,	.71,	5,	.145,	.327
FLT24: Russian acous,	68313.,	.342,	.063,	.18,	4,	.131,	.416
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	93855.,	.227,	.114,	.50,	5,	.333,	.319
FLT31: Norway acoust,	92131.,	.218,	.079,	.36,	5,	.347,	.324
P shrinkage mean ,	14189.,	1.58,,,,				.013,	1.248
F shrinkage mean ,	80820.,	1.00,,,,				.032,	.362

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
86554.,	.13,	.08,	21,	.578,	.341

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	175365.,	.295,	.152,	.51,	6,	.192,	.347
FLT24: Russian acous,	115748.,	.281,	.063,	.23,	5,	.177,	.488
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	157435.,	.225,	.110,	.49,	6,	.285,	.380
FLT31: Norway acoust,	181191.,	.212,	.070,	.33,	6,	.315,	.338
F shrinkage mean ,	94826.,	1.00,,,,				.032,	.569

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
156586.,	.12,	.06,	24,	.488,	.382

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	15617.,	.268,	.115,	.43,	7,	.266,	.509
FLT24: Russian acous,	14711.,	.266,	.129,	.48,	6,	.136,	.534
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	13992.,	.225,	.122,	.54,	7,	.281,	.555
FLT31: Norway acoust,	17232.,	.213,	.111,	.52,	7,	.271,	.471
F shrinkage mean ,	9599.,	1.00,,,,				.046,	.733

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
15086.,	.13,	.06,	28,	.470,	.523

Table 4.11 (Continued)

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	896.,	.288,	.105,	.37,	7,	.216,	1.230
FLT24: Russian acous,	1125.,	.301,	.089,	.30,	7,	.106,	1.074
FLT29: Norwegian tra,	984.,	.557,	.000,	.00,	1,	.146,	1.164
FLT30: Norway bottom,	954.,	.248,	.129,	.52,	7,	.210,	1.185
FLT31: Norway acoust,	991.,	.236,	.115,	.49,	7,	.190,	1.159
F shrinkage mean ,	2902.,	1.00,,,,				.132,	.558

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1123.,	.18,	.09,	30,	.472,	1.075

Age 9 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
FLT23: Russian botto,	97.,	.274,	.232,	.85,	7,	.167,	1.489
FLT24: Russian acous,	106.,	.293,	.429,	1.46,	7,	.092,	1.423
FLT29: Norwegian tra,	103.,	.527,	.244,	.46,	2,	.169,	1.444
FLT30: Norway bottom,	124.,	.234,	.214,	.92,	7,	.175,	1.306
FLT31: Norway acoust,	97.,	.223,	.140,	.63,	7,	.167,	1.495
F shrinkage mean ,	334.,	1.00,,,,				.230,	.695

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
137.,	.26,	.14,	31,	.523,	1.235

Age 10 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
FLT23: Russian botto,	87.,	.273,	.215,	.79,	7,	.145,	1.091
FLT24: Russian acous,	64.,	.311,	.204,	.65,	7,	.080,	1.311
FLT29: Norwegian tra,	50.,	.536,	.659,	1.23,	3,	.189,	1.496
FLT30: Norway bottom,	66.,	.236,	.235,	1.00,	7,	.157,	1.289
FLT31: Norway acoust,	57.,	.226,	.155,	.69,	7,	.155,	1.398
F shrinkage mean ,	110.,	1.00,,,,				.273,	.942

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
73.,	.30,	.12,	32,	.386,	1.214

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	127.,	.269,	.270,	1.01,	7,	.132,	.971
FLT24: Russian acous,	160.,	.297,	.132,	.44,	7,	.084,	.832
FLT29: Norwegian tra,	108.,	.524,	.284,	.54,	4,	.237,	1.074
FLT30: Norway bottom,	141.,	.229,	.101,	.44,	7,	.148,	.909
FLT31: Norway acoust,	99.,	.224,	.179,	.80,	7,	.146,	1.130
F shrinkage mean ,	216.,	1.00,,,,				.253,	.675

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
140.,	.29,	.09,	33,	.316,	.913

Table 4.11 (Continued)

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

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	106.,	.279,	.182,	.65,	7,	.078,	.908
FLT24: Russian acous,	110.,	.307,	.131,	.43,	7,	.047,	.886
FLT29: Norwegian tra,	59.,	.602,	.494,	.82,	5,	.270,	1.301
FLT30: Norway bottom,	118.,	.240,	.086,	.36,	7,	.084,	.846
FLT31: Norway acoust,	69.,	.241,	.171,	.71,	7,	.077,	1.180
F shrinkage mean ,	109.,	1.00,,,,				.444,	.890

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
89.,	.47,	.11,	34,	.235,	1.011

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	281.,	.318,	.119,	.37,	7,	.086,	1.019
FLT24: Russian acous,	370.,	.396,	.171,	.43,	6,	.033,	.851
FLT29: Norwegian tra,	123.,	.489,	.238,	.49,	6,	.314,	1.615
FLT30: Norway bottom,	208.,	.315,	.091,	.29,	7,	.069,	1.219
FLT31: Norway acoust,	188.,	.300,	.166,	.55,	7,	.062,	1.292
F shrinkage mean ,	247.,	1.00,,,,				.438,	1.103

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
198.,	.47,	.09,	34,	.190,	1.256

Table 4.12

Run title : Arctic Haddock (run: XSALOR10/X10)

At 27-Aug-97 20:12:57

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	.0000,	.0000,	.0000,	.0003,	.0000,	.0017,	.0000,	.0034,	.0080,	.0136,
2,	.0024,	.0017,	.0058,	.0026,	.0031,	.0307,	.0942,	.0662,	.0673,	.0571,
3,	.0619,	.0369,	.1015,	.1663,	.0229,	.2844,	.3355,	.2199,	.2562,	.3190,
4,	.3032,	.4022,	.1474,	.2316,	.2666,	.3824,	.6008,	.3415,	.5747,	.6498,
5,	.4252,	.5648,	.5076,	.2042,	.1817,	1.0679,	.9526,	.4193,	.5171,	.6132,
6,	.4945,	.4642,	.5550,	.5092,	.1460,	.9646,	.4685,	.6385,	.4446,	.7085,
7,	.5020,	.6417,	.4099,	.4779,	.4188,	.4094,	.3011,	.5789,	.5106,	.8005,
8,	.5559,	.6438,	.4261,	.4129,	.3393,	.6184,	.1776,	.4964,	.3370,	.6450,
9,	.3452,	.4586,	.4136,	.3020,	.3028,	.5529,	.3023,	.4260,	.2096,	.7647,
10,	.2901,	.5453,	.4182,	.3280,	.2575,	.6332,	.1984,	.7421,	.1479,	.9097,
11,	.5455,	.2708,	.2348,	.4068,	.2758,	.4158,	.1946,	.6491,	.3989,	.5382,
12,	.9341,	1.0711,	.1764,	.2175,	.6543,	.8336,	.2431,	.6788,	.1929,	1.5173,
13,	.5385,	.6031,	.3359,	.3355,	.3683,	.6162,	.2243,	.6037,	.2586,	.8843,
+gp,	.5385,	.6031,	.3359,	.3355,	.3683,	.6162,	.2243,	.6037,	.2586,	.8843,
FBAR 4- 7,	.4312,	.5182,	.4050,	.3558,	.2533,	.7061,	.5807,	.4945,	.5118,	.6930,

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	.0010,	.0018,	.0000,	.0000,	.0002,	.0002,	.0000,	.9536,	1.3674,	2.3608,
2,	.0927,	.0135,	.0023,	.0000,	.0076,	.0055,	.0158,	.0539,	.0144,	1.2871,
3,	.7673,	.3628,	.1546,	.0371,	.0991,	.1297,	.1787,	.0676,	.1345,	.3751,
4,	1.2842,	.6420,	.5081,	.3098,	.2089,	.2687,	.4617,	.3361,	.1990,	.4555,
5,	.9476,	.8913,	.9734,	.6922,	.5602,	.4677,	.4617,	.3717,	.3809,	.2696,
6,	.4987,	.4521,	.9569,	.8243,	.9104,	.7050,	.3521,	.2862,	.6353,	.4942,
7,	.6374,	.6862,	.5245,	.4196,	.7857,	.5900,	.4100,	.3382,	.5389,	.7437,
8,	.5330,	.4514,	.5183,	.7399,	.5320,	.6639,	.4139,	.5523,	.5233,	.5066,
9,	.3229,	.6615,	.5001,	.4299,	.5624,	.5061,	.1912,	.4230,	.7445,	.4955,
10,	.5161,	.2777,	.5546,	.6074,	.2299,	.6075,	.5058,	.4252,	.7681,	.6894,
11,	2.3164,	.7954,	.5742,	.7116,	.5109,	.5091,	.4621,	.7838,	.6204,	.4780,
12,	.3770,	.4290,	.6942,	.8699,	.7987,	1.5596,	.2071,	2.2138,	.3434,	1.3280,
13,	.8215,	.5272,	.5731,	.6780,	.5310,	.7769,	.3583,	.8890,	.3237,	.3571,
+gp,	.8215,	.5272,	.5731,	.6780,	.5310,	.7769,	.3583,	.8890,	.3237,	.3571,
FBAR 4- 7,	.8420,	.6679,	.7407,	.5614,	.6163,	.5078,	.4214,	.3330,	.4385,	.4907,

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	FBAR 94-96
AGE											
1,	3.5424,	.3916,	.8984,	.3709,	.3006,	1.4741,	2.0587,	1.6239,	2.2050,	2.3423,	2.0571,
2,	.0032,	.0301,	.0067,	.3474,	.0575,	.1557,	.3950,	.5949,	.8328,	1.0227,	.8168,
3,	.0532,	.2975,	.0744,	.2174,	.0526,	.0685,	.0713,	.1067,	.2019,	.9264,	.4117,
4,	.4691,	.1667,	.1835,	.1114,	.1463,	.2361,	.2046,	.1006,	.2574,	.3081,	.2221,
5,	.9242,	.5499,	.3593,	.1239,	.2630,	.2689,	.5414,	.4150,	.3038,	.3414,	.3534,
6,	.2467,	1.1610,	.5170,	.1955,	.2845,	.4139,	.5712,	.6397,	.4896,	.3816,	.5036,
7,	.5617,	.2521,	.6369,	.2777,	.3328,	.3415,	.4311,	.8618,	.5892,	.5232,	.6581,
8,	.6524,	.3411,	.2567,	.3153,	.2957,	.3346,	.3732,	.6326,	.4736,	1.0750,	.7271,
9,	.5344,	.3854,	.0878,	.8279,	.2379,	.3013,	.5025,	.7159,	.6611,	1.2353,	.8708,
10,	.3798,	.7197,	.8932,	.7120,	.0888,	.2215,	.3791,	1.1700,	.6939,	1.2136,	1.0258,
11,	.5768,	1.1186,	.4323,	.1588,	.0257,	.0670,	.5017,	.6224,	.7154,	.9128,	.7502,
12,	.8711,	1.3288,	.4942,	.1805,	.6745,	.1360,	.4909,	1.2452,	.5153,	1.0115,	.9240,
13,	.4896,	.5607,	.5570,	.3848,	.1756,	.1840,	.5112,	1.0427,	.5623,	1.2562,	.9537,
+gp,	.4896,	.5607,	.5570,	.3848,	.1756,	.1840,	.5112,	1.0427,	.5623,	1.2562,	
FBAR 4- 7,	.5504,	.5324,	.4242,	.1771,	.2566,	.3151,	.4371,	.5043,	.4100,	.3886,	

Table 4.13

Run title : Arctic Haddock (run: XSALOR10/X10)

At 27-Aug-97 20:12:57

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	26006,	248988,	144604,	1538754,	418728,	88999,	78238,	90638,	183815,	285138,
2,	24567,	21292,	203854,	118392,	1259392,	342812,	72746,	64056,	73954,	149300,
3,	293297,	20066,	17402,	165944,	96682,	1027905,	272193,	54206,	49085,	56607,
4,	174808,	225729,	15834,	12873,	115049,	77366,	633268,	159329,	35618,	31106,
5,	43089,	105684,	123615,	11188,	8360,	72153,	43214,	284328,	92714,	16414,
6,	72902,	23058,	49187,	60919,	7468,	5707,	20305,	13648,	153061,	45260,
7,	24860,	36400,	11868,	23119,	29973,	5283,	1781,	10405,	5901,	80336,
8,	4191,	12321,	15687,	6449,	11737,	16144,	2872,	1079,	4775,	2899,
9,	825,	1968,	5299,	8387,	3494,	6844,	7122,	1969,	538,	2791,
10,	768,	479,	1019,	2869,	5077,	2113,	3224,	4310,	1053,	357,
11,	407,	470,	227,	549,	1692,	3213,	918,	2164,	1680,	744,
12,	137,	193,	294,	147,	299,	1051,	1736,	619,	926,	923,
13,	72,	44,	54,	202,	97,	127,	374,	1114,	257,	625,
+gp,	37,	125,	35,	169,	28,	159,	148,	487,	1128,	630,
TOTAL,	665965,	696818,	588980,	1949962,	1958075,	1649876,	1138139,	688353,	604504,	673129,

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	204818,	28509,	8494,	12058,	7134,	13985,	408482,	1819165,	1776256,	679473,
2,	230306,	167524,	23300,	6954,	9872,	5840,	11448,	334437,	573973,	370497,
3,	115453,	171859,	135318,	19033,	5693,	8021,	4755,	9227,	259443,	463198,
4,	33689,	43884,	97898,	94918,	15015,	4222,	5768,	3256,	7060,	185678,
5,	13298,	7636,	18908,	48220,	57011,	9976,	2642,	2976,	1905,	4737,
6,	7279,	4221,	2564,	5848,	19759,	26658,	5117,	1363,	1680,	1066,
7,	18245,	3619,	2199,	806,	2100,	6509,	10784,	2946,	838,	729,
8,	29540,	7897,	1492,	1065,	434,	784,	2954,	5860,	1720,	400,
9,	1246,	14193,	4117,	727,	416,	209,	330,	1599,	2762,	834,
10,	1064,	738,	5997,	2044,	387,	194,	103,	223,	858,	1074,
11,	118,	520,	458,	2820,	912,	252,	87,	51,	120,	326,
12,	355,	10,	192,	211,	1133,	448,	124,	45,	19,	53,
13,	166,	200,	5,	79,	72,	417,	77,	83,	4,	11,
+gp,	190,	174,	133,	33,	111,	69,	331,	342,	226,	26,
TOTAL,	655766,	450984,	301072,	194817,	120052,	77585,	453004,	2181572,	2626862,	1708101,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	GMST
AGE												
1,	860058,	53886,	443848,	514463,	1933634,	3088165,	2000453,	2304962,	4114336,	1964369,	0,	2205
2,	52487,	20381,	29821,	147986,	290687,	1172149,	578942,	209025,	372010,	371391,	154569,	1299
3,	83742,	42833,	16193,	24253,	85606,	224685,	821344,	319329,	94398,	132434,	109353,	973
4,	260605,	65008,	26044,	12307,	15977,	66498,	171776,	626152,	234995,	63156,	42934,	672
5,	96400,	133471,	45052,	17748,	9014,	11301,	42996,	114613,	463574,	148730,	37997,	368
6,	2962,	31321,	63051,	25752,	12838,	5674,	7071,	20486,	61966,	280115,	86554,	172
7,	532,	1895,	8031,	30781,	17339,	7908,	3071,	3270,	8847,	31092,	156586,	80
8,	284,	249,	1206,	3478,	19090,	10177,	4602,	1634,	1131,	4018,	15086,	37
9,	198,	121,	145,	764,	2077,	11629,	5963,	2594,	711,	577,	1123,	18
10,	416,	95,	67,	108,	273,	1341,	7044,	2953,	1038,	300,	137,	8
11,	441,	233,	38,	23,	44,	205,	880,	3948,	750,	425,	73,	4
12,	165,	203,	62,	20,	16,	35,	157,	436,	1735,	300,	140,	1
13,	11,	57,	44,	31,	14,	7,	25,	79,	103,	848,	89,	
+gp,	54,	28,	38,	51,	48,	7,	16,	3,	5,	12,	201,	
TOTAL,	1358355,	349780,	633640,	777765,	2386659,	4599777,	3644339,	3609484,	5355595,	2997769,	604841,	

Table 4.14

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:21

Table 4 Natural Mortality (M) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2110,	.2000,	.5019,
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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	.2000,	.4738,	.2000,	.3911,	.2000,	.2057,	.2527,	.2950,	.3845,	1.0980,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2261,	.2154,	.3854,	.3871,
5,	.2000,	.2024,	.2000,	.2000,	.2000,	.2000,	.3035,	.2114,	.2978,	.2370,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2007,	.2090,	.2269,
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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4.15

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:21

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	.0623,	.0370,	.1024,	.1677,	.0231,	.2856,	.3364,	.2211,	.2579,	.3227,
4,	.3042,	.4029,	.1478,	.2334,	.2689,	.3846,	.6004,	.3427,	.5748,	.6510,
5,	.4253,	.5645,	.5080,	.2047,	.1836,	1.0625,	.9490,	.4204,	.5180,	.6128,
6,	.4947,	.4640,	.5546,	.5097,	.1466,	.9623,	.4693,	.6378,	.4462,	.7078,
7,	.5022,	.6399,	.4101,	.4782,	.4202,	.4093,	.3036,	.5791,	.5110,	.7988,
8,	.5554,	.6422,	.4260,	.4132,	.3405,	.6192,	.1783,	.5003,	.3387,	.6438,
9,	.3455,	.4589,	.4137,	.3025,	.3037,	.5533,	.3047,	.4261,	.2131,	.7638,
10,	.2902,	.5437,	.4190,	.3288,	.2584,	.6316,	.1999,	.7445,	.1487,	.9200,
11,	.5473,	.2710,	.2351,	.4080,	.2769,	.4164,	.1954,	.6499,	.4039,	.5378,
12,	.9309,	1.0635,	.1769,	.2179,	.6540,	.8280,	.2444,	.6755,	.1949,	1.5091,
13,	.5385,	.6031,	.3359,	.3355,	.3683,	.6162,	.2243,	.6037,	.2586,	.8843,
+gp,	.5385,	.6031,	.3359,	.3355,	.3683,	.6162,	.2243,	.6037,	.2586,	.8843,
FBAR 4- 7,	.4316,	.5178,	.4051,	.3565,	.2548,	.7047,	.5806,	.4950,	.5125,	.6926,

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	.7674,	.3641,	.1555,	.0373,	.0996,	.1305,	.1793,	.0568,	.1358,	.0734,
4,	1.2793,	.6439,	.5096,	.3111,	.2097,	.2694,	.4623,	.3367,	.1998,	.4584,
5,	.9442,	.8902,	.9715,	.6928,	.5607,	.4677,	.4617,	.3731,	.3815,	.2705,
6,	.4993,	.4534,	.9524,	.8233,	.9071,	.7040,	.3529,	.2872,	.6357,	.4943,
7,	.6371,	.6849,	.5262,	.4202,	.7845,	.5897,	.4114,	.3394,	.5387,	.7426,
8,	.5339,	.4528,	.5183,	.7405,	.5321,	.6636,	.4150,	.5537,	.5240,	.5066,
9,	.3240,	.6616,	.5021,	.4307,	.5655,	.5064,	.1927,	.4246,	.7449,	.4969,
10,	.5176,	.2792,	.5560,	.6100,	.2313,	.6129,	.5063,	.4277,	.7670,	.6908,
11,	2.2928,	.7944,	.5752,	.7123,	.5158,	.5107,	.4706,	.7801,	.6238,	.4796,
12,	.3777,	.4298,	.6940,	.8668,	.7985,	1.5449,	.2092,	2.1888,	.3435,	1.3183,
13,	.8215,	.5272,	.5731,	.6780,	.5310,	.7769,	.3583,	.8890,	.3237,	.3571,
+gp,	.8215,	.5272,	.5731,	.6780,	.5310,	.7769,	.3583,	.8890,	.3237,	.3571,
FBAR 4- 7,	.8400,	.6681,	.7399,	.5618,	.6155,	.5077,	.4221,	.3341,	.4389,	.4914,

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	FBAR 94-96
AGE											
3,	.0536,	.0237,	.0748,	.0264,	.0530,	.0632,	.0188,	.0117,	.0174,	.0284,	.0192,
4,	.4693,	.1675,	.1842,	.1121,	.1474,	.2376,	.1793,	.0856,	.0722,	.1210,	.0929,
5,	.9246,	.5471,	.3601,	.1246,	.2642,	.2708,	.4391,	.4041,	.2062,	.3044,	.3049,
6,	.2479,	1.1547,	.5166,	.1967,	.2856,	.4153,	.5735,	.6406,	.4808,	.3547,	.4920,
7,	.5611,	.2536,	.6360,	.2786,	.3345,	.3429,	.4331,	.8626,	.5926,	.5232,	.6595,
8,	.6519,	.3421,	.2587,	.3166,	.2969,	.3370,	.3752,	.6349,	.4782,	1.0750,	.7294,
9,	.5342,	.3869,	.0885,	.8269,	.2395,	.3028,	.5061,	.7166,	.6653,	1.2353,	.8724,
10,	.3823,	.7158,	.8884,	.7099,	.0898,	.2234,	.3812,	1.1667,	.6956,	1.2136,	1.0253,
11,	.5805,	1.1113,	.4308,	.1595,	.0259,	.0678,	.5051,	.6248,	.7178,	.9128,	.7518,
12,	.8682,	1.3200,	.4935,	.1805,	.6707,	.1367,	.4944,	1.2376,	.5200,	1.0115,	.9231,
13,	.4896,	.5607,	.5570,	.3848,	.1756,	.1840,	.5112,	1.0427,	.5623,	1.2562,	.9537,
+gp,	.4896,	.5607,	.5570,	.3848,	.1756,	.1840,	.5112,	1.0427,	.5623,	1.2562,	
FBAR 4- 7,	.5508,	.5307,	.4242,	.1780,	.2579,	.3166,	.4062,	.4982,	.3379,	.3258,	

Table 4.16

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:21

Traditional vpa using file input for terminal F

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	290555,	19932,	17204,	163910,	95481,	1017727,	269620,	53662,	48502,	55669,
4,	173138,	223523,	15726,	12715,	113476,	76387,	626266,	157681,	35219,	30682,
5,	42706,	104568,	122318,	11107,	8243,	71000,	42574,	281290,	91641,	16229,
6,	72170,	22851,	48682,	60260,	7410,	5617,	20089,	13494,	151259,	44694,
7,	24606,	36029,	11763,	22890,	29634,	5239,	1757,	10287,	5838,	79265,
8,	4148,	12192,	15555,	6391,	11617,	15938,	2849,	1062,	4720,	2868,
9,	819,	1949,	5252,	8318,	3462,	6767,	7025,	1951,	527,	2754,
10,	763,	474,	1008,	2843,	5032,	2092,	3186,	4241,	1043,	349,
11,	402,	467,	226,	543,	1675,	3182,	911,	2136,	1649,	736,
12,	135,	190,	292,	146,	296,	1040,	1718,	613,	913,	902,
13,	71,	43,	54,	200,	96,	126,	372,	1102,	256,	615,
+gp,	37,	125,	35,	169,	28,	159,	148,	487,	1128,	630,
TOTAL,	609550,	422347,	238115,	289493,	276451,	1205274,	976514,	528005,	342696,	235392,

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	113809,	170003,	134035,	18874,	5648,	7944,	4717,	9152,	256117,	458742,
4,	33008,	43256,	96706,	93935,	14887,	4186,	5708,	3228,	7002,	183060,
5,	13101,	7519,	18601,	47565,	56347,	9883,	2617,	2944,	1887,	4695,
6,	7199,	4172,	2527,	5764,	19479,	26332,	5069,	1351,	1659,	1055,
7,	18030,	3578,	2171,	798,	2072,	6438,	10663,	2916,	830,	720,
8,	29195,	7807,	1477,	1050,	429,	774,	2923,	5785,	1700,	396,
9,	1233,	14015,	4064,	720,	410,	207,	326,	1580,	2723,	824,
10,	1051,	730,	5921,	2014,	383,	191,	102,	220,	846,	1058,
11,	114,	513,	452,	2780,	896,	249,	85,	50,	118,	322,
12,	352,	9,	190,	208,	1117,	438,	122,	43,	19,	52,
13,	163,	198,	5,	78,	72,	411,	76,	81,	4,	11,
+gp,	190,	174,	133,	33,	111,	69,	331,	342,	226,	26,
TOTAL,	217447,	251973,	266282,	173821,	101851,	57122,	32741,	27693,	273132,	650960,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	GMST
AGE												
3,	83041,	42480,	16049,	23988,	84678,	222779,	815419,	317020,	93794,	130290,	0,	963
4,	258065,	64443,	25829,	12192,	15800,	65747,	170255,	621565,	233280,	62751,	42239,	665
5,	94769,	132142,	44626,	17589,	8924,	11164,	42445,	113515,	460013,	147624,	37753,	364
6,	2933,	30778,	62453,	25488,	12714,	5610,	6972,	20199,	61342,	277910,	85907,	170
7,	527,	1874,	7942,	30504,	17142,	7824,	3032,	3217,	8709,	30773,	155353,	79
8,	280,	246,	1191,	3442,	18902,	10044,	4546,	1610,	1112,	3942,	14931,	37
9,	196,	120,	143,	753,	2053,	11500,	5871,	2558,	698,	564,	1102,	18
10,	411,	94,	66,	107,	270,	1323,	6956,	2898,	1023,	294,	134,	8
11,	434,	229,	38,	22,	43,	202,	866,	3890,	739,	418,	72,	4
12,	163,	199,	62,	20,	16,	34,	154,	428,	1705,	295,	137,	1
13,	11,	56,	44,	31,	14,	7,	25,	77,	102,	830,	88,	
+gp,	54,	28,	38,	51,	48,	7,	16,	3,	5,	12,	196,	
TOTAL,	440884,	272689,	158481,	114187,	160603,	336241,	1056557,	1086979,	862521,	655703,	337912,	

Table 4.17

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:21

Traditional vpa using file input for terminal F

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	151686,	10406,	9110,	81471,	63484,	575357,	147115,	30447,	25908,	22882,
4,	141059,	182121,	12995,	9863,	117746,	67394,	533283,	139621,	29359,	19681,
5,	60467,	148065,	175659,	14972,	14865,	108862,	63002,	432854,	132760,	18092,
6,	135865,	43021,	92954,	108009,	17766,	11451,	39527,	27609,	291355,	66246,
7,	55665,	81512,	26991,	49301,	85381,	12835,	4154,	25292,	13514,	141184,
8,	10926,	32117,	41557,	16028,	38973,	45462,	7843,	3040,	12720,	5947,
9,	2396,	5704,	15591,	23178,	12903,	21445,	21490,	6207,	1578,	6346,
10,	2661,	1655,	3567,	9442,	22357,	7902,	11615,	16079,	3724,	958,
11,	1718,	1996,	977,	2208,	9115,	14718,	4066,	9914,	7208,	2476,
12,	713,	1009,	1569,	736,	1995,	5968,	9516,	3532,	4950,	3762,
13,	415,	254,	320,	1116,	716,	798,	2276,	7007,	1530,	2835,
+gp,	233,	794,	222,	1020,	229,	1090,	977,	3348,	7304,	3138,
TOTALBIO,	563803,	508656,	381512,	317344,	385530,	873282,	844863,	704950,	531910,	293547,

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	57671,	106332,	99497,	12857,	3663,	4896,	2835,	5500,	108787,	115770,
4,	26104,	42223,	112031,	99859,	15070,	4025,	5355,	3027,	5543,	135293,
5,	18005,	12755,	37448,	87875,	99130,	16517,	4267,	4798,	3243,	6474,
6,	13156,	9411,	6766,	14160,	45564,	58516,	10986,	2927,	3845,	2149,
7,	39592,	9697,	6983,	2357,	5823,	17193,	27772,	7594,	2155,	1466,
8,	74644,	24636,	5531,	3609,	1405,	2407,	8864,	17542,	5466,	1190,
9,	3503,	49144,	16912,	2750,	1491,	713,	1100,	5324,	9725,	2749,
10,	3557,	3052,	29370,	9167,	1661,	785,	409,	885,	3603,	4207,
11,	472,	2623,	2747,	15496,	4755,	1255,	416,	247,	613,	1566,
12,	1811,	60,	1429,	1440,	7353,	2739,	746,	264,	122,	312,
13,	927,	1385,	42,	592,	521,	2843,	515,	547,	28,	73,
+gp,	1170,	1315,	1195,	274,	877,	512,	2415,	2488,	1747,	184,
TOTALBIO,	240612,	262632,	319950,	250436,	187314,	112402,	65680,	51143,	144876,	271432,

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	19580,	11508,	4384,	6375,	31558,	83746,	250201,	74126,	19358,	27339,
4,	121698,	24940,	11029,	8418,	11414,	54294,	140741,	338495,	83203,	28279,
5,	86589,	80511,	30215,	16023,	12687,	17420,	61563,	119327,	366855,	101338,
6,	6396,	33534,	61206,	31097,	19757,	11778,	14883,	31002,	88497,	312682,
7,	1481,	2901,	10968,	44237,	27738,	18692,	7173,	6281,	17040,	56763,
8,	917,	813,	3813,	6643,	37068,	22848,	13972,	4036,	3244,	9572,
9,	711,	439,	509,	2681,	5127,	32325,	20094,	6067,	2053,	1587,
10,	1779,	411,	282,	456,	1139,	5628,	23870,	7589,	3108,	976,
11,	2304,	1229,	195,	116,	223,	1104,	3673,	12282,	2681,	1452,
12,	1073,	1323,	398,	129,	100,	234,	1044,	2866,	11444,	1975,
13,	82,	411,	310,	220,	97,	49,	184,	570,	754,	6136,
+gp,	422,	222,	295,	397,	366,	53,	132,	27,	41,	97,
TOTALBIO,	243033,	158243,	123604,	116792,	147275,	248170,	537531,	602669,	598279,	548196,

Table 4.18

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:21

Traditional vpa using file input for terminal F

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	7053,	9106,	650,	493,	5887,	3370,	26664,	6981,	1468,	984,
5,	13907,	34055,	40402,	3444,	3419,	25038,	14490,	99556,	30535,	4161,
6,	72008,	22801,	49266,	57245,	9416,	6069,	20950,	14633,	154418,	35110,
7,	48985,	71731,	23752,	43385,	75135,	11295,	3655,	22257,	11892,	124242,
8,	10707,	31474,	40726,	15707,	38193,	44553,	7686,	2979,	12466,	5828,
9,	2396,	5704,	15591,	23178,	12903,	21445,	21490,	6207,	1578,	6346,
10,	2661,	1655,	3567,	9442,	22357,	7902,	11615,	16079,	3724,	958,
11,	1718,	1996,	977,	2208,	9115,	14718,	4066,	9914,	7208,	2476,
12,	713,	1009,	1569,	736,	1995,	5968,	9516,	3532,	4950,	3762,
13,	415,	254,	320,	1116,	716,	798,	2276,	7007,	1530,	2835,
+gp,	233,	794,	222,	1020,	229,	1090,	977,	3348,	7304,	3138,
TOTSPBIO,	160797,	180580,	177041,	157974,	179366,	142246,	123384,	192494,	237074,	189840,

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
3,	0,	0,	0,	0,	37,	441,	482,	385,	2176,	0,
4,	1305,	2111,	5602,	4993,	1808,	2214,	3748,	424,	443,	29764,
5,	4141,	2934,	8613,	20211,	63443,	12058,	4267,	1679,	2594,	3431,
6,	6972,	4988,	3586,	7505,	33262,	54420,	10986,	1376,	3576,	1848,
7,	34841,	8533,	6145,	2074,	5590,	16505,	27772,	5620,	2068,	1260,
8,	73151,	24143,	5420,	3537,	1405,	2407,	8864,	17542,	5466,	1190,
9,	3503,	49144,	16912,	2750,	1491,	713,	1100,	5324,	9725,	2749,
10,	3557,	3052,	29370,	9167,	1661,	785,	409,	885,	3603,	4207,
11,	472,	2623,	2747,	15496,	4755,	1255,	416,	247,	613,	1566,
12,	1811,	60,	1429,	1440,	7353,	2739,	746,	264,	122,	312,
13,	927,	1385,	42,	592,	521,	2843,	515,	547,	28,	73,
+gp,	1170,	1315,	1195,	274,	877,	512,	2415,	2488,	1747,	184,
TOTSPBIO,	131851,	100288,	81060,	68039,	122203,	96892,	61721,	36781,	32162,	46585,

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
3,	0,	0,	0,	0,	0,	1675,	5004,	0,	0,	0,
4,	1217,	748,	441,	168,	799,	7058,	30963,	6770,	1664,	0,
5,	18184,	26569,	9065,	4807,	3806,	8710,	30166,	15513,	44023,	10134,
6,	3390,	17103,	38560,	16792,	9878,	7302,	11311,	12711,	37169,	112565,
7,	1481,	2901,	8994,	34063,	22190,	14393,	5667,	5653,	13803,	44275,
8,	917,	813,	3813,	5779,	34103,	18278,	12296,	3552,	2855,	8232,
9,	711,	439,	509,	2145,	5127,	30385,	17683,	6067,	2053,	1428,
10,	1779,	411,	282,	456,	1139,	5628,	20767,	7589,	2704,	908,
11,	2304,	1229,	195,	116,	223,	1104,	3673,	11914,	2681,	1307,
12,	1073,	1323,	398,	129,	100,	234,	1044,	2866,	10758,	1975,
13,	82,	411,	310,	220,	97,	49,	184,	570,	754,	6136,
+gp,	422,	222,	295,	397,	366,	53,	132,	27,	41,	97,
TOTSPBIO,	31560,	52169,	62862,	65072,	77830,	94870,	138889,	73230,	118504,	187057,

Table 4.19

Run title : Arctic Haddock (run: SVPLOR05/V05)

At 27-Aug-97 21:41:21

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,	.9394,	.4483,	.8412,
1951,	552707,	439081,	111584,	120077,	1.0761,	.6468,	.6273,
1952,	62333,	317969,	64151,	127660,	1.9900,	.5115,	.7325,
1953,	1030188,	652916,	81680,	123920,	1.5171,	.5709,	.5328,
1954,	122540,	716191,	124221,	156788,	1.2622,	.5998,	.3865,
1955,	52309,	580934,	176276,	202286,	1.1476,	.4730,	.5158,
1956,	169104,	532421,	237439,	213924,	.9010,	.5526,	.4431,
1957,	53254,	353841,	197612,	123583,	.6254,	.5668,	.4446,
1958,	68972,	292205,	155117,	112672,	.7264,	.6119,	.5333,
1959,	324527,	414699,	133923,	88211,	.6587,	.7979,	.3937,
1960,	242520,	529752,	128196,	155454,	1.2126,	.8371,	.4989,
1961,	109130,	491160,	133522,	193234,	1.4472,	.8017,	.6494,
1962,	240726,	429465,	122878,	187888,	1.5291,	.7438,	.8256,
1963,	274815,	401756,	91083,	146744,	1.6111,	.7422,	.8878,
1964,	320311,	378959,	62714,	98900,	1.5770,	.6155,	.6541,
1965,	100310,	438630,	92977,	118079,	1.2700,	.6922,	.5089,
1966,	240270,	471105,	126356,	160621,	1.2712,	.6598,	.6198,
1967,	290555,	563803,	160797,	136486,	.8488,	.7910,	.4316,
1968,	19932,	508656,	180580,	181726,	1.0063,	.7910,	.5178,
1969,	17204,	381512,	177041,	130502,	.7371,	.8023,	.4051,
1970,	163910,	317344,	157974,	86601,	.5482,	.7531,	.3565,
1971,	95481,	385530,	179366,	78908,	.4399,	1.0074,	.2548,
1972,	1017727,	873282,	142246,	265317,	1.8652,	.8566,	.7047,
1973,	269620,	844863,	123384,	320065,	2.5941,	.8267,	.5806,
1974,	53662,	704950,	192494,	221138,	1.1488,	.8597,	.4950,
1975,	48502,	531910,	237074,	175758,	.7414,	.8093,	.5125,
1976,	55669,	293546,	189840,	137218,	.7228,	.6228,	.6926,
1977,	113809,	240612,	131851,	110158,	.8355,	.7678,	.8400,
1978,	170002,	262633,	100288,	95422,	.9515,	.9477,	.6681,
1979,	134035,	319950,	81060,	103623,	1.2784,	1.1247,	.7399,
1980,	18874,	250436,	68039,	87889,	1.2917,	1.0321,	.5618,
1981,	5648,	187314,	122203,	77153,	.6313,	.9828,	.6155,
1982,	7944,	112402,	96892,	46955,	.4846,	.9337,	.5077,
1983,	4717,	65680,	61721,	21607,	.3501,	.9107,	.4221,
1984,	9152,	51143,	36781,	17661,	.4802,	.9105,	.3341,
1985,	256117,	144876,	32162,	41270,	1.2832,	.9654,	.4389,
1986,	458742,	271432,	46585,	96585,	2.0733,	.9013,	.4914,
1987,	83041,	243033,	31560,	150659,	4.7737,	.9825,	.5508,
1988,	42480,	158243,	52169,	91744,	1.7586,	.9923,	.5307,
1989,	16049,	123605,	62862,	55122,	.8769,	.9617,	.4242,
1990,	23988,	116792,	65072,	25816,	.3967,	.9630,	.1780,
1991,	84678,	147275,	77830,	33605,	.4318,	.9581,	.2579,
1992,	222779,	248170,	94870,	53886,	.5680,	1.0132,	.3166,
1993,	815418,	537531,	138889,	77355,	.5570,	1.0093,	.4062,
1994,	317020,	602669,	73230,	121365,	1.6573,	.9992,	.4982,
1995,	93794,	598279,	118504,	138509,	1.1688,	1.0019,	.3379,
1996,	130290,	548196,	187057,	173438,	.9272,	.9992,	.3258,
Arith. Mean	193005,	390353,	119166,	123738,	1.1530		.5211,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 4.20

Haddock in the North-East Arctic (Areas I and II)

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	3.645	7405.565	1.370	5984.283	1.370	5984.283
0.0500	0.0163	0.044	94.990	3.431	6157.011	1.173	4766.744	1.173	4766.744
0.1000	0.0326	0.078	163.777	3.264	5243.766	1.022	3882.722	1.022	3882.722
0.1500	0.0489	0.106	215.094	3.130	4554.293	0.904	3220.826	0.904	3220.826
0.2000	0.0652	0.129	254.282	3.019	4020.321	0.807	2712.917	0.807	2712.917
0.2500	0.0815	0.149	284.773	2.925	3597.935	0.728	2315.199	0.728	2315.199
0.3000	0.0977	0.166	308.866	2.844	3257.743	0.661	1998.387	0.661	1998.387
0.3500	0.1140	0.180	328.147	2.774	2979.432	0.605	1742.269	0.605	1742.269
0.4000	0.1303	0.194	343.744	2.713	2748.585	0.556	1532.516	0.556	1532.516
0.4500	0.1466	0.205	356.477	2.658	2554.738	0.514	1358.743	0.514	1358.743
0.5000	0.1629	0.216	366.953	2.609	2390.144	0.477	1213.278	0.477	1213.278
0.5500	0.1792	0.226	375.629	2.565	2248.976	0.444	1090.360	0.444	1090.360
0.6000	0.1955	0.234	382.856	2.525	2126.782	0.415	985.598	0.415	985.598
0.6500	0.2118	0.243	388.905	2.489	2020.117	0.389	895.603	0.389	895.603
0.7000	0.2281	0.250	393.990	2.455	1926.285	0.366	817.731	0.366	817.731
0.7500	0.2444	0.257	398.278	2.424	1843.153	0.345	749.892	0.345	749.892
0.8000	0.2606	0.264	401.904	2.395	1769.015	0.326	690.426	0.326	690.426
0.8500	0.2769	0.270	404.978	2.368	1702.496	0.309	637.996	0.309	637.996
0.9000	0.2932	0.275	407.588	2.343	1642.479	0.293	591.521	0.293	591.521
0.9500	0.3095	0.281	409.805	2.320	1588.048	0.279	550.117	0.279	550.117
1.0000	0.3258	0.286	411.691	2.298	1538.447	0.266	513.059	0.266	513.059
1.0500	0.3421	0.291	413.294	2.277	1493.048	0.253	479.746	0.253	479.746
1.1000	0.3584	0.296	414.655	2.258	1451.325	0.242	449.680	0.242	449.680
1.1500	0.3747	0.300	415.809	2.239	1412.835	0.232	422.440	0.232	422.440
1.2000	0.3910	0.304	416.785	2.221	1377.205	0.222	397.676	0.222	397.676
1.2500	0.4073	0.308	417.607	2.205	1344.115	0.213	375.088	0.213	375.088
1.3000	0.4235	0.312	418.297	2.189	1313.291	0.205	354.421	0.205	354.421
1.3500	0.4398	0.316	418.872	2.174	1284.499	0.197	335.460	0.197	335.460
1.4000	0.4561	0.319	419.348	2.159	1257.535	0.190	318.016	0.190	318.016
1.4500	0.4724	0.323	419.737	2.145	1232.223	0.183	301.928	0.183	301.928
1.5000	0.4887	0.326	420.050	2.132	1208.408	0.176	287.057	0.176	287.057
1.5500	0.5050	0.329	420.298	2.119	1185.955	0.170	273.280	0.170	273.280
1.6000	0.5213	0.333	420.488	2.107	1164.744	0.165	260.490	0.165	260.490
1.6500	0.5376	0.336	420.628	2.095	1144.671	0.159	248.595	0.159	248.595
1.7000	0.5539	0.339	420.725	2.084	1125.643	0.154	237.511	0.154	237.511
1.7500	0.5702	0.341	420.784	2.073	1107.575	0.149	227.166	0.149	227.166
1.8000	0.5864	0.344	420.809	2.062	1090.393	0.145	217.495	0.145	217.495
1.8500	0.6027	0.347	420.805	2.052	1074.031	0.140	208.440	0.140	208.440
1.9000	0.6190	0.349	420.776	2.042	1058.429	0.136	199.950	0.136	199.950
1.9500	0.6353	0.352	420.725	2.033	1043.532	0.133	191.979	0.133	191.979
2.0000	0.6516	0.354	420.655	2.023	1029.291	0.129	184.485	0.129	184.485
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDLOR02
Date and time : 27AUG97:22:44
Computation of ref. F: Simple mean, age 4 - 7
F-0.1 factor : 0.4563
F-max factor : 1.8179
F-0.1 reference F : 0.1487
F-max reference F : 0.5923
Recruitment : Single recruit

Table 4.21

Haddock in the North-East Arctic (Areas I and II)

Prediction with management option table: Input data

Year: 1997								
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	109353.00	0.5925	0.0000	0.0000	0.0000	0.217	0.0241	0.650
4	42239.000	0.3293	0.0300	0.0000	0.0000	0.451	0.1202	0.787
5	37753.000	0.2488	0.1000	0.0000	0.0000	0.845	0.2808	1.143
6	85907.000	0.2122	0.2900	0.0000	0.0000	1.367	0.4261	1.590
7	155353.00	0.2000	0.6000	0.0000	0.0000	1.918	0.4761	1.993
8	14931.000	0.2000	0.8200	0.0000	0.0000	2.617	0.5014	2.220
9	1102.000	0.2000	1.0000	0.0000	0.0000	2.708	0.5923	2.510
10	134.000	0.2000	0.8300	0.0000	0.0000	2.992	0.6362	2.843
11	72.000	0.2000	1.0000	0.0000	0.0000	3.421	0.4889	2.800
12	137.000	0.2000	1.0000	0.0000	0.0000	6.700	0.5878	3.080
13	88.000	0.2000	1.0000	0.0000	0.0000	7.400	0.6148	2.923
14+	196.000	0.2000	1.0000	0.0000	0.0000	8.000	0.6148	3.150
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	55915.000	0.5925	0.0000	0.0000	0.0000	0.217	0.0241	0.650
4	.	0.3293	0.0300	0.0000	0.0000	0.451	0.1202	0.787
5	.	0.2488	0.1000	0.0000	0.0000	0.845	0.2808	1.143
6	.	0.2122	0.2900	0.0000	0.0000	1.367	0.4261	1.590
7	.	0.2000	0.6000	0.0000	0.0000	1.918	0.4761	1.993
8	.	0.2000	0.8200	0.0000	0.0000	2.617	0.5014	2.220
9	.	0.2000	1.0000	0.0000	0.0000	2.708	0.5923	2.510
10	.	0.2000	0.8300	0.0000	0.0000	2.992	0.6362	2.843
11	.	0.2000	1.0000	0.0000	0.0000	3.421	0.4889	2.800
12	.	0.2000	1.0000	0.0000	0.0000	6.700	0.5878	3.080
13	.	0.2000	1.0000	0.0000	0.0000	7.400	0.6148	2.923
14+	.	0.2000	1.0000	0.0000	0.0000	8.000	0.6148	3.150
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
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	128000.00	0.5925	0.0000	0.0000	0.0000	0.217	0.0241	0.650
4	.	0.3293	0.0300	0.0000	0.0000	0.451	0.1202	0.787
5	.	0.2488	0.1000	0.0000	0.0000	0.845	0.2808	1.143
6	.	0.2122	0.2900	0.0000	0.0000	1.367	0.4261	1.590
7	.	0.2000	0.6000	0.0000	0.0000	1.918	0.4761	1.993
8	.	0.2000	0.8200	0.0000	0.0000	2.617	0.5014	2.220
9	.	0.2000	1.0000	0.0000	0.0000	2.708	0.5923	2.510
10	.	0.2000	0.8300	0.0000	0.0000	2.992	0.6362	2.843
11	.	0.2000	1.0000	0.0000	0.0000	3.421	0.4889	2.800
12	.	0.2000	1.0000	0.0000	0.0000	6.700	0.5878	3.080
13	.	0.2000	1.0000	0.0000	0.0000	7.400	0.6148	2.923
14+	.	0.2000	1.0000	0.0000	0.0000	8.000	0.6148	3.150
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANLOR05
Date and time: 27AUG97:22:39

Table 4.22

Haddock in the North-East Arctic (Areas I and II)

Prediction with management option table

Year: 1997					Year: 1998					Year: 1999	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.2364	0.4028	535857	255320	210000	0.0000	0.0000	373367	230529	0	400827	276171
.	.	.	.	.	0.1000	0.0326	.	230529	13885	385417	263158
.	.	.	.	.	0.2000	0.0652	.	230529	27158	370718	250769
.	.	.	.	.	0.3000	0.0977	.	230529	39846	356694	238975
.	.	.	.	.	0.4000	0.1303	.	230529	51977	343314	227746
.	.	.	.	.	0.5000	0.1629	.	230529	63577	330548	217055
.	.	.	.	.	0.6000	0.1955	.	230529	74670	318367	206876
.	.	.	.	.	0.7000	0.2281	.	230529	85281	306742	197184
.	.	.	.	.	0.8000	0.2606	.	230529	95432	295647	187956
.	.	.	.	.	0.9000	0.2932	.	230529	105143	285058	179169
.	.	.	.	.	1.0000	0.3258	.	230529	114435	274950	170802
.	.	.	.	.	1.1000	0.3584	.	230529	123328	265300	162835
.	.	.	.	.	1.2000	0.3910	.	230529	131840	256088	155248
.	.	.	.	.	1.3000	0.4235	.	230529	139989	247291	148024
.	.	.	.	.	1.4000	0.4561	.	230529	147791	238892	141143
.	.	.	.	.	1.5000	0.4887	.	230529	155262	230870	134591
.	.	.	.	.	1.6000	0.5213	.	230529	162417	223209	128351
.	.	.	.	.	1.7000	0.5539	.	230529	169272	215891	122407
.	.	.	.	.	1.8000	0.5864	.	230529	175839	208900	116747
.	.	.	.	.	1.9000	0.6190	.	230529	182131	202220	111356
.	.	.	.	.	2.0000	0.6516	.	230529	188163	195838	106221
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANLOR05
Date and time : 27AUG97:22:39
Computation of ref. F: Simple mean, age 4 - 7
Basis for 1997 : TAC constraints

Table 4.23

Haddock in the North-East Arctic (Areas I and II)

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.2364	0.4028	119684	209999	447265	535857	137117	255320	137117	255320
1998	1.0000	0.3258	61566	114436	280484	373368	100104	230529	100104	230529
1999	1.0000	0.3258	45285	85052	281188	274950	70607	170803	70607	170803
2000	1.0000	0.3258	35997	63847	249094	209782	44802	105499	44802	105499
2001	1.0000	0.3258	31411	49429	236111	180547	33899	78697	33899	78697
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.2364	0.4028	119684	209999	447265	535857	137117	255320	137117	255320
1998	0.8000	0.2606	51183	95432	280484	373368	100104	230529	100104	230529
1999	0.8000	0.2606	40404	77237	290305	295648	77300	187957	77300	187957
2000	0.8000	0.2606	33451	61970	260682	237334	52899	127247	52899	127247
2001	0.8000	0.2606	29257	48925	247621	209342	41956	102416	41956	102416
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.2364	0.4028	119684	209999	447265	535857	137117	255320	137117	255320
1998	0.6000	0.1955	39924	74671	280484	373368	100104	230529	100104	230529
1999	0.6000	0.1955	33910	65924	300233	318367	84667	206876	84667	206876
2000	0.6000	0.1955	29465	56885	274388	270596	62712	153814	62712	153814
2001	0.6000	0.1955	26054	46320	262154	247314	52625	134443	52625	134443
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.2364	0.4028	119684	209999	447265	535857	137117	255320	137117	255320
1998	0.4000	0.1303	27704	51977	280484	373368	100104	230529	100104	230529
1999	0.4000	0.1303	25381	50140	311052	343315	92777	227746	92777	227746
2000	0.4000	0.1303	23323	46800	290663	310843	74626	186302	74626	186302
2001	0.4000	0.1303	21059	39750	280730	297764	66839	177864	66839	177864
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	1.2364	0.4028	119684	209999	447265	535857	137117	255320	137117	255320
1998	0.2000	0.0652	14430	27158	280484	373368	100104	230529	100104	230529
1999	0.2000	0.0652	14294	28671	322849	370718	101706	250770	101706	250770
2000	0.2000	0.0652	13994	29101	310061	359644	89111	226068	89111	226068
2001	0.2000	0.0652	13045	26063	304740	365241	85875	236943	85875	236943
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
Date and time : 28AUG97:14:20
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

Table 4.24

The SAS System 19:59 Thursday, August 28, 1997

Haddock in the North-East Arctic (Areas I and II)

Single option prediction: Detailed tables

Year: 1997	F-factor: 1.2364	Reference F: 0.4028				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0298	2426	1577	109353	23693	0	0	0	0
4	0.1486	4990	3926	42239	19036	1267	571	1267	571
5	0.3472	9874	11289	37753	31901	3775	3190	3775	3190
6	0.5268	31993	50869	85907	117464	24913	34064	24913	34064
7	0.5887	63259	126096	155353	297915	93212	178749	93212	178749
8	0.6199	6317	14023	14931	39079	12243	32045	12243	32045
9	0.7323	525	1317	1102	2984	1102	2984	1102	2984
10	0.7866	67	191	134	401	111	333	111	333
11	0.6045	30	84	72	246	72	246	72	246
12	0.7268	65	200	137	918	137	918	137	918
13	0.7601	43	126	88	651	88	651	88	651
14+	0.7601	96	302	196	1568	196	1568	196	1568
Total		119684	209999	447265	535857	137117	255320	137117	255320
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1998	F-factor: 1.0000	Reference F: 0.3258				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0241	1006	654	55915	12115	0	0	0	0
4	0.1202	5682	4470	58691	26450	1761	794	1761	794
5	0.2808	5710	6528	26191	22132	2619	2213	2619	2213
6	0.4261	6552	10418	20803	28444	6033	8249	6033	8249
7	0.4761	14197	28299	41027	78676	24616	47206	24616	47206
8	0.5014	25442	56482	70601	184787	57893	151526	57893	151526
9	0.5923	2690	6753	6577	17807	6577	17807	6577	17807
10	0.6362	187	532	434	1298	360	1077	360	1077
11	0.4889	18	49	50	171	50	171	50	171
12	0.5878	13	40	32	216	32	216	32	216
13	0.6148	23	67	54	401	54	401	54	401
14+	0.6148	46	144	109	870	109	870	109	870
Total		61566	114436	280484	373368	100104	230529	100104	230529
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1999	F-factor: 1.0000	Reference F: 0.3258				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0241	2302	1497	128000	27733	0	0	0	0
4	0.1202	2922	2299	30182	13602	905	408	905	408
5	0.2808	8162	9332	37442	31638	3744	3164	3744	3164
6	0.4261	4857	7723	15423	21088	4473	6115	4473	6115
7	0.4761	3802	7579	10988	21071	6593	12643	6593	12643
8	0.5014	7519	16693	20866	54614	17110	44784	17110	44784
9	0.5923	14322	35948	35011	94797	35011	94797	35011	94797
10	0.6362	1284	3650	2978	8911	2472	7396	2472	7396
11	0.4889	66	186	188	643	188	643	188	643
12	0.5878	10	31	25	168	25	168	25	168
13	0.6148	6	18	15	108	15	108	15	108
14+	0.6148	30	96	72	577	72	577	72	577
Total		45285	85052	281188	274950	70607	170803	70607	170803
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

The SAS System 19:59 Thursday, August 28, 1997

Haddock in the North-East Arctic (Areas I and II)

Single option prediction: Detailed tables

(cont.)

Year: 2000 F-factor: 1.0000 Reference F: 0.3258

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.0241	1751	1138	97332	21089	0	0	0	0
4	0.1202	6689	5262	69091	31137	2073	934	2073	934
5	0.2808	4197	4799	19254	16270	1925	1627	1925	1627
6	0.4261	6944	11041	22047	30146	6394	8742	6394	8742
7	0.4761	2819	5619	8146	15621	4888	9373	4888	9373
8	0.5014	2014	4471	5588	14627	4582	11994	4582	11994
9	0.5923	4233	10624	10347	28017	10347	28017	10347	28017
10	0.6362	6834	19433	15853	47437	13158	39373	13158	39373
11	0.4889	456	1277	1290	4414	1290	4414	1290	4414
12	0.5878	38	118	94	632	94	632	94	632
13	0.6148	5	14	11	84	11	84	11	84
14+	0.6148	16	51	38	307	38	307	38	307
Total		35997	63847	249094	209782	44802	105499	44802	105499
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 1.0000 Reference F: 0.3258

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.0241	1751	1138	97332	21089	0	0	0	0
4	0.1202	5086	4001	52538	23677	1576	710	1576	710
5	0.2808	9609	10986	44077	37245	4408	3724	4408	3724
6	0.4261	3571	5678	11338	15502	3288	4496	3288	4496
7	0.4761	4030	8032	11645	22331	6987	13399	6987	13399
8	0.5014	1493	3314	4143	10844	3397	8892	3397	8892
9	0.5923	1134	2845	2771	7504	2771	7504	2771	7504
10	0.6362	2020	5743	4685	14020	3889	11637	3889	11637
11	0.4889	2427	6797	6870	23500	6870	23500	6870	23500
12	0.5878	264	812	648	4341	648	4341	648	4341
13	0.6148	18	53	43	318	43	318	43	318
14+	0.6148	9	29	22	177	22	177	22	177
Total		31411	49429	236111	180547	33899	78697	33899	78697
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
Date and time : 28AUG97:20:01
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

Table 5.1 North-East Arctic SAITHE. Nominal catch (t) by countries. (Sub-area I and Divisions IIa and IIb combined.) as officially reported to ICES.

Year	Faroe Islands	France	Germany Dem.Rep	Fed.Rep. Germany	Norway	Poland	Portugal	Russia[3]	Spain	UK (England & Wales)	UK (Scotland)	Others[5]	Total all countries
1960	23	1,700	-	25,948	96,050	-	-	-	-	9,780	-	14	133,515
1961	61	3,625	-	19,757	77,875	-	-	-	-	4,595	20	18	105,951
1962	2	544	-	12,651	101,895	-	-	912	-	4,699	-	4	120,707
1963	-	1,110	-	8,108	135,297	-	-	-	-	4,112	-	-	148,627
1964	-	1,525	-	4,420	184,700	-	-	84	-	6,511	-	186	197,506
1965	-	1,618	-	11,387	165,531	-	-	137	-	6,741	5	181	185,600
1966	-	2,987	813	11,269	175,037	-	-	563	-	13,078	-	41	203,788
1967	-	9,472	304	11,822	150,860	-	-	441	-	8,379	-	48	181,326
1968	-	-	70	4,753	96,641	-	-	-	-	8,781	2	-	110,246
1969	20	193	6,744	4,355	115,140	-	-	-	-	13,585	-	23	140,033
1970	1,097	-	29,362	23,466	151,759	-	-	43,550	-	15,469	221	-	264,924
1971	215	14,536	16,840	12,204	128,499	6,017	-	39,397	13,097	10,361	106	-	241,272
1972	109	14,519	7,474	24,595	143,775	1,111	-	1,278	13,125	8,223	125	-	210,456
1973	7	11,320	12,015	30,338	148,789	23	-	2,411	2,115	6,593	248	-	213,769
1974	46	7,119	29,466	33,155	152,699	2,521	-	38,931	7,075	3,001	103	5	264,121
1975	28	3,156	28,517	41,260	122,598	3,860	6,430	13,389	11,397	2,,623	140	55	233,453
1976	20	5,609	10,266	49,056	131,675	3,164	7,233	9,013	21,661	4,651	73	47	242,486
1977	270	5,658	7,164	19,985	139,705	1	783	989	1,327	6,853	82	-	182,817
1978	809	4,345	6,484	18,190	121,069	35	203	381	121	2,790	37	-	154,464
1979	1,117	2,601	2,435	14,823	141,346	-	-	3	685	1,170	-	-	164,180
1980	532	1,016	-	12,511	128,878	-	-	43	780	794	-	-	144,554
1981	236	194	-	8,431	166,139	-	-	121	-	395	-	-	175,498
1982	339	82	-	7,224	159,643	-	-	14	-	731	1	-	168,034
1983	539	418	-	4,933	149,556	-	-	206	33	1,251	-	-	156,936
1984	503	431	6	4,532	152,818	-	-	161	-	335	-	-	158,786
1985	490	657	11	1,873	103,899	-	-	51	-	202	-	-	107,147
1986	426	308	-	3,470	66,152	-	-	27	-	54	21	-	67,396
1987	712	576	-	4,909	85,710	-	-	426	-	54	3	1	92,391
1988	441	411	-	4,574	108,244	-	-	130	-	436	6	-	114,242
1989	388	460 [2]	-	606	119,625	-	-	23	506	-	702	-	122,310
1990	1,207	340 [2]	-	1,143	92,397	-	-	52	-	681	28	-	95,848
1991	963	77 [2]	Greenland	2,003	103,283	-	-	504 [4]	-	449	42	5	107,326
1992	165	1,890 [2]	734	3,451	119,765	-	-	964	6	516	25	-	127,606
1993	31	566 [2]	78	3,687	139,288	-	1	9,509	4	408	7	5	153,584
1994	67	151 [2]	15	1,863	137,298	-	1	1,640	655	548	9	6	142,253
1995	172 [2]	222 [2]	53	934	166,205	-	4	1,148	-	589	99	18	169,444
1996 [1]	248 [2]	365 [2]	271 [2]	2,615	166,149	-	24	1,159	9 [2]	692	16	47 [2]	171,595

[1] Provisional figures.
[2] As reported to Norwegian authorities.
[3] USSR prior to 1991.
[4] Includes Estonia.
[5] Includes Denmark,Netherlands, Iceland, Ireland and Sweden

Table 5.2 North-East Arctic SAITHE. Landings ('000 tonnes) by gear category for Sub-area I, Division IIa and Division IIb combined.

Year	Purse Seine	Trawl	Gill Net	Others	Total
1977	75.2	69.5	19.3	12.7	176.7 [2]
1978	62.9	57.7	21.1	13.9	155.6 [2]
1979	74.7	52.0	21.6	15.8	164.1
1980	61.3	46.8	21.1	15.4	144.6
1981	64.3	72.4	24.0	14.8	175.5
1982	76.4	59.4	16.7	15.6	168.0
1983	54.1	68.2	19.6	15.1	156.9
1984	36.4	85.6	23.7	13.1	158.8
1985	31.1	49.9	14.6	11.5	107.1
1986	7.9	36.2	12.3	8.2	64.6 [2]
1987	34.9	28.0	19.0	10.8	92.7 [2]
1988	43.5	45.4	15.3	10.0	114.2
1989	48.6	44.8	16.8	12.4	122.7
1990	24.6	44.0	19.3	7.9	95.8
1991	38.9	40.1	18.9	9.4	107.3
1992	27.1	66.9	21.2	12.4	127.6
1993	33.1	75.9	21.2	15.7	145.9 [4]
1994	29.3	79.3	20.5	13.1	142.2
1995	22.0 [3]	104.3	27.1	16.0	169.4
1996 [1]	46.9	72.8	31.6	20.3	171.6

[1] Preliminary.
[2] Unresolved discrepancy between Norwegian catch by gear figures and the total reported to ICES for these years.
[3] Includes 0.144 tonnes not categorized by vessel size in Table 5.3.
4 As reported by Working Group members.

Table 5.3

SAI-ARCT: Saithe in the North-East Arctic (Fishing Areas I and II)

FLT06: Norway Ac Survey (Catch: Thousands)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5
1988	1	15.7	22.5	19.0	7.1
1989	1	24.8	28.4	17.0	10.1
1990	1	99.6	31.9	14.7	5.1
1991	1	87.8	104.0	4.6	4.0
1992	1	163.5	273.6	57.5	6.2
1993	1	106.9	227.7	103.9	12.7
1994	1	34.4	87.8	112.4	39.5
1995	1	38.7	165.2	87.0	46.8
1996	1	37.0	118.9	214.7	32.1

SAI-ARCT: Saithe in the North-East Arctic (Fishing Areas I and II)

FLT07: Norway Purse Seine

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1977	206	30547	81152	8964	2144	133	9
1978	214	43402	37652	8788	2126	456	88
1979	199	23054	41942	6706	6575	1362	363
1980	215	15615	23353	15280	3280	1683	681
1981	203	10325	68716	5770	2219	154	36
1982	213	14490	28360	43980	250	140	0
1983	161	8924	12402	9775	12090	463	179
1984	124	8576	21699	3842	2144	1363	21
1985	98	632	28815	2688	1096	340	95
1986	96	1408	9869	593	181	108	51
1987	94	1848	12364	32183	386	19	2
1988	103	875	3253	27063	13169	72	6
1989	131	4231	5250	8521	18211	2880	24
1990	96	8551	7207	3319	2582	1845	673
1991	107	3694	43110	1907	453	162	95
1992	90	3954	27527	5214	89	45	38
1993	79	1762	8010	24251	1302	39	23
1994	71	1099	6365	16182	8997	1151	90
1995	90	14	5524	13357	4368	1335	105
1996	105	116	763	5470	8059	8557	2968

SAI-ARCT: Saithe in the North-East Arctic (Fishing Areas I and II)

FLT08: Norway Trawl

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1976	37	11184	583	1080	1137	869	612	332	284
1977	53	4557	9047	3260	202	660	322	361	209
1978	51	488	3104	3440	1400	319	591	254	304
1979	43	7374	6538	2340	762	845	419	294	129
1980	57	10270	10301	1726	2891	1392	406	24	108
1981	71	5698	12137	10877	1901	1053	1351	83	108
1982	58	1719	10344	10006	5519	420	306	215	134
1983	58	3341	10024	14949	2189	1720	535	181	60
1984	86	14876	25819	7038	7161	656	744	180	176
1985	64	10070	6177	3844	3877	2446	441	564	66
1986	45	4388	8150	4078	3172	2044	779	208	215
1987	30	470	7862	2452	1169	1405	189	153	67
1988	50	1539	2241	14077	3031	1438	609	346	137
1989	60	3923	9038	9226	8659	1154	178	83	150
1990	60	8909	7960	3932	3722	3967	479	54	66
1991	52	20741	7106	2683	2456	1516	1044	139	37
1992	58	10361	13228	3067	2269	2660	2029	890	214
1993	68	10746	26279	17961	1947	657	604	190	240
1994	79	1456	16229	28224	10542	1045	151	68	83
1995	106	7626	27085	24940	21565	2560	329	18	61
1996	75	3455	14960	9222	10051	9775	708	152	0

Table 5.4

```
NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds
1,12,2                (No. of surveys, No. of years, VPA Column No.)
1983, 271,  3.1
1984, 204,  19.5
1985, 102,  1.8
1986, 78,   15.7
1987, 90,   24.8
1988, 288,  99.6
1989, 459,  87.8
1990, 305,  163.5
1991, 211,  106.9
1992, 174,  34.4
1993, 70,   38.7
1994, -11,  37.0
```

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

 g:\acfm\afwg\sai_arct\rct3.in

 NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds

 Data for    1 surveys over   12 years :  1983 - 1994

 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.
```

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1986	182	5.21	.50	.15	.10	78	4.37
1987	143	4.97	.58	.30	.27	90	4.51
1988	123	4.82	.54	.53	.99	288	5.67
1989	160	5.08	.58	.47	.66	460	6.13
1990	220	5.40	.65	.67	1.06	306	5.72
1991	233	5.45	.60	.44	.54	212	5.36
1992	196	5.28	.56	.04	.00	174	5.16
1993	197	5.29	.52	.06	.01	71	4.26
1994	176	5.17	.59	.04	.00		

Table 5.5

Lowestoft VPA Version 3.1

25-Aug-97 13:48:49

Extended Survivors Analysis

Arctic Saithe (run: XSASME01/X01)

CPUE data from file /users/fish/ifad/ifapwork/afwg/sai_arct/FLEET.X01

Catch data for 37 years. 1960 to 1996. Ages 2 to 11.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT06: Norway Ac Sur,	1988,	1996,	2,	5,	.750,	.850
FLT07: Norway Purse ,	1977,	1996,	2,	7,	.000,	1.000
FLT08: Norway Trawl ,	1976,	1996,	3,	10,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 8

Terminal population estimation :

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

S.E. of the mean to which the estimates are shrunk = .500

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

Prior weighting not applied

Tuning converged after 17 iterations

Table 5.5 continued

Log catchability residuals.

Fleet : FLT06: Norway Ac Sur

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	99.99	-.51	-.13	.02	-.60	.46	.37	-.57	.44	.39
3	99.99	-.97	-.33	-.12	-.21	.03	.27	-.41	.47	1.04
4	99.99	-1.01	-.36	-.05	-1.09	.00	-.17	.30	.50	1.59
5	99.99	-1.01	-.14	-.39	-.18	.38	-.28	.02	.64	.74
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	No data for this fleet at this age									
10	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 ,	2,	3,	4,	5
Mean Log q,	-7.7894,	-6.9507,	-7.2377,	-7.7946,
S.E(Log q),	.4597,	.5739,	.8126,	.5401,

Regression statistics :

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	1.17,	-.598,	7.08,	.65,	9,	.56,	-7.79,
3,	1.04,	-.126,	6.75,	.58,	9,	.64,	-6.95,
4,	.72,	.883,	8.41,	.61,	9,	.60,	-7.24,
5,	.99,	.032,	7.82,	.68,	9,	.57,	-7.79,

Table 5.5 continued

Fleet : FLT07: Norway Purse

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
2	2.34	2.18	2.15	.86	1.36	1.77	1.71	1.79	-1.31	-.20
3	1.29	.94	.56	.47	.66	.59	.11	1.30	1.69	-.44
4	-.31	-.40	-.17	-.16	-.44	.57	.15	-.43	-.02	-1.63
5	-.14	-.31	.77	.54	-.60	-2.08	1.14	.29	.04	-1.34
6	-.86	-.18	.86	.93	-.81	-1.74	.59	1.08	.30	-.77
7	-3.28	.05	1.16	1.53	-1.40	99.99	.25	-.83	.36	-.05
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	.79	.23	1.47	1.27	-.16	.51	.18	.01	-3.69	-1.74
3	.10	-.61	-.01	.64	1.05	.22	-.53	-.35	-.51	-1.74
4	.91	.94	.28	.10	-.44	-.62	.27	.38	.32	-.51
5	-.80	1.24	1.74	.68	-.71	-2.04	-.65	.59	.05	1.00
6	-2.00	-1.11	1.15	1.53	-.73	-1.19	-1.23	1.00	-.03	2.21
7	-3.11	-1.50	-.95	1.68	-.10	-.40	.06	1.21	-.02	2.23
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	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	2	3	4	5	6	7
Mean Log q	-9.2309	-7.0697	-6.7594	-7.4033	-8.2491	-9.0068
S.E(Log q)	1.5401	.8673	.6431	1.1348	1.3059	1.3727

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.56	1.084	10.44	.37	20	.85	-9.23
3	.81	.545	7.98	.44	20	.72	-7.07
4	.68	1.807	8.23	.76	20	.40	-6.76
5	.52	2.570	8.97	.74	20	.48	-7.40
6	.46	2.931	9.14	.74	20	.46	-8.25
7	.47	2.136	9.01	.63	19	.56	-9.01

Table 5.5 continued

Fleet : FLT08: Norway Trawl

Age	1976
2	No data for this fleet at this age
3	99.99
4	99.99
5	99.99
6	99.99
7	99.99
8	99.99
9	99.99
10	99.99

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
2	No data for this fleet at this age									
3	-.10	-1.85	.49	1.10	-.66	-.79	-.05	1.42	1.20	-.38
4	.19	-.90	.46	-.11	.48	-.46	.33	.97	.36	.86
5	-.24	-.28	-.61	-.67	.15	1.02	.49	-.03	-.17	.64
6	-2.06	-.61	-1.16	-.19	-.22	.25	.19	.14	.18	.39
7	-1.40	-1.02	-.24	-.21	-.75	-.92	-.24	-.80	.27	.62
8	-.79	-.57	.48	-.12	.76	-.88	.31	-.51	.00	.62
9	-.81	-.32	-.46	-2.05	-1.17	.07	-.77	-.21	.19	.20
10	-.79	-.30	-.06	-1.03	-.18	.17	-.42	-.43	.01	.26

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	No data for this fleet at this age									
3	-1.90	-.52	.60	1.44	1.18	-.26	.04	-1.81	-.22	.23
4	-.24	-1.71	.24	.56	.73	-.13	-.38	-.61	-.02	-.05
5	.30	.14	-.04	-.32	-.09	.06	.24	-.26	-.25	-.41
6	.28	.37	.05	-.28	-.26	.20	-.15	.14	-.39	-.27
7	.81	.92	-.07	.14	-.38	.52	-.21	-.22	-.76	-.01
8	-.36	.91	.02	.09	.07	.94	.23	-.68	-.69	-.59
9	.20	.54	-.30	-.52	-.30	.52	-.46	-1.34	-2.48	-.43
10	.12	.42	.50	.12	-.13	.65	-.10	-.47	-1.02	99.99

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

Age	3	4	5	6	7	8	9	10
Mean Log q	-7.1959	-5.8797	-5.5169	-5.2723	-5.2297	-5.5258	-5.5258	-5.5258
S.E(Log q)	1.0536	.6733	.3430	.2824	.5448	.5820	.9670	.4923

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	2.45	-1.162	.54	.06	20	2.54	-7.20
4	3.26	-3.130	-6.53	.16	20	1.64	-5.88
5	1.17	-1.085	4.65	.81	20	.40	-5.52
6	1.23	-1.845	4.19	.86	20	.32	-5.27
7	1.08	-.303	4.93	.58	20	.61	-5.23
8	.87	.465	5.84	.57	20	.53	-5.53
9	.54	2.135	6.50	.68	20	.40	-5.96
10	1.05	-.146	5.52	.51	19	.54	-5.56

Table 5.5 continued

Terminal year survivor and F summaries :

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	85587.,	.486,	.000,	.00,	1,	.488,	.010
FLT07: Norway Purse ,	10108.,	1.603,	.000,	.00,	1,	.045,	.083
FLT08: Norway Trawl ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	45208.,	.50,,,,				.467,	.019

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
57709.,	.34,	.38,	3,	1.110,	.015

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	80378.,	.379,	.293,	.77,	2,	.496,	.076
FLT07: Norway Purse ,	4473.,	.786,	.835,	1.06,	2,	.115,	.886
FLT08: Norway Trawl ,	51453.,	1.096,	.000,	.00,	1,	.059,	.117
F shrinkage mean ,	30549.,	.50,,,,				.330,	.190

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
40778.,	.27,	.44,	6,	1.605,	.145

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	63318.,	.348,	.579,	1.66,	3,	.371,	.371
FLT07: Norway Purse ,	33989.,	.511,	.106,	.21,	3,	.183,	.608
FLT08: Norway Trawl ,	49123.,	.592,	.076,	.13,	2,	.139,	.457
F shrinkage mean ,	60862.,	.50,,,,				.307,	.383

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
53889.,	.24,	.20,	9,	.834,	.424

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	47750.,	.310,	.241,	.78,	4,	.290,	.336
FLT07: Norway Purse ,	45049.,	.482,	.271,	.56,	4,	.111,	.353
FLT08: Norway Trawl ,	21235.,	.312,	.238,	.76,	3,	.360,	.641
F shrinkage mean ,	34022.,	.50,,,,				.240,	.445

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
32675.,	.19,	.15,	12,	.753,	.460

Table 5.5 continued

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	33626.,	.305,	.087,	.28,	4,	.155,	.493
FLT07: Norway Purse ,	36277.,	.470,	.457,	.97,	5,	.080,	.464
FLT08: Norway Trawl ,	15971.,	.223,	.052,	.23,	4,	.520,	.851
F shrinkage mean ,	23765.,	.50,,,,				.245,	.643

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
21098.,	.18,	.12,	14,	.651,	.701

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	11967.,	.308,	.160,	.52,	4,	.114,	.897
FLT07: Norway Purse ,	29525.,	.495,	.391,	.79,	6,	.075,	.463
FLT08: Norway Trawl ,	11073.,	.216,	.075,	.35,	5,	.486,	.944
F shrinkage mean ,	19480.,	.50,,,,				.326,	.638

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
14456.,	.20,	.12,	16,	.582,	.790

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	2191.,	.323,	.078,	.24,	4,	.059,	.838
FLT07: Norway Purse ,	2645.,	.555,	.308,	.56,	6,	.048,	.736
FLT08: Norway Trawl ,	2005.,	.240,	.192,	.80,	6,	.466,	.889
F shrinkage mean ,	3389.,	.50,,,,				.426,	.614

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2555.,	.24,	.12,	17,	.479,	.754

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

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	504.,	.344,	.279,	.81,	4,	.054,	.624
FLT07: Norway Purse ,	402.,	.534,	.528,	.99,	6,	.041,	.735
FLT08: Norway Trawl ,	388.,	.235,	.132,	.56,	7,	.468,	.753
F shrinkage mean ,	683.,	.50,,,,				.436,	.494

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
505.,	.25,	.12,	18,	.491,	.623

Table 5.5 continued

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	108.,	.339,	.088,	.26,	4,	.026,	.994
FLT07: Norway Purse ,	113.,	.596,	.218,	.37,	6,	.021,	.966
FLT08: Norway Trawl ,	74.,	.286,	.384,	1.34,	7,	.292,	1.247
F shrinkage mean ,	193.,	.50,,,,				.661,	.672

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
142.,	.34,	.22,	18,	.636,	.832

Table 5.6

Run title : Arctic Saithe (run: XSASME01/X01)

At 25-Aug-97 13:49:52

Table 1 Catch numbers at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
2,	6952,	5297,	4090,	25952,	19842,	11608,	13829,	21159,	81601,	54151,
3,	29664,	25196,	77333,	43540,	77019,	65178,	76296,	36782,	60832,	125030,
4,	24836,	18384,	11949,	62846,	59280,	52389,	25206,	44027,	11691,	30576,
5,	35956,	5101,	16939,	13987,	26961,	29146,	26911,	15671,	16366,	7947,
6,	4125,	8282,	4747,	16189,	9556,	10186,	16031,	20419,	4436,	8712,
7,	5616,	787,	4798,	5122,	9592,	5616,	7114,	12148,	7808,	3435,
8,	2916,	1913,	1126,	7950,	2901,	3547,	3935,	4802,	6789,	3212,
9,	1413,	900,	1711,	2504,	4352,	1865,	2871,	3258,	2914,	2679,
10,	1397,	577,	675,	3697,	2195,	2140,	2610,	2505,	2350,	1724,
+gp,	3493,	1166,	511,	2799,	5490,	3149,	3924,	3821,	4140,	2880,
TOTALNUM,	116368,	67603,	123879,	184586,	217188,	184824,	178727,	164592,	198927,	240346,
TONSLAND,	191191,	107181,	140379,	260404,	244732,	210508,	215659,	262301,	233453,	242486,
SOPCOF %,	100,	113,	98,	96,	80,	82,	82,	97,	102,	100,

Table 1 Catch numbers at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
2,	31662,	45758,	28334,	18226,	10467,	17225,	11638,	14624,	2216,	3311,
3,	99049,	48969,	61963,	40796,	83954,	34733,	17244,	41466,	48917,	22115,
4,	34317,	27685,	23328,	36644,	21822,	65052,	23768,	33233,	11974,	12895,
5,	10140,	12476,	14122,	9211,	21528,	13060,	32700,	12064,	7189,	6062,
6,	2062,	4534,	4400,	6379,	3619,	8212,	3226,	11204,	5279,	4525,
7,	4332,	1468,	2901,	3200,	2550,	1054,	3008,	1135,	3740,	2805,
8,	1456,	1848,	963,	1338,	2008,	1251,	1177,	1772,	775,	1399,
9,	1606,	938,	1356,	147,	369,	461,	760,	560,	878,	351,
10,	963,	976,	438,	730,	279,	263,	247,	557,	134,	454,
+gp,	1134,	2150,	1192,	1629,	629,	448,	760,	897,	701,	285,
TOTALNUM,	186721,	146802,	138997,	118300,	147225,	141759,	94528,	117512,	81803,	54202,
TONSLAND,	182808,	154465,	164234,	154379,	175516,	170903,	155405,	158796,	107147,	70458,
SOPCOF %,	101,	103,	114,	100,	100,	100,	100,	100,	99,	99,

Table 1 Catch numbers at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	3867,	5017,	11157,	11543,	6135,	14333,	3379,	1389,	70,	970,
3,	17869,	8126,	12378,	21002,	73878,	49750,	26933,	9088,	16411,	7045,
4,	49829,	35847,	19915,	13463,	11619,	26640,	63451,	37361,	48600,	31410,
5,	4339,	32827,	32643,	8996,	5395,	4865,	26254,	47178,	37726,	21087,
6,	3118,	4560,	18751,	9152,	5066,	5594,	3427,	17101,	32365,	23703,
7,	3490,	2328,	1939,	7735,	2988,	4850,	1636,	1720,	4891,	19214,
8,	755,	1219,	377,	1126,	2009,	3353,	1263,	502,	580,	3177,
9,	620,	966,	191,	154,	272,	1480,	950,	296,	140,	482,
10,	257,	320,	179,	121,	81,	291,	650,	267,	282,	204,
+gp,	797,	102,	149,	253,	132,	267,	106,	676,	300,	457,
TOTALNUM,	84941,	91312,	97679,	73545,	107575,	111423,	128049,	115578,	141365,	107749,
TONSLAND,	91679,	114508,	122664,	95393,	107326,	127606,	153584,	142253,	169444,	171595,
SOPCOF %,	102,	99,	100,	100,	99,	100,	100,	100,	100,	100,

Table 5.7

Run title : Arctic Saithe (run: XSASME01/X01)

At 25-Aug-97 13:49:52

Table 2 Catch weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
2,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,
3,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,
4,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,
5,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,
6,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,
7,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,
8,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,
9,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,
10,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,
+gp,	7.9940,	7.7160,	7.4790,	7.4040,	7.0520,	7.4770,	7.3850,	7.2170,	7.1270,	7.3200,
SOPCOFAC,	.9990,	1.1338,	.9756,	.9575,	.7953,	.8212,	.8167,	.9694,	1.0155,	1.0020,

Table 2 Catch weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
2,	.3400,	.3400,	.3400,	.4500,	.4300,	.5100,	.6000,	.5300,	.3800,	.3200,
3,	.7100,	.7100,	.7100,	.7900,	.7300,	.7700,	1.0500,	.7100,	.7500,	.5900,
4,	1.1100,	1.1100,	1.1100,	1.2700,	1.4000,	1.1200,	1.3300,	1.2600,	1.3300,	1.2200,
5,	1.6300,	1.6300,	1.6300,	2.0300,	2.0500,	2.0200,	1.8600,	2.0200,	2.0700,	1.9700,
6,	2.3300,	2.3300,	2.3300,	2.5500,	2.7600,	2.6100,	2.8000,	2.7000,	2.6300,	2.3000,
7,	3.1600,	3.1600,	3.1600,	3.2900,	3.3000,	3.2700,	4.0000,	3.8800,	3.2800,	2.8700,
8,	4.0300,	4.0300,	4.0300,	4.3400,	4.3800,	3.9100,	4.1800,	4.4700,	3.9600,	3.7200,
9,	4.8700,	4.8700,	4.8700,	5.1500,	5.9500,	4.6900,	5.3300,	5.3600,	4.5400,	4.3000,
10,	5.6300,	5.6300,	5.6300,	5.7500,	6.3900,	5.6300,	5.6800,	6.0600,	5.5500,	4.6900,
+gp,	7.3940,	7.5270,	7.8090,	6.9370,	6.8410,	7.5580,	8.6650,	7.1900,	8.0120,	6.5970,
SOPCOFAC,	1.0061,	1.0278,	1.1388,	.9991,	.9975,	.9961,	.9991,	.9997,	.9930,	.9929,

Table 2 Catch weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	.3400,	.3300,	.4500,	.5400,	.4000,	.4500,	.4600,	.3500,	.5000,	.4100,
3,	.5300,	.6200,	.7400,	.7600,	.7200,	.7000,	.6300,	.5200,	.5600,	.5900,
4,	.8400,	.8700,	.9700,	1.0800,	1.1900,	1.1000,	1.0200,	.7400,	.7800,	.8300,
5,	1.6600,	1.3100,	1.3900,	1.5600,	1.7800,	1.9800,	1.7000,	1.2200,	1.2100,	1.4000,
6,	2.3200,	2.4300,	1.8100,	2.1200,	2.2400,	2.3400,	2.5000,	2.1600,	1.7400,	1.9400,
7,	2.9700,	3.8700,	3.0200,	2.4000,	2.8600,	2.8100,	2.8800,	3.1900,	2.8000,	2.4900,
8,	4.0000,	5.3800,	3.7600,	3.6500,	3.3200,	3.2500,	3.0900,	3.9700,	3.7400,	3.5800,
9,	4.7200,	5.8300,	4.6400,	3.6000,	4.5300,	4.0600,	3.7000,	4.6200,	4.4000,	4.3000,
10,	5.4400,	5.3600,	4.7500,	6.3700,	5.7000,	6.1900,	6.1900,	5.2800,	5.2800,	5.2800,
+gp,	6.9040,	7.4480,	7.5000,	4.7950,	7.1250,	7.3760,	8.1750,	6.0700,	7.4900,	6.9120,
SOPCOFAC,	1.0154,	.9902,	.9978,	1.0001,	.9912,	1.0000,	1.0008,	1.0038,	1.0008,	.9996,

Table 5.8

Run title : Arctic Saithe (run: XSASME01/X01)

At 25-Aug-97 13:49:52

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
2,	.0409,	.0160,	.0131,	.0785,	.1053,	.0472,	.1397,	.1204,	.2764,	.2185,
3,	.1886,	.2043,	.3403,	.1881,	.3512,	.5895,	.4916,	.6678,	.5963,	.9060,
4,	.3280,	.1710,	.1407,	.5148,	.4217,	.4302,	.4770,	.5933,	.4601,	.6944,
5,	.4320,	.1024,	.2355,	.2434,	.4351,	.3784,	.4114,	.6239,	.4585,	.6638,
6,	.1522,	.1649,	.1308,	.3710,	.2613,	.2897,	.3696,	.6380,	.3560,	.4752,
7,	.1596,	.0391,	.1357,	.2035,	.3932,	.2412,	.3378,	.5342,	.5395,	.5182,
8,	.2757,	.0747,	.0722,	.3482,	.1698,	.2453,	.2659,	.4025,	.6577,	.4453,
9,	.1777,	.1275,	.0886,	.2272,	.3264,	.1570,	.3214,	.3682,	.4578,	.5950,
10,	.2407,	.1020,	.1330,	.2802,	.3190,	.2637,	.3433,	.5175,	.4977,	.5439,
+gp,	.2407,	.1020,	.1330,	.2802,	.3190,	.2637,	.3433,	.5175,	.4977,	.5439,
FBAR 3- 6,	.2752,	.1606,	.2118,	.3293,	.3673,	.4220,	.4374,	.6308,	.4677,	.6848,

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
2,	.2178,	.1961,	.2064,	.0581,	.0786,	.1459,	.1145,	.1245,	.0091,	.0181,
3,	.7885,	.6156,	.4437,	.5163,	.4106,	.4026,	.2133,	.7508,	.7799,	.1177,
4,	.6818,	.5271,	.6832,	.5164,	.5825,	.6549,	.5350,	.8203,	.5018,	.4786,
5,	.5210,	.5692,	.5664,	.6401,	.6638,	.8624,	.8392,	.5772,	.4093,	.5158,
6,	.3547,	.4674,	.4009,	.5454,	.5626,	.5779,	.5327,	.7986,	.5404,	.4923,
7,	.4611,	.4623,	.6267,	.5765,	.4371,	.3129,	.4308,	.3600,	.6900,	.6256,
8,	.4331,	.3642,	.6366,	.6752,	.9104,	.3982,	.6953,	.4901,	.4485,	.6052,
9,	.4194,	.5560,	.5005,	.1814,	.3928,	.5387,	.4510,	.8761,	.4826,	.3755,
10,	.4415,	.4890,	.5519,	.5571,	.6184,	.5427,	.6294,	.7135,	.5269,	.4971,
+gp,	.4415,	.4890,	.5519,	.5571,	.6184,	.5427,	.6294,	.7135,	.5269,	.4971,
FBAR 3- 6,	.5865,	.5448,	.5236,	.5545,	.5549,	.6245,	.5300,	.7367,	.5578,	.4011,

Table 8 Fishing mortality (F) at age

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	FBAR 94-96
AGE											
2,	.0427,	.0733,	.1473,	.0453,	.0149,	.0533,	.0178,	.0089,	.0011,	.0151,	.0084,
3,	.1285,	.1188,	.2604,	.4540,	.4498,	.1608,	.1342,	.0609,	.1378,	.1453,	.1146,
4,	.4214,	.4093,	.4740,	.5027,	.4915,	.2879,	.3171,	.2787,	.5281,	.4236,	.4101,
5,	.2907,	.5477,	.8266,	.4074,	.3852,	.3925,	.5135,	.4139,	.5050,	.4599,	.4596,
6,	.5518,	.5676,	.7110,	.5802,	.4244,	.9041,	.5336,	.7635,	.5613,	.7014,	.6754,
7,	.9144,	1.1131,	.5055,	.7380,	.3763,	.9630,	.7445,	.5661,	.5112,	.7897,	.6223,
8,	.3366,	1.0159,	.5180,	.6283,	.4252,	.9840,	.7239,	.5349,	.3762,	.7539,	.5550,
9,	.5982,	.9820,	.4112,	.4134,	.2984,	.6478,	.8667,	.3626,	.2756,	.6230,	.4204,
10,	.5234,	.7260,	.4747,	.5002,	.3988,	.6059,	.6712,	.6413,	.7105,	.8319,	.7279,
+gp,	.5234,	.7260,	.4747,	.5002,	.3988,	.6059,	.6712,	.6413,	.7105,	.8319,	
FBAR 3- 6,	.3481,	.4108,	.5680,	.4861,	.4377,	.4363,	.3746,	.3792,	.4330,	.4325,	

Table 5.9

Run title : Arctic Saithe (run: XSASME01/X01)

At 25-Aug-97 13:49:52

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
2,	191784,	367751,	347332,	379690,	219455,	278018,	117198,	206197,	373423,	304956,
3,	190702,	150729,	296296,	280671,	287381,	161720,	217119,	83441,	149675,	231897,
4,	98167,	129292,	100608,	172613,	190397,	165598,	73430,	108726,	35034,	67500,
5,	113274,	57900,	89221,	71559,	84458,	102245,	88177,	37312,	49180,	18105,
6,	32285,	60206,	42789,	57721,	45932,	44753,	57339,	47843,	16369,	25457,
7,	42075,	22700,	41799,	30737,	32609,	28959,	27424,	32440,	20695,	9388,
8,	13373,	29367,	17873,	29881,	20531,	18019,	18628,	16016,	15567,	9878,
9,	9590,	8310,	22312,	13615,	17271,	14184,	11543,	11691,	8768,	6603,
10,	7218,	6573,	5989,	16720,	8881,	10202,	9926,	6853,	6624,	4542,
+gp,	17946,	13238,	4517,	12579,	22059,	14922,	14813,	10347,	11554,	7507,
TOTAL,	716413,	846067,	968737,	1065785,	928974,	838622,	635597,	560866,	686888,	685831,

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
2,	178790,	283995,	167874,	356670,	153036,	140208,	118869,	138088,	271200,	203751,
3,	200678,	117732,	191112,	111806,	275525,	115825,	99207,	86791,	99825,	220035,
4,	76730,	74678,	52082,	100403,	54625,	149616,	63401,	65621,	33539,	37468,
5,	27598,	31770,	36091,	21533,	49046,	24978,	63634,	30403,	23655,	16625,
6,	7632,	13420,	14722,	16771,	9295,	20676,	8633,	22511,	13976,	12862,
7,	12959,	4383,	6885,	8072,	7959,	4336,	9498,	4149,	8292,	6666,
8,	4578,	6690,	2260,	3012,	3713,	4209,	2596,	5054,	2370,	3405,
9,	5181,	2431,	3806,	979,	1255,	1223,	2314,	1061,	2535,	1239,
10,	2982,	2789,	1141,	1889,	669,	694,	584,	1207,	362,	1281,
+gp,	3480,	6084,	3073,	4169,	1490,	1170,	1777,	1918,	1872,	796,
TOTAL,	520609,	543973,	479046,	625304,	556614,	462935,	370514,	356802,	457625,	504128,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	GMST 60-
AGE												
2,	102219,	78435,	90017,	288046,	458876,	305414,	211311,	173663,	[70418]	[71556]	[0]	210546,
3,	163822,	80191,	59677,	63604,	225387,	370145,	237083,	169949,	140927,	[57590]	[57709]	156000,
4,	160139,	117957,	58302,	37660,	33072,	117684,	258033,	169737,	130920,	100532,	[40778]	88009,
5,	19008,	86024,	64139,	29714,	18651,	16563,	72247,	153847,	105163,	63213,	53889,	45348,
6,	8126,	11636,	40727,	22976,	16188,	10389,	9159,	35395,	83271,	51964,	32675,	22807,
7,	6437,	3832,	5401,	16378,	10530,	8670,	3444,	4398,	13505,	38891,	21098,	12173,
8,	2919,	2112,	1031,	2667,	6410,	5918,	2710,	1339,	2044,	6632,	14456,	6631,
9,	1522,	1707,	626,	503,	1165,	3430,	1811,	1076,	642,	1149,	2555,	3735,
10,	697,	685,	523,	340,	272,	708,	1469,	623,	613,	399,	505,	2148,
+gp,	2139,	215,	432,	703,	440,	642,	237,	1559,	643,	881,	456,	
TOTAL,	467028,	382794,	320875,	462591,	770992,	839563,	797503,	711586,	[548146]	[392807]	[224121]	

Table 5.10

Run title : Arctic Saithe (run: XSASME01/X01)

At 25-Aug-97 13:49:52

Terminal Fs derived using XSA (With F shrinkage)

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
2,	65142,	141765,	115215,	123604,	59343,	77628,	32543,	67961,	128934,	103890,
3,	135264,	121336,	205243,	190800,	162279,	94295,	125898,	57429,	107918,	164972,
4,	108858,	162716,	108953,	183451,	168085,	150953,	66567,	116992,	39491,	75073,
5,	184453,	107004,	141886,	111680,	109490,	136866,	117383,	58957,	81408,	29569,
6,	75150,	159050,	97268,	128770,	85117,	85633,	109111,	108062,	38731,	59432,
7,	132826,	81331,	128865,	92999,	81955,	75151,	70775,	99371,	66410,	29724,
8,	53839,	134182,	70274,	115297,	65805,	59635,	61311,	62568,	63710,	39889,
9,	46657,	45886,	106013,	63483,	66894,	56729,	45912,	55191,	43361,	32218,
10,	40597,	41958,	32899,	90128,	39767,	47170,	45639,	37402,	37870,	25620,
+gp,	143315,	115814,	32957,	89172,	123719,	91626,	89344,	72389,	83623,	55057,
TOTALBIO,	986103,	1111042,	1039575,	1189383,	962454,	875685,	764483,	736322,	691459,	615443,

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
2,	61160,	99242,	64999,	160352,	65643,	71229,	71257,	73168,	102334,	64737,
3,	143351,	85913,	154522,	88244,	200637,	88839,	104073,	61606,	74344,	128898,
4,	85690,	85197,	65834,	127393,	76287,	166920,	84247,	82661,	45293,	45386,
5,	45260,	53224,	66993,	43671,	100297,	50260,	118251,	61398,	49093,	32518,
6,	17891,	32138,	39063,	42726,	25592,	53756,	24151,	60764,	36498,	29373,
7,	41202,	14235,	24777,	26532,	26199,	14123,	37957,	16095,	27009,	18994,
8,	18562,	27712,	10372,	13060,	16224,	16392,	10842,	22587,	9343,	12577,
9,	25388,	12166,	21105,	5038,	7452,	5715,	12322,	5683,	11402,	5291,
10,	16889,	16139,	7318,	10850,	4262,	3892,	3317,	7311,	1989,	5965,
+gp,	25886,	47068,	27326,	28895,	10165,	8806,	15382,	13784,	15224,	5215,
TOTALBIO,	481279,	473033,	482309,	546762,	532756,	479932,	481798,	405056,	372530,	348954,

Table 14 Stock biomass at age with SOP (start of year) Tonnes

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	35289,	25630,	40417,	155561,	181944,	137435,	97281,	61013,	[35236]	[29328]
3,	88161,	49232,	44063,	48344,	160859,	259100,	149482,	88709,	78980,	[33966]
4,	136585,	101619,	56427,	40677,	39011,	129452,	263405,	126082,	102197,	83412,
5,	32038,	111589,	88955,	46359,	32909,	32795,	122918,	188406,	127346,	88467,
6,	19142,	28000,	73551,	48715,	35943,	24309,	22916,	76744,	145004,	100776,
7,	19410,	14683,	16274,	39311,	29853,	24361,	9926,	14082,	37844,	96806,
8,	11857,	11251,	3846,	9737,	21095,	19233,	8379,	5337,	7652,	23733,
9,	7295,	9854,	2899,	1810,	5232,	13927,	6707,	4988,	2828,	4939,
10,	3850,	3637,	2481,	2165,	1538,	4381,	9103,	3304,	3238,	2107,
+gp,	14996,	1589,	3230,	3373,	3107,	4734,	1936,	9498,	4822,	6085,
TOTALBIO,	368623,	357084,	332142,	396051,	511491,	649728,	692053,	578164,	[545147]	[469618]

Table 5.11

Run title : Arctic Saithe (run: XSASME01/X01)

At 25-Aug-97 13:49:52

Terminal Fs derived using XSA (With F shrinkage)

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1089,	1627,	1090,	1835,	1681,	1510,	666,	1170,	395,	751,
5,	101449,	58852,	78037,	61424,	60220,	75276,	64561,	32426,	44775,	16263,
6,	63878,	135192,	82678,	109454,	72349,	72788,	92744,	91852,	32922,	50517,
7,	130169,	79704,	126288,	91139,	80316,	73648,	69360,	97384,	65082,	29130,
8,	53839,	134182,	70274,	115297,	65805,	59635,	61311,	62568,	63710,	39889,
9,	46657,	45886,	106013,	63483,	66894,	56729,	45912,	55191,	43361,	32218,
10,	40597,	41958,	32899,	90128,	39767,	47170,	45639,	37402,	37870,	25620,
+gp,	143315,	115814,	32957,	89172,	123719,	91626,	89344,	72389,	83623,	55057,
TOTSPBIO,	580994,	613216,	530237,	621931,	510750,	478382,	469536,	450383,	371738,	249443,

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	857,	852,	658,	1274,	763,	1669,	842,	827,	453,	454,
5,	24893,	29273,	36846,	24019,	55163,	27643,	65038,	33769,	27001,	17885,
6,	15208,	27318,	33204,	36317,	21753,	45692,	20528,	51649,	31024,	24967,
7,	40378,	13950,	24281,	26002,	25675,	13840,	37197,	15773,	26469,	18614,
8,	18562,	27712,	10372,	13060,	16224,	16392,	10842,	22587,	9343,	12577,
9,	25388,	12166,	21105,	5038,	7452,	5715,	12322,	5683,	11402,	5291,
10,	16889,	16139,	7318,	10850,	4262,	3892,	3317,	7311,	1989,	5965,
+gp,	25886,	47068,	27326,	28895,	10165,	8806,	15382,	13784,	15224,	5215,
TOTSPBIO,	168060,	174478,	161110,	145455,	141457,	123650,	165469,	151382,	122905,	90968,

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1366,	1016,	564,	407,	390,	1295,	2634,	1261,	1022,	834,
5,	17621,	61374,	48925,	25497,	18100,	18037,	67605,	103623,	70040,	48657,
6,	16271,	23800,	62519,	41408,	30552,	20663,	19478,	65232,	123253,	85659,
7,	19022,	14390,	15949,	38525,	29256,	23874,	9728,	13801,	37087,	94869,
8,	11857,	11251,	3846,	9737,	21095,	19233,	8379,	5337,	7652,	23733,
9,	7295,	9854,	2899,	1810,	5232,	13927,	6707,	4988,	2828,	4939,
10,	3850,	3637,	2481,	2165,	1538,	4381,	9103,	3304,	3238,	2107,
+gp,	14996,	1589,	3230,	3373,	3107,	4734,	1936,	9498,	4822,	6085,
TOTSPBIO,	92277,	126910,	140412,	122921,	109270,	106144,	125570,	207044,	249942,	266883,

Table 5.12

Run title : Arctic Saithe (run: XSASME01/X01)

At 25-Aug-97 13:49:52

Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 3- 6,
1960,	121637,	623130,	320629,	136006,	.4242,	1.2793,	.2667,
1961,	213257,	777102,	406888,	109821,	.2699,	1.4354,	.2338,
1962,	355464,	863438,	423005,	122841,	.2904,	1.2489,	.2289,
1963,	121787,	925321,	439208,	148036,	.3371,	1.2026,	.2244,
1964,	368858,	1072442,	525322,	198110,	.3771,	1.1684,	.2263,
1965,	210304,	997748,	519820,	184548,	.3550,	1.0721,	.2255,
1966,	241157,	1075000,	563238,	201860,	.3584,	1.0963,	.2768,
1967,	191784,	986103,	580994,	191191,	.3291,	.9990,	.2752,
1968,	367751,	1111042,	613216,	107181,	.1748,	1.1338,	.1606,
1969,	347332,	1039575,	530237,	140379,	.2647,	.9756,	.2118,
1970,	379690,	1189383,	621931,	260404,	.4187,	.9575,	.3293,
1971,	219455,	962454,	510750,	244732,	.4792,	.7953,	.3673,
1972,	278018,	875685,	478382,	210508,	.4400,	.8212,	.4220,
1973,	117198,	764483,	469536,	215659,	.4593,	.8167,	.4374,
1974,	206197,	736321,	450383,	262301,	.5824,	.9694,	.6308,
1975,	373423,	691459,	371738,	233453,	.6280,	1.0155,	.4677,
1976,	304955,	615443,	249444,	242486,	.9721,	1.0020,	.6848,
1977,	178790,	481279,	168060,	182808,	1.0878,	1.0061,	.5865,
1978,	283995,	473034,	174478,	154465,	.8853,	1.0278,	.5448,
1979,	167874,	482309,	161110,	164234,	1.0194,	1.1388,	.5236,
1980,	356670,	546762,	145455,	154379,	1.0614,	.9991,	.5545,
1981,	153036,	532756,	141457,	175516,	1.2408,	.9975,	.5549,
1982,	140208,	479932,	123650,	170903,	1.3821,	.9961,	.6245,
1983,	118869,	481798,	165469,	155405,	.9392,	.9991,	.5300,
1984,	138088,	405056,	151382,	158796,	1.0490,	.9997,	.7367,
1985,	271200,	372530,	122905,	107147,	.8718,	.9930,	.5578,
1986,	203751,	348954,	90968,	70458,	.7745,	.9929,	.4011,
1987,	102219,	368623,	92277,	91679,	.9935,	1.0154,	.3481,
1988,	78435,	357084,	126910,	114508,	.9023,	.9902,	.4108,
1989,	90017,	332142,	140412,	122664,	.8736,	.9978,	.5680,
1990,	288046,	396051,	122921,	95393,	.7761,	1.0001,	.4861,
1991,	458876,	511491,	109270,	107326,	.9822,	.9912,	.4377,
1992,	305414,	649728,	106144,	127606,	1.2022,	1.0000,	.4363,
1993,	211311,	692053,	125570,	153584,	1.2231,	1.0008,	.3746,
1994,	173664,	578164,	207044,	142253,	.6871,	1.0038,	.3792,
1995,	197000,	608438,	249942,	169444,	.6779,	1.0008,	.4330,
1996,	176000,	572790,	266883,	171595,	.6430,	.9996,	.4325,
Arith. Mean ,	223803,	670558,	299109,	162153,	.7144		.4214,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 5.13. North-East Arctic Saithe
Estimation of weight at age (kilogrammes) in the prediction.

	Observed weight-at-age in the catch			
Age	**1994**	**1995**	**1996**	**1994-96** [1]
2	0.35	0.50	0.41	0.42
3	0.52	0.56	0.59	0.56
4	0.74	0.78	0.83	0.78
5	1.22	1.21	1.40	1.28
6	2.16	1.74	1.94	1.95
7	3.19	2.80	2.49	2.83
8	3.97	3.74	3.58	3.76
9	4.62	4.40	4.30	4.44
10	5.28	5.28	5.28	5.28
11+	6.07	7.48	6.91	6.82

1) Weight-at-age used in the predictions.

Table 5.14

Saithe in the North-East Arctic (Areas I and II)

Prediction with management option table: Input data

Year: 1997								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.420	0.0087	0.420
3	142848.00	0.2000	0.0000	0.0000	0.0000	0.560	0.1194	0.560
4	116176.00	0.2000	0.0100	0.0000	0.0000	0.780	0.4275	0.780
5	53889.000	0.2000	0.5500	0.0000	0.0000	1.280	0.4791	1.280
6	32675.000	0.2000	0.8500	0.0000	0.0000	1.950	0.7040	1.950
7	21098.000	0.2000	0.9800	0.0000	0.0000	2.830	0.6487	2.830
8	14456.000	0.2000	1.0000	0.0000	0.0000	3.760	0.5785	3.760
9	2555.000	0.2000	1.0000	0.0000	0.0000	4.440	0.4382	4.440
10	505.000	0.2000	1.0000	0.0000	0.0000	5.280	0.7587	5.280
11+	456.000	0.2000	1.0000	0.0000	0.0000	6.820	0.7587	6.820
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.420	0.0087	0.420
3	.	0.2000	0.0000	0.0000	0.0000	0.560	0.1194	0.560
4	.	0.2000	0.0100	0.0000	0.0000	0.780	0.4275	0.780
5	.	0.2000	0.5500	0.0000	0.0000	1.280	0.4791	1.280
6	.	0.2000	0.8500	0.0000	0.0000	1.950	0.7040	1.950
7	.	0.2000	0.9800	0.0000	0.0000	2.830	0.6487	2.830
8	.	0.2000	1.0000	0.0000	0.0000	3.760	0.5785	3.760
9	.	0.2000	1.0000	0.0000	0.0000	4.440	0.4382	4.440
10	.	0.2000	1.0000	0.0000	0.0000	5.280	0.7587	5.280
11+	.	0.2000	1.0000	0.0000	0.0000	6.820	0.7587	6.820
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.420	0.0087	0.420
3	.	0.2000	0.0000	0.0000	0.0000	0.560	0.1194	0.560
4	.	0.2000	0.0100	0.0000	0.0000	0.780	0.4275	0.780
5	.	0.2000	0.5500	0.0000	0.0000	1.280	0.4791	1.280
6	.	0.2000	0.8500	0.0000	0.0000	1.950	0.7040	1.950
7	.	0.2000	0.9800	0.0000	0.0000	2.830	0.6487	2.830
8	.	0.2000	1.0000	0.0000	0.0000	3.760	0.5785	3.760
9	.	0.2000	1.0000	0.0000	0.0000	4.440	0.4382	4.440
10	.	0.2000	1.0000	0.0000	0.0000	5.280	0.7587	5.280
11+	.	0.2000	1.0000	0.0000	0.0000	6.820	0.7587	6.820
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANSME02
Date and time: 25AUG97:15:35

Table 5.15

Saithe in the North-East Arctic (Areas I and II)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	13533.640	2.713	11669.164	2.713	11669.164
0.0500	0.0216	0.090	301.834	5.066	11039.280	2.278	9195.329	2.278	9195.329
0.1000	0.0433	0.158	483.542	4.730	9271.938	1.956	7447.775	1.956	7447.775
0.1500	0.0649	0.211	594.894	4.467	7964.165	1.707	6159.089	1.707	6159.089
0.2000	0.0865	0.254	663.101	4.255	6964.264	1.510	5177.607	1.510	5177.607
0.2500	0.1081	0.289	703.990	4.079	6179.904	1.348	4411.029	1.348	4411.029
0.3000	0.1298	0.319	727.201	3.931	5551.757	1.213	3800.058	1.213	3800.058
0.3500	0.1514	0.345	738.807	3.805	5040.025	1.100	3304.924	1.100	3304.924
0.4000	0.1730	0.367	742.743	3.695	4617.066	1.002	2898.010	1.002	2898.010
0.4500	0.1946	0.386	741.605	3.598	4263.113	0.918	2559.576	0.918	2559.576
0.5000	0.2163	0.404	737.136	3.513	3963.686	0.845	2275.165	0.845	2275.165
0.5500	0.2379	0.419	730.519	3.436	3707.955	0.780	2033.970	0.780	2033.970
0.6000	0.2595	0.433	722.563	3.368	3487.676	0.723	1827.766	0.723	1827.766
0.6500	0.2811	0.446	713.825	3.305	3296.471	0.672	1650.199	0.672	1650.199
0.7000	0.3028	0.458	704.686	3.249	3129.343	0.626	1496.288	0.626	1496.288
0.7500	0.3244	0.468	695.411	3.197	2982.326	0.585	1362.085	0.585	1362.085
0.8000	0.3460	0.478	686.177	3.149	2852.239	0.548	1244.428	0.548	1244.428
0.8500	0.3676	0.487	677.104	3.105	2736.507	0.514	1140.757	0.514	1140.757
0.9000	0.3893	0.495	668.272	3.065	2633.024	0.483	1048.982	0.483	1048.982
0.9500	0.4109	0.503	659.730	3.027	2540.059	0.455	967.387	0.455	967.387
1.0000	0.4325	0.510	651.507	2.992	2456.174	0.429	894.547	0.429	894.547
1.0500	0.4541	0.517	643.618	2.959	2380.170	0.406	829.276	0.406	829.276
1.1000	0.4758	0.524	636.067	2.928	2311.039	0.384	770.579	0.384	770.579
1.1500	0.4974	0.530	628.852	2.899	2247.928	0.364	717.616	0.364	717.616
1.2000	0.5190	0.535	621.967	2.872	2190.115	0.345	669.675	0.345	669.675
1.2500	0.5406	0.541	615.400	2.846	2136.982	0.328	626.149	0.328	626.149
1.3000	0.5623	0.546	609.140	2.821	2088.000	0.312	586.520	0.312	586.520
1.3500	0.5839	0.551	603.174	2.798	2042.712	0.297	550.340	0.297	550.340
1.4000	0.6055	0.555	597.489	2.776	2000.725	0.283	517.226	0.283	517.226
1.4500	0.6271	0.560	592.069	2.755	1961.695	0.269	486.843	0.269	486.843
1.5000	0.6488	0.564	586.902	2.735	1925.325	0.257	458.901	0.257	458.901
1.5500	0.6704	0.568	581.974	2.716	1891.353	0.246	433.148	0.246	433.148
1.6000	0.6920	0.572	577.273	2.698	1859.550	0.235	409.362	0.235	409.362
1.6500	0.7136	0.575	572.786	2.680	1829.715	0.225	387.349	0.225	387.349
1.7000	0.7353	0.579	568.501	2.663	1801.669	0.215	366.938	0.215	366.938
1.7500	0.7569	0.582	564.407	2.647	1775.255	0.206	347.978	0.206	347.978
1.8000	0.7785	0.585	560.494	2.632	1750.333	0.197	330.335	0.197	330.335
1.8500	0.8001	0.589	556.752	2.617	1726.777	0.189	313.890	0.189	313.890
1.9000	0.8218	0.592	553.171	2.603	1704.476	0.182	298.539	0.182	298.539
1.9500	0.8434	0.594	549.742	2.589	1683.330	0.174	284.185	0.174	284.185
2.0000	0.8650	0.597	546.459	2.576	1663.250	0.167	270.746	0.167	270.746
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDSME02
Date and time : 25AUG97:15:46
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.2289
F-max factor : 0.4110
F-0.1 reference F : 0.0990
F-max reference F : 0.1777
Recruitment : Single recruit

Table 5.16

Saithe in the North-East Arctic (Areas I and II)

Prediction with management option table

Year: 1997					Year: 1998					Year: 1999	
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
0.9503	0.4110	522689	222991	140000	0.0000	0.0000	514864	205092	0	684242	326245
.	.	.	.	.	0.0500	0.0216	.	205092	8523	673282	317414
.	.	.	.	.	0.1000	0.0433	.	205092	16829	662607	308832
.	.	.	.	.	0.1500	0.0649	.	205092	24925	652209	300492
.	.	.	.	.	0.2000	0.0865	.	205092	32818	642081	292387
.	.	.	.	.	0.2500	0.1081	.	205092	40511	632214	284509
.	.	.	.	.	0.3000	0.1298	.	205092	48012	622601	276853
.	.	.	.	.	0.3500	0.1514	.	205092	55325	613235	269412
.	.	.	.	.	0.4000	0.1730	.	205092	62456	604110	262179
.	.	.	.	.	0.4500	0.1946	.	205092	69410	595218	255148
.	.	.	.	.	0.5000	0.2163	.	205092	76191	586553	248314
.	.	.	.	.	0.5500	0.2379	.	205092	82805	578109	241671
.	.	.	.	.	0.6000	0.2595	.	205092	89255	569879	235214
.	.	.	.	.	0.6500	0.2811	.	205092	95547	561858	228936
.	.	.	.	.	0.7000	0.3028	.	205092	101685	554039	222833
.	.	.	.	.	0.7500	0.3244	.	205092	107673	546418	216900
.	.	.	.	.	0.8000	0.3460	.	205092	113515	538988	211131
.	.	.	.	.	0.8500	0.3676	.	205092	119215	531745	205523
.	.	.	.	.	0.9000	0.3893	.	205092	124778	524682	200069
.	.	.	.	.	0.9500	0.4109	.	205092	130206	517796	194767
.	.	.	.	.	1.0000	0.4325	.	205092	135503	511082	189611
.	.	.	.	.	1.0500	0.4541	.	205092	140674	504534	184598
.	.	.	.	.	1.1000	0.4758	.	205092	145720	498148	179723
.	.	.	.	.	1.1500	0.4974	.	205092	150647	491919	174982
.	.	.	.	.	1.2000	0.5190	.	205092	155457	485844	170372
.	.	.	.	.	1.2500	0.5406	.	205092	160153	479918	165888
.	.	.	.	.	1.3000	0.5623	.	205092	164738	474138	161528
.	.	.	.	.	1.3500	0.5839	.	205092	169216	468498	157287
.	.	.	.	.	1.4000	0.6055	.	205092	173588	462995	153162
.	.	.	.	.	1.4500	0.6271	.	205092	177859	457626	149150
.	.	.	.	.	1.5000	0.6488	.	205092	182030	452387	145248
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSME02
Date and time : 25AUG97:15:35
Computation of ref. F: Simple mean, age 3 - 6
Basis for 1997 : TAC constraints

Table 5.17

The SAS System 12:42 Monday, August 25, 199

Saithe in the North-East Arctic (Areas I and II)

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	0.9503	0.4110	99204	140002	594658	522689	97223	222991	97223	222991
1998	0.2289	0.0990	26759	37288	607892	514861	91025	205089	91025	205089
1999	0.2289	0.0990	34690	51751	683569	636343	125247	287803	125247	287803
2000	0.2289	0.0990	40902	66754	738379	762818	166893	394309	166893	394309
2001	0.2289	0.0990	45790	81077	777655	877688	203170	505495	203170	505495
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	0.9503	0.4110	99204	140002	594658	522689	97223	222991	97223	222991
1998	0.4110	0.1778	46249	64001	607892	514861	91025	205089	91025	205089
1999	0.4110	0.1778	56603	81912	666049	602131	114133	260612	114133	260612
2000	0.4110	0.1778	63861	98459	704347	685415	141979	327885	141979	327885
2001	0.4110	0.1778	69156	112899	729172	752359	164566	392635	164566	392635
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	0.9503	0.4110	99204	140002	594658	522689	97223	222991	97223	222991
1998	0.8324	0.3600	86034	117224	607892	514861	91025	205089	91025	205089
1999	0.8324	0.3600	93095	125478	630451	534271	92196	207477	92196	207477
2000	0.8324	0.3600	96801	130817	642591	551970	98755	216092	98755	216092
2001	0.8324	0.3600	99426	135313	649205	561517	104313	225719	104313	225719
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	0.9503	0.4110	99204	140002	594658	522689	97223	222991	97223	222991
1998	1.0000	0.4325	100044	135502	607892	514861	91025	205089	91025	205089
1999	1.0000	0.4325	103474	135567	617976	511080	84744	189610	84744	189610
2000	1.0000	0.4325	104912	134702	623161	512290	85845	183803	85845	183803
2001	1.0000	0.4325	106320	135291	626112	511225	88049	183399	88049	183399
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	0.9503	0.4110	99204	140002	594658	522689	97223	222991	97223	222991
1998	1.4335	0.6200	132238	176459	607892	514861	91025	205089	91025	205089
1999	1.4335	0.6200	122858	149653	589448	459382	68251	150460	68251	150460
2000	1.4335	0.6200	118611	134357	582707	434206	60421	122269	60421	122269
2001	1.4335	0.6200	117757	128477	580957	421162	58448	110862	58448	110862
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSME01
Date and time : 25AUG97:16:02
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors

Table 5.18

Saithe in the North-East Arctic (Areas I and II)

Single option prediction: Detailed tables

Year: 1997 F-factor: 0.9503 Reference F: 0.4110

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2	0.0083	1567	658	210000	88200	0	0	0	0
3	0.1135	13914	7792	142848	79995	0	0	0	0
4	0.4063	35391	27605	116176	90617	1162	906	1162	906
5	0.4553	17998	23038	53889	68978	29639	37938	29639	37938
6	0.6690	14606	28481	32675	63716	27774	54159	27774	54159
7	0.6165	8889	25156	21098	59707	20676	58513	20676	58513
8	0.5497	5592	21024	14456	54355	14456	54355	14456	54355
9	0.4164	794	3526	2555	11344	2555	11344	2555	11344
10	0.7210	238	1256	505	2666	505	2666	505	2666
11+	0.7210	215	1465	456	3110	456	3110	456	3110
Total		99204	140002	594658	522689	97223	222991	97223	222991
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1998 F-factor: 0.8324 Reference F: 0.3600

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2	0.0072	1374	577	210000	88200	0	0	0	0
3	0.0994	14646	8202	170518	95490	0	0	0	0
4	0.3559	28502	22232	104409	81439	1044	814	1044	814
5	0.3988	19012	24335	63361	81102	34849	44606	34849	44606
6	0.5860	11357	22146	27984	54569	23787	46384	23787	46384
7	0.5400	5228	14796	13703	38779	13429	38003	13429	38003
8	0.4815	3256	12242	9325	35063	9325	35063	9325	35063
9	0.3648	1904	8452	6830	30326	6830	30326	6830	30326
10	0.6315	592	3123	1379	7283	1379	7283	1379	7283
11+	0.6315	164	1119	383	2609	383	2609	383	2609
Total		86034	117224	607892	514861	91025	205089	91025	205089
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1999 F-factor: 0.8324 Reference F: 0.3600

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2	0.0072	1374	577	210000	88200	0	0	0	0
3	0.0994	14661	8210	170693	95588	0	0	0	0
4	0.3559	34506	26914	126400	98592	1264	986	1264	986
5	0.3988	17969	23001	59887	76656	32938	42161	32938	42161
6	0.5860	14129	27552	34815	67889	29593	57706	29593	57706
7	0.5400	4865	13769	12751	36086	12496	35364	12496	35364
8	0.4815	2283	8583	6538	24583	6538	24583	6538	24583
9	0.3648	1315	5837	4717	20944	4717	20944	4717	20944
10	0.6315	1665	8792	3883	20502	3883	20502	3883	20502
11+	0.6315	329	2243	767	5232	767	5232	767	5232
Total		93095	125478	630451	534271	92196	207477	92196	207477
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 5.18 (Continued)

The SAS System 21:18 Monday, August 25, 1997

Saithe in the North-East Arctic (Areas I and II)

Single option prediction: Detailed tables

(cont.)

Year: 2000	F-factor: 0.8324	Reference F: 0.3600				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0072	1374	577	210000	90300	0	0	0	0
3	0.0994	14661	8210	170693	95588	0	0	0	0
4	0.3559	34541	26942	126530	98693	1265	987	1265	987
5	0.3988	21754	27845	72501	92801	39876	51041	39876	51041
6	0.5860	13354	26041	32906	64167	27970	54542	27970	54542
7	0.5400	6053	17130	15864	44895	15547	43997	15547	43997
8	0.4815	2124	7987	6084	22876	6084	22876	6084	22876
9	0.3648	922	4092	3307	14684	3307	14684	3307	14684
10	0.6315	1150	6072	2682	14159	2682	14159	2682	14159
11+	0.6315	868	5921	2025	13807	2025	13807	2025	13807
Total		96801	130817	642591	551970	98755	216092	98755	216092
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001	F-factor: 0.8324	Reference F: 0.3600				1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
2	0.0072	1374	577	210000	88200	0	0	0	0
3	0.0994	14661	8210	170693	95588	0	0	0	0
4	0.3559	34541	26942	126530	98693	1265	987	1265	987
5	0.3988	21777	27874	72575	92897	39916	51093	39916	51093
6	0.5860	16167	31526	39837	77682	33861	66030	33861	66030
7	0.5400	5721	16190	14994	42433	14694	41584	14694	41584
8	0.4815	2643	9937	7569	28459	7569	28459	7569	28459
9	0.3648	858	3808	3077	13664	3077	13664	3077	13664
10	0.6315	806	4257	1880	9927	1880	9927	1880	9927
11+	0.6315	879	5992	2049	13974	2049	13974	2049	13974
Total		99426	135313	649205	561517	104313	225719	104313	225719
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSME01
Date and time : 25AUG97:21:38
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors

Table 5.19

Saithe in the North-East Arctic (Areas I and II) The SAS System 10:15 Thursday, August 28, 1997

(cont.)

Single option prediction: Input data

Year: 1998								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.420	0.0000	0.680
3	.	0.2000	0.0000	0.0000	0.0000	0.560	0.0173	0.810
4	.	0.2000	0.0100	0.0000	0.0000	0.780	0.2408	0.970
5	.	0.2000	0.5500	0.0000	0.0000	1.280	0.4694	1.280
6	.	0.2000	0.8500	0.0000	0.0000	1.950	0.5952	1.950
7	.	0.2000	0.9800	0.0000	0.0000	2.830	0.6487	2.830
8	.	0.2000	1.0000	0.0000	0.0000	3.760	0.5785	3.760
9	.	0.2000	1.0000	0.0000	0.0000	4.440	0.4382	4.440
10	.	0.2000	1.0000	0.0000	0.0000	5.280	0.7587	5.280
11+	.	0.2000	1.0000	0.0000	0.0000	6.820	0.7587	6.820
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SPRSME02
Date and time: 28AUG97:10:16

Saithe in the North-East Arctic (Areas I and II) The SAS System 22:18 Wednesday, August 27, 1997

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	0.9503	0.4110	99204	140002	594658	522689	97223	222991	97223	222991
1998	1.0000	0.3307	68968	117726	607892	514861	91025	205089	91025	205089
1999	1.0000	0.3307	77065	125685	645841	541244	92713	201901	92713	201901
2000	1.0000	0.3307	85311	135978	669636	569382	105548	216312	105548	216312
2001	1.0000	0.3307	90184	144400	681728	590783	115672	234080	115672	234080
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1997	0.9503	0.4110	99204	140002	594658	522689	97223	222991	97223	222991
1998	1.0886	0.3600	73831	125728	607892	514861	91025	205089	91025	205089
1999	1.0886	0.3600	80780	130160	641519	531645	89449	193704	89449	193704
2000	1.0886	0.3600	88507	138243	662803	553285	100164	202218	100164	202218
2001	1.0886	0.3600	92999	145240	673308	570184	108825	215726	108825	215726
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSME02
Date and time : 27AUG97:22:20
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors

Table 6.1 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I and Divisions IIa and IIb combined.

Year	Canada	Denmark	Faroe Islands	France	Germany[3]	Greenland	Ireland	Norway	Portugal	Russia[4]	Spain	UK England and Wales	UK Scotland	Total
1986	-	-	-	-	1,252	-	-	1,274	1,273	17,815	-	84	-	23,112[2]
1987	-	-	200	63	1,321	-	-	1,488	1,175	6,196	25	49	1	10,518
1988	No species specific data presently available													15,586
1989	-	-	335	1,093	3,833	-	-	4,633	340	13,080	5	174	1	23,494
1990	-	-	108	142	6,354	36	-	10,173	830	17,355	-	72	-	35,070
1991	-	-	487	85	-	23	-	33,592	166	14,302	1	68	3	48,727
1992	-	-	23	12	-	-	-	10,751	972	3,577	14	238	3	15,590
1993	8	4	13	50	35	1	-	4,939	963	6,260	57	293	-	12,623
1994[1]	-	28	4	74	18	1	3	6,029	895	5,021	30	124	12	12,239
1995[1]	-	-	3	16	176	2	4	2,534	927	6,346	67	93	4	10,172
1996[1]	-	-	4	46	119	3	2	6,131	429	925	328	76	23	8,086

[1] Provisional figures.
[2] Including 1,414 tonnes in Division IIb not split on countries.
[3] Includes former GDR prior to 1991.
[4] USSR prior to 1991.

Table 6.2 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Sub-area 1.

Year	Faroe Islands	Germany[4]	Norway	Russia[5]	UK England & Wales	Total
1986[3]	-	-	1,274	911	-	2,185
1987[3]	-	2	1,166	234	3	1,405
1988		No species specific data presently available				
1989	13	-	60	484	9[2]	566
1990	2	-	-	100	-	102
1991	-	-	8	420	-	428
1992	-		561	408	-	969
1993	2[2]	-	24	588	-	614
1994[1]	2[2]	2	37	308	-	349
1995[1]	2[2]	-	23	203	-	228
1996[1]	-	-	6	101	-	107

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 6.3 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Norway	Portugal	Russia[5]	Spain	UK England & Wales	UK Scotland	Total
1986[3]	-	-	1,252	-	-	-	1,273	16,904	-	84	-	19,513
1987[3]	200	63	970	-	-	149	1,156	4,469	-	34	1	7,042
1988	No species specific data presently available											
1989	312[2]	1,065[2]	3,200	-	-	4,573	251	9,749	-	158[2]	1[2]	19,309
1990	98[2]	137[2]	1,673	-	-	8,842	824	6,492	-	9	-	18,075
1991	487[2]	72[2]	-	-	-	32,810	159[2]	7,596	-	23[2]	-	41,147
1992	23[2]	7[2]	-	-	-	9,816	824[2]	1,096	-	27[2]	-	11,793
1993	11[2]	15[2]	35	1[2]	-	4,870	648[2]	5,328	-	2[2]	-	10;910
1994[1]	2[2]	33[2]	16[2]	1[2]	2[2]	5,629	687[2]	4,692	8[2]	4[2]	-	11,074
1995[1]	1[2]	16[2]	176[2]	2[2]	2[2]	2,092	715[2]	5,916	65[2]	41[2]	2[2]	9,028
1996[1]	-	39[2]	119[2]	3[2]	-	5,942	429[2]	677	5[2]	42[2]	19[2]	7,275

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 6.4 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Division IIb

Year	Canada	Denmark	Faroe Islands	France	Germany[5]	Greenland	Ireland	Norway	Portugal	Russia[6]	Spain	UK England and Wales	UK Scotland	Total
1986[4]						Data not available on countries								1,414
1987[4]	-	-	-	-	349	-	-	173	19	1,493	25	12	-	2,071
1988						No species specific data presently available								
1989	-	-	10	28	633	-	-	-	89	2,847	5	7[2]	-	3,619
1990	-	-	8[2]	5[2]	4,681	36[2]	-	1,331	6	10,763	-	63[2]	-	16,893
1991	-	-	-	13[2]	-	23	-	774	7	6,286	1	45[2]	3[2]	7,152
1992	-	-	-	5[2]	-	-	-	374	148[2]	2,073	14	211[2]	3[2]	2,826
1993	8[2]	4[2]	-	35[2]	-	-	-	45	315[2]	344	57[3]	291[2]	-	1,099
1994[1]	-	28[2]	-	41[2]	-	-	1[2]	363	208[2]	21	22[3]	120[2]	12[2]	816
1995[1]	-	-	-	-	-	-	2[2]	419	212[2]	227	2[3]	52[2]	2[2]	916
1996[1]	-	-	42[2]	72[2]	-	-	2[2]	183	-	147	323[2]	34[2]	4[2]	704

[1] Provisional figures. .
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.

Table 6.5

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 27-Aug-97 22:33:09

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

YEAR,	1965,	1966,
AGE		
1,	0,	0,
2,	0,	0,
3,	0,	0,
4,	0,	0,
5,	0,	0,
6,	48,	0,
7,	285,	0,
8,	1592,	27,
9,	2163,	279,
10,	1141,	532,
11,	1545,	465,
12,	1972,	731,
13,	2471,	1223,
14,	2804,	1927,
15,	1996,	2007,
16,	2067,	1741,
17,	1592,	1422,
18,	1473,	944,
+gp,	2589,	1980,
TOTALNUM,	23738,	13278,
TONSLAND,	15662,	10143,
SOPCOF %,	104,	102,

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

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
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,	7,	31,	0,	0,	466,	172,	606,	5834,	18891,
7,	0,	0,	94,	0,	0,	792,	1660,	4847,	19417,	29815,
8,	7,	15,	409,	33,	114,	5728,	4865,	15451,	42425,	59395,
9,	15,	89,	524,	131,	284,	3586,	9729,	28781,	82480,	78241,
10,	182,	192,	838,	620,	681,	2049,	4636,	30144,	108462,	110712,
11,	285,	355,	933,	2122,	1590,	1770,	2633,	19843,	119075,	112524,
12,	343,	436,	954,	3428,	4429,	3865,	3148,	10603,	57231,	93144,
13,	394,	554,	849,	3983,	4884,	4564,	5208,	8634,	29651,	49550,
14,	489,	864,	618,	3526,	5451,	4704,	5666,	8634,	20894,	26134,
15,	496,	768,	482,	2808,	4940,	4098,	4578,	6514,	16499,	13881,
16,	628,	931,	807,	3983,	7496,	4704,	5380,	5908,	13465,	9839,
17,	613,	694,	451,	2743,	4486,	3632,	3777,	3332,	13668,	6300,
18,	540,	665,	849,	3559,	7382,	3167,	2747,	2878,	12207,	7233,
+gp,	3254,	1802,	2536,	5714,	14934,	3447,	3053,	5300,	22366,	11439,
TOTALNUM,	7246,	7372,	10375,	32650,	56671,	46572,	57252,	151475,	563674,	627098,
TONSLAND,	6239,	5413,	6836,	22916,	45063,	28862,	38380,	69372,	239070,	269022,
SOPCOF %,	100,	94,	95,	94,	98,	101,	118,	99,	91,	98,

Table 6.5 (continued)

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 27-Aug-97 22:33:09

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
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,	2905,	3633,	1065,	932,	5,	20,	0,	98,	29,
7,	2418,	30158,	20497,	7412,	3000,	854,	86,	34,	571,	117,
8,	17175,	65162,	43553,	26296,	8620,	4775,	1987,	525,	2009,	215,
9,	33454,	53391,	46996,	44131,	26716,	12554,	4576,	2106,	4949,	1049,
10,	52102,	33569,	37469,	40441,	48290,	47348,	16695,	7969,	17096,	3079,
11,	49617,	19909,	26298,	27089,	39206,	57134,	31310,	22092,	31564,	5921,
12,	53938,	17242,	20717,	19950,	33394,	46529,	51099,	36763,	41511,	10701,
13,	33287,	9270,	16341,	11172,	21178,	37731,	48307,	47096,	33190,	15930,
14,	19095,	7410,	6059,	6400,	11853,	15506,	29973,	25468,	10519,	7051,
15,	12605,	5456,	3589,	5607,	6038,	9492,	17132,	12002,	4243,	2495,
16,	5796,	4134,	3465,	6801,	2697,	5780,	8347,	4336,	1971,	704,
17,	4874,	2134,	2465,	3441,	2172,	3368,	5238,	1499,	658,	390,
18,	5499,	1545,	1964,	3001,	1344,	2160,	2055,	517,	343,	81,
+gp,	13906,	2917,	6579,	2546,	1910,	4184,	673,	472,	52,	67,
TOTALNUM,	303766,	255202,	239625,	205352,	207350,	247420,	217498,	160879,	148774,	47829,
TONSLAND,	146365,	92611,	87145,	79354,	81546,	115383,	105273,	72934,	63068,	23112,
SOPCOF %,	95,	101,	100,	97,	95,	100,	99,	104,	101,	100,

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

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	5,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	60,	0,	0,
4,	0,	0,	0,	0,	0,	1108,	558,	61,	0,	0,
5,	0,	0,	0,	0,	2044,	957,	292,	85,	118,	141,
6,	0,	0,	48,	1,	1653,	1873,	156,	710,	655,	203,
7,	0,	0,	475,	748,	5453,	2498,	156,	702,	931,	576,
8,	109,	0,	1933,	4036,	7994,	1898,	171,	695,	1265,	1541,
9,	1055,	379,	3972,	6797,	6781,	1622,	502,	954,	711,	1449,
10,	3145,	1838,	4432,	7297,	8226,	1780,	2054,	2464,	732,	1206,
11,	2679,	3512,	4303,	6038,	5344,	1531,	3080,	2630,	1217,	1054,
12,	3580,	4084,	4667,	8568,	6227,	2108,	2581,	2944,	1991,	1114,
13,	6213,	6958,	7062,	11600,	9880,	2288,	2264,	1477,	4250,	1382,
14,	3702,	7313,	6068,	7499,	10824,	2258,	2931,	2168,	3264,	1841,
15,	1459,	4022,	4412,	3174,	4049,	2506,	1840,	2099,	2138,	863,
16,	656,	1960,	3282,	1698,	2105,	2137,	1485,	3210,	1438,	618,
17,	210,	983,	2399,	1419,	9603,	1512,	1033,	1235,	749,	495,
18,	66,	328,	1733,	1093,	6522,	677,	517,	706,	785,	679,
+gp,	0,	106,	2220,	15595,	19299,	9258,	5908,	3134,	2378,	2223,
TOTALNUM,	22874,	31483,	47006,	75563,	106004,	36011,	25528,	25339,	22622,	15385,
TONSLAND,	10518,	15586,	23494,	35070,	48727,	15590,	12623,	12239,	10172,	8086,
SOPCOF %,	100,	100,	99,	97,	100,	103,	100,	104,	100,	100,

Table 6.6

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 27-Aug-97 22:33:09

Table 2 Catch weights at age (kg)

YEAR,	1965,	1966,
AGE		
1,	.0000,	.0000,
2,	.0000,	.0000,
3,	.0000,	.0000,
4,	.0000,	.0000,
5,	.0000,	.0000,
6,	.1680,	.1680,
7,	.1830,	.1830,
8,	.2250,	.2250,
9,	.3110,	.3110,
10,	.3670,	.3670,
11,	.4320,	.4320,
12,	.5080,	.5080,
13,	.6110,	.6110,
14,	.6790,	.6790,
15,	.7530,	.7530,
16,	.8210,	.8210,
17,	.8720,	.8720,
18,	.9100,	.9100,
+gp,	.9990,	.9930,
SOPCOFAC,	1.0367,	1.0223,

Table 2 Catch weights at age (kg)

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,
7,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,
8,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,
9,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,
10,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,
11,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,
12,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,
13,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,
14,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,
15,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,
16,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,
17,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,
18,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,
+gp,	1.0320,	1.0100,	1.0260,	1.0000,	1.0220,	.9770,	.9800,	1.0000,	1.0070,	1.0210,
SOPCOFAC,	1.0037,	.9372,	.9489,	.9357,	.9849,	1.0143,	1.1784,	.9888,	.9146,	.9847,

Table 6.6 (continued)

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 27-Aug-97 22:33:09

Table 2 Catch weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,	.1680,	.1680,	.1070,	.1070,	.1020,	.1020,	.1020,	.1020,	.1020,	.1020,
7,	.1830,	.1830,	.1550,	.1550,	.1380,	.1380,	.1380,	.1050,	.1350,	.1200,
8,	.2250,	.2250,	.2000,	.2000,	.1880,	.1880,	.1880,	.1650,	.1670,	.1370,
9,	.3110,	.3110,	.2520,	.2520,	.2520,	.2520,	.2520,	.2120,	.2150,	.2180,
10,	.3670,	.3670,	.3100,	.3100,	.3100,	.3100,	.3100,	.2830,	.3030,	.3010,
11,	.4320,	.4320,	.3740,	.3740,	.3640,	.3640,	.3200,	.3380,	.3520,	.3530,
12,	.5080,	.5080,	.4720,	.4720,	.4400,	.4400,	.4000,	.3830,	.4200,	.4480,
13,	.6110,	.6110,	.5680,	.5680,	.5600,	.5600,	.4660,	.4380,	.4810,	.5100,
14,	.6790,	.6790,	.7150,	.7150,	.6800,	.6800,	.5630,	.5020,	.5640,	.5810,
15,	.7530,	.7530,	.8980,	.8980,	.8280,	.8280,	.7300,	.5660,	.6730,	.6480,
16,	.8210,	.8210,	.9340,	.9340,	.9060,	.9060,	.9920,	.7110,	.8090,	.8450,
17,	.8720,	.8720,	1.0240,	1.0240,	.9700,	.9700,	1.1260,	.8610,	1.0140,	.9480,
18,	.9100,	.9100,	1.0500,	1.0500,	1.0500,	1.0500,	1.1490,	.9660,	1.0690,	1.0560,
+gp,	1.0320,	1.0300,	1.1300,	1.1050,	1.1180,	1.1220,	1.2280,	1.2910,	1.1600,	1.2610,
SOPCOFAC,	.9515,	1.0130,	.9966,	.9734,	.9503,	1.0022,	.9891,	1.0415,	1.0066,	1.0023,

Table 2 Catch weights at age (kg)

YEAR,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0200,	.0200,	.0200,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0600,	.0600,	.0600,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0500,	.0500,	.0500,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.1300,	.0900,	.1000,	.2000,
6,	.1440,	.1440,	.1980,	.1400,	.1300,	.1900,	.1700,	.1600,	.1400,	.2100,
7,	.1800,	.1800,	.2020,	.1460,	.1800,	.2200,	.2300,	.2200,	.1600,	.2100,
8,	.1950,	.1950,	.2420,	.1580,	.2100,	.2600,	.2500,	.2400,	.1900,	.2500,
9,	.2190,	.2090,	.2820,	.2060,	.2700,	.2800,	.2800,	.3000,	.2100,	.3100,
10,	.2880,	.2800,	.3310,	.2800,	.3400,	.3100,	.3300,	.3400,	.2800,	.4100,
11,	.3300,	.3330,	.3780,	.3550,	.3500,	.3300,	.3800,	.3700,	.3200,	.4600,
12,	.4390,	.3970,	.4560,	.4710,	.4200,	.3800,	.4400,	.4000,	.3700,	.4900,
13,	.5110,	.4680,	.5140,	.5430,	.4600,	.4600,	.4700,	.4400,	.4100,	.5500,
14,	.5640,	.5370,	.5680,	.6110,	.5100,	.4300,	.5000,	.4500,	.4700,	.6200,
15,	.6360,	.5850,	.5890,	.6250,	.5800,	.4300,	.5700,	.4900,	.5300,	.5900,
16,	.7720,	.7470,	.6720,	.7220,	.5900,	.4500,	.5800,	.5500,	.5800,	.6600,
17,	.8090,	.8080,	.7080,	.5760,	.5800,	.5200,	.6200,	.5800,	.6600,	.6700,
18,	.9540,	.9010,	.7740,	.6590,	.5900,	.5700,	.6500,	.6700,	.7100,	.7300,
+gp,	1.1800,	1.0470,	.8380,	.6590,	.7000,	.6700,	.6620,	.7900,	.8060,	.8430,
SOPCOFAC,	.9976,	1.0000,	.9915,	.9668,	1.0032,	1.0291,	1.0022,	1.0365,	.9987,	1.0018,

Table 6.7

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 27-Aug-97 22:28:10

Table 5 Proportion mature at age

YEAR,	1965,	1966,
AGE		
1,	.0000,	.0000,
2,	.0000,	.0000,
3,	.0000,	.0000,
4,	.0000,	.0000,
5,	.0000,	.0000,
6,	.0000,	.0000,
7,	.0000,	.0000,
8,	.0300,	.0300,
9,	.0600,	.0600,
10,	.0800,	.0800,
11,	.2200,	.2200,
12,	.3600,	.3600,
13,	.5500,	.5500,
14,	.7200,	.7200,
15,	.8500,	.8500,
16,	.8800,	.8800,
17,	.9500,	.9500,
18,	.9700,	.9700,
+gp,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,	.0090,
8,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0160,
9,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.1010,
10,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.1950,
11,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.3000,
12,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.5400,
13,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.7020,
14,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.8620,
15,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.9660,
16,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.9940,
17,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	1.0000,
18,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 6.7 (Continued)

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 27-Aug-97 22:28:10

Table 5 Proportion mature at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,	.0090,	.0090,	.0090,	.0090,	.0090,	.0090,	.0090,	.0050,	.0000,	.0000,
8,	.0160,	.0160,	.0160,	.0160,	.0160,	.0160,	.0160,	.0080,	.0000,	.0000,
9,	.1010,	.1010,	.1010,	.1010,	.1010,	.1010,	.1010,	.0570,	.0100,	.0340,
10,	.1950,	.1950,	.1950,	.1950,	.1950,	.1950,	.1950,	.1680,	.0790,	.1130,
11,	.3000,	.3000,	.3000,	.3000,	.3000,	.3000,	.3000,	.3020,	.2180,	.2380,
12,	.5400,	.5400,	.5400,	.5400,	.5400,	.5400,	.5400,	.5340,	.4530,	.5070,
13,	.7020,	.7020,	.7020,	.7020,	.7020,	.7020,	.7020,	.7210,	.7810,	.7940,
14,	.8620,	.8620,	.8620,	.8620,	.8620,	.8620,	.8620,	.8790,	.8460,	.8720,
15,	.9660,	.9660,	.9660,	.9660,	.9660,	.9660,	.9660,	.9520,	.9000,	.9120,
16,	.9940,	.9940,	.9940,	.9940,	.9940,	.9940,	.9940,	.9850,	.9250,	.9500,
17,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
18,	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,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,	.0000,	.0000,	.0000,	.0150,	.0150,	.0150,	.0000,	.0000,	.0000,	.0000,
9,	.0450,	.0830,	.0040,	.0500,	.0550,	.0620,	.0230,	.0230,	.0000,	.0140,
10,	.0760,	.0950,	.0780,	.1260,	.1320,	.1330,	.1130,	.1130,	.0550,	.0930,
11,	.1780,	.1940,	.2010,	.2050,	.2020,	.2240,	.2670,	.2670,	.1110,	.2120,
12,	.4300,	.4620,	.4860,	.5060,	.4810,	.4110,	.4380,	.4380,	.3680,	.3250,
13,	.7350,	.6890,	.6530,	.6230,	.5450,	.5390,	.5740,	.5740,	.5870,	.5770,
14,	.8270,	.8010,	.7670,	.7260,	.7410,	.7740,	.8430,	.8430,	.6960,	.7160,
15,	.8850,	.8620,	.8320,	.8010,	.8500,	.8880,	.9510,	.9510,	.7290,	.7800,
16,	.9580,	1.0000,	1.0000,	1.0000,	.9620,	.9460,	.9200,	.9200,	.7890,	.8740,
17,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9920,	.9890,	.9890,	1.0000,	.9750,
18,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 6.8

The SAS System 21:49 Wednesday, August 27, 1997 1
SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT03: Norwegian bottom trawl survey, Svalbard 100-500m, autumn (Catch: Number)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12
1992	1	2830	4190	4840	1310	580	450	140	80	50	20	70
1993	1	20	5270	1170	2020	1420	80	230	60	130	10	70
1994	1	70	2800	2900	2020	2350	420	940	10	10	30	40
1995	1	40	500	3650	2370	1320	610	190	170	110	10	10
1996	1	230	460	150	370	1050	1440	840	170	510	320	340

The SAS System 21:49 Wednesday, August 27, 1997 2
SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT04: RUSSIAN PST-TRAWLERS. S.mentella, effort and catch-in-numbers

Year	Fishing effort	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15	Catch, age 16	Catch, age 17	Catch, age 18
1982	107438	12274	46292	55860	45491	36890	15160	9280	5651	3293	2112
1983	93578	4434	16176	30337	49510	46805	29041	16599	8087	5075	1991
1984	51171	1823	7253	20429	34813	43613	23884	11197	3898	1383	418
1985	56802	3699	14997	28079	37598	30822	9769	3967	1826	617	318
1986	26976	587	2315	4522	8434	13164	5747	2010	522	309	52
1987	9093	637	1898	1618	2161	3751	2235	880	396	126	40
1988	11241	191	928	1773	2062	3513	3692	2031	990	496	166
1989	14533	2827	3274	2899	2891	5310	4882	2041	1250	730	320
1990	17355	4590	5031	4261	6224	8590	5580	1910	811	165	17
1991	17878	3998	4055	3694	3653	4949	4612	2030	724	178	150
1992	5962	983	850	654	596	614	572	488	306	194	80
1993	6260	403	1590	2506	2044	1584	1543	1296	809	491	240
1994	6341	399	1343	1406	1728	600	1132	948	1519	663	231
1995	7395	512	471	972	1484	3545	2676	1656	1027	360	322
1996	846	96	107	123	174	163	160	143	70	38	74

The SAS System 21:49 Wednesday, August 27, 1997 3
SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT10: RUSSIAN SURVEY. Effort and catch rates. S.mentella (Catch: Number)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1978	1	2.0	81.0	17.0	49.0	43.0	67.0	195.0	198.0	87.0	15.0
1979	1	0.0	2.0	12.0	64.0	228.0	373.0	576.0	519.0	349.0	122.0
1980	1	19.0	9.0	2.0	25.0	24.0	48.0	86.0	123.0	180.0	119.0
1981	1	4.0	14.0	10.0	9.0	68.0	35.0	48.0	56.0	67.0	57.0
1982	1	22.0	20.0	36.0	50.0	51.0	49.0	50.0	0.0	0.0	0.0
1983	1	132.0	39.0	25.0	23.0	38.0	37.0	50.0	0.0	0.0	0.0
1984	1	30.0	130.0	200.0	160.0	90.0	20.0	10.0	10.0	0.0	0.0
1985	1	100.0	50.0	150.0	60.0	60.0	110.0	200.0	190.0	130.0	40.0
1986	1	70.0	20.0	60.0	340.0	120.0	110.0	160.0	60.0	20.0	0.0
1987	1	0.0	0.0	0.0	310.0	440.0	470.0	250.0	10.0	0.0	0.0
1988	1	30.0	10.0	10.0	50.0	340.0	390.0	180.0	20.0	0.0	0.0
1989	1	581.0	379.0	18.0	52.0	183.0	323.0	326.0	63.0	0.0	0.0
1990	1	90.0	43.0	13.0	84.0	162.0	190.0	133.0	43.0	16.0	15.0
1991	1	63.0	170.0	133.0	80.0	36.0	17.0	22.0	40.0	31.0	5.0
1992	1	10.0	61.0	234.0	258.0	41.0	21.0	17.0	24.0	42.0	49.0
1993	1	1.0	5.0	10.0	46.0	39.0	20.0	12.0	6.0	2.0	6.0
1994	1	1.0	2.0	15.0	43.0	54.0	86.0	106.0	56.0	28.0	17.0
1995	1	35.0	15.0	1.0	12.0	17.0	40.0	112.0	96.0	82.0	38.0
1996	1	10.0	17.0	18.0	43.0	113.0	115.0	66.0	28.0	14.0	9.0

The SAS System 21:49 Wednesday, August 27, 1997 4
SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT14: Norw bottom Barents (Catch: Millions)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14
1992	1	3510	2520	1320	560	140	110	30	90	180	160	120	110	20
1993	1	380	4730	1920	2420	620	450	190	220	130	110	100	40	20
1994	1	70	850	3320	1890	3700	2280	730	420	30	300	80	140	250
1995	1	3080	450	1460	2640	3640	2110	690	230	70	170	230	90	110
1996	1	1730	1190	1090	1140	1280	1220	1060	640	240	190	120	70	80

Table 6.8 (Continued)

The SAS System 21:49 Wednesday, August 27, 1997 1

SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT03: Norwegian bottom trawl survey, Svalbard 100-500m, autumn (Catch: Number)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12
1992	1	2830	4190	4840	1310	580	450	140	80	50	20	70
1993	1	20	5270	1170	2020	1420	80	230	60	130	10	70
1994	1	70	2800	2900	2020	2350	420	940	10	10	30	40
1995	1	40	500	3650	2370	1320	610	190	170	110	10	10
1996	1	230	460	150	370	1050	1440	840	170	510	320	340

The SAS System 21:49 Wednesday, August 27, 1997 2

SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT04: RUSSIAN PST-TRAWLERS. S.mentella, effort and catch-in-numbers

Year	Fishing effort	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15	Catch, age 16	Catch, age 17	Catch, age 18
1982	107438	12274	46292	55860	45491	36890	15160	9280	5651	3293	2112
1983	93578	4434	16176	30337	49510	46805	29041	16599	8087	5075	1991
1984	51171	1823	7253	20429	34813	43613	23884	11197	3898	1383	418
1985	56802	3699	14997	28079	37598	30822	9769	3967	1826	617	318
1986	26976	587	2315	4522	8434	13164	5747	2010	522	309	52
1987	9093	637	1898	1618	2161	3751	2235	880	396	126	40
1988	11241	191	928	1773	2062	3513	3692	2031	990	496	166
1989	14533	2827	3274	2899	2891	5310	4882	2041	1250	730	320
1990	17355	4590	5031	4261	6224	8590	5580	1910	811	165	17
1991	17878	3998	4055	3694	3653	4949	4612	2030	724	178	150
1992	5962	983	850	654	596	614	572	488	306	194	80
1993	6260	403	1590	2506	2044	1584	1543	1296	809	491	240
1994	6341	399	1343	1406	1728	600	1132	948	1519	663	231
1995	7395	512	471	972	1484	3545	2676	1656	1027	360	322
1996	846	96	107	123	174	163	160	143	70	38	74

The SAS System 21:49 Wednesday, August 27, 1997 3

SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT10: RUSSIAN SURVEY. Effort and catch rates. S.mentella (Catch: Number)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1978	1	2.0	81.0	17.0	49.0	43.0	67.0	195.0	198.0	87.0	15.0
1979	1	0.0	2.0	12.0	64.0	228.0	373.0	576.0	519.0	349.0	122.0
1980	1	19.0	9.0	2.0	25.0	24.0	48.0	86.0	123.0	180.0	119.0
1981	1	4.0	14.0	10.0	9.0	68.0	35.0	48.0	56.0	67.0	57.0
1982	1	22.0	20.0	36.0	50.0	51.0	49.0	50.0	0.0	0.0	0.0
1983	1	132.0	39.0	25.0	23.0	38.0	37.0	50.0	0.0	0.0	0.0
1984	1	30.0	130.0	200.0	160.0	90.0	20.0	10.0	10.0	0.0	0.0
1985	1	100.0	50.0	150.0	60.0	60.0	110.0	200.0	190.0	130.0	40.0
1986	1	70.0	20.0	60.0	340.0	120.0	110.0	160.0	60.0	20.0	0.0
1987	1	0.0	0.0	0.0	310.0	440.0	470.0	250.0	10.0	0.0	0.0
1988	1	30.0	10.0	10.0	50.0	340.0	390.0	180.0	20.0	0.0	0.0
1989	1	581.0	379.0	18.0	52.0	183.0	323.0	326.0	63.0	0.0	0.0
1990	1	90.0	43.0	13.0	84.0	162.0	190.0	133.0	43.0	16.0	15.0
1991	1	63.0	170.0	133.0	80.0	36.0	17.0	22.0	40.0	31.0	5.0
1992	1	10.0	61.0	234.0	258.0	41.0	21.0	17.0	24.0	42.0	49.0
1993	1	1.0	5.0	10.0	46.0	39.0	20.0	12.0	6.0	2.0	6.0
1994	1	1.0	2.0	15.0	43.0	54.0	86.0	106.0	56.0	28.0	17.0
1995	1	35.0	15.0	1.0	12.0	17.0	40.0	112.0	96.0	82.0	38.0
1996	1	10.0	17.0	18.0	43.0	113.0	115.0	66.0	28.0	14.0	9.0

The SAS System 21:49 Wednesday, August 27, 1997 4

SMN-ARCT: Sebastes mentella in the North-East Arctic (Areas I & II)

FLT14: Norw bottom Barents (Catch: Millions)

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14
1992	1	3510	2520	1320	560	140	110	30	90	180	160	120	110	20
1993	1	380	4730	1920	2420	620	450	190	220	130	110	100	40	20
1994	1	70	850	3320	1890	3700	2280	730	420	30	300	80	140	250
1995	1	3080	450	1460	2640	3640	2110	690	230	70	170	230	90	110
1996	1	1730	1190	1090	1140	1280	1220	1060	640	240	190	120	70	80

Table 6.9

Lowestoft VPA Version 3.1

27-Aug-97 22:31:40

Extended Survivors Analysis

Arctic S. mentella (run: XSAKHN06/X06)

CPUE data from file /users/fish/ifad/ifapwork/afwg/smn_arct/FLEET.X06

Catch data for 32 years. 1965 to 1996. Ages 1 to 19.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT03: Norwegian bot,	1992,	1996,	2,	12,	.650,	.800
FLT04: RUSSIAN PST-T,	1982,	1996,	9,	18,	.000,	1.000
FLT10: RUSSIAN SURVE,	1978,	1996,	1,	10,	.850,	.950
FLT14: Norw bottom B,	1992,	1996,	2,	14,	.080,	.160

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 17

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 2 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 2.000

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

Prior weighting not applied

Tuning converged after 88 iterations

Regression weights

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

Fishing mortalities

Age,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996
1,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000
2,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000
3,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.001,	.000,	.000
4,	.000,	.000,	.000,	.000,	.000,	.005,	.004,	.000,	.000,	.000
5,	.000,	.000,	.000,	.000,	.028,	.008,	.001,	.001,	.001,	.003
6,	.000,	.000,	.000,	.000,	.028,	.029,	.001,	.004,	.006,	.002
7,	.000,	.000,	.005,	.008,	.091,	.049,	.003,	.007,	.006,	.005
8,	.002,	.000,	.027,	.046,	.105,	.037,	.004,	.014,	.015,	.011
9,	.015,	.006,	.067,	.111,	.091,	.025,	.011,	.024,	.016,	.019
10,	.050,	.029,	.088,	.151,	.171,	.028,	.036,	.063,	.021,	.030
11,	.059,	.065,	.079,	.148,	.142,	.039,	.056,	.053,	.036,	.034
12,	.103,	.108,	.104,	.200,	.201,	.069,	.077,	.063,	.047,	.038
13,	.171,	.265,	.245,	.356,	.332,	.095,	.088,	.052,	.109,	.038
14,	.159,	.279,	.346,	.394,	.582,	.105,	.152,	.103,	.140,	.057
15,	.188,	.231,	.241,	.273,	.340,	.226,	.105,	.139,	.126,	.045
16,	.109,	.366,	.267,	.123,	.262,	.270,	.182,	.239,	.120,	.044
17,	.089,	.213,	.910,	.158,	1.720,	.271,	.181,	.202,	.072,	.050
18,	.076,	.176,	.620,	1.378,	2.046,	.442,	.125,	.162,	.171,	.078

Table 6.9 (continued)

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8		
1987	1.16E+05	9.36E+04	9.80E+04	1.27E+05	1.28E+05	9.42E+04	7.88E+04	6.84E+04	7.58E+04	6.83E+04
1988	1.89E+05	1.05E+05	8.47E+04	8.87E+04	1.15E+05	1.16E+05	8.52E+04	7.13E+04	6.18E+04	6.76E+04
1989	3.13E+05	1.71E+05	9.50E+04	7.67E+04	8.03E+04	1.04E+05	1.05E+05	7.71E+04	6.45E+04	5.56E+04
1990	2.06E+05	2.83E+05	1.55E+05	8.60E+04	6.94E+04	7.26E+04	9.44E+04	9.46E+04	6.79E+04	5.46E+04
1991	2.07E+05	1.86E+05	2.56E+05	1.40E+05	7.78E+04	6.28E+04	6.57E+04	8.47E+04	8.18E+04	5.50E+04
1992	7.58E+04	1.87E+05	1.68E+05	2.32E+05	1.27E+05	6.85E+04	5.52E+04	5.43E+04	6.90E+04	6.75E+04
1993	1.91E+04	6.86E+04	1.69E+05	1.52E+05	2.09E+05	1.14E+05	6.02E+04	4.76E+04	4.73E+04	6.09E+04
1994	2.47E+04	1.73E+04	6.21E+04	1.53E+05	1.37E+05	1.89E+05	1.03E+05	5.43E+04	4.29E+04	4.23E+04
1995	1.05E+05	2.23E+04	1.57E+04	5.61E+04	1.39E+05	1.24E+05	1.70E+05	9.22E+04	4.85E+04	3.79E+04
1996	4.30E+04	9.46E+04	2.02E+04	1.42E+04	5.08E+04	1.25E+05	1.12E+05	1.53E+05	8.22E+04	4.32E+04

Estimated population abundance at 1st Jan 1997

.00E+00	3.89E+04	8.56E+04	1.83E+04	1.28E+04	4.58E+04	1.13E+05	1.01E+05	1.37E+05	7.31E+04

Taper weighted geometric mean of the VPA populations:

9.84E+04	9.88E+04	9.23E+04	9.75E+04	1.05E+05	1.02E+05	9.12E+04	8.17E+04	7.07E+04	6.33E+04

Standard error of the weighted Log(VPA populations) :

.8688	.8413	.8507	.7103	.3803	.3248	.3559	.4064	.4121	.4606

YEAR	AGE 11	12	13	14	15	16	17	18
1987	4.93E+04	3.85E+04	4.15E+04	2.65E+04	8.97E+03	6.65E+03	2.58E+03	9.54E+02
1988	5.88E+04	4.21E+04	3.14E+04	3.16E+04	2.05E+04	6.72E+03	5.39E+03	2.14E+03
1989	5.94E+04	4.99E+04	3.42E+04	2.18E+04	2.16E+04	1.47E+04	4.22E+03	3.94E+03
1990	4.61E+04	4.97E+04	4.07E+04	2.42E+04	1.40E+04	1.54E+04	1.02E+04	1.54E+03
1991	4.24E+04	3.59E+04	3.68E+04	2.58E+04	1.48E+04	9.61E+03	1.23E+04	7.87E+03
1992	4.19E+04	3.33E+04	2.66E+04	2.39E+04	1.30E+04	9.50E+03	6.69E+03	1.99E+03
1993	5.94E+04	3.65E+04	2.81E+04	2.19E+04	1.95E+04	9.40E+03	6.57E+03	4.62E+03
1994	5.31E+04	5.08E+04	3.06E+04	2.33E+04	1.70E+04	1.59E+04	7.10E+03	4.96E+03
1995	3.59E+04	4.56E+04	4.32E+04	2.62E+04	1.90E+04	1.34E+04	1.13E+04	5.25E+03
1996	3.36E+04	3.14E+04	3.94E+04	3.50E+04	2.06E+04	1.52E+04	1.08E+04	9.51E+03

Estimated population abundance at 1st Jan 1997

3.79E+04	2.94E+04	2.73E+04	3.43E+04	3.00E+04	1.79E+04	1.32E+04	9.27E+03

Taper weighted geometric mean of the VPA populations:

5.66E+04	4.95E+04	3.98E+04	2.64E+04	1.60E+04	9.87E+03	5.83E+03	2.90E+03

Standard error of the weighted Log(VPA populations) :

.4800	.4381	.3333	.2410	.3152	.4778	.7109	.9108

Table 6.9 (continued)

Log catchability residuals.

Fleet : FLT03: Norwegian bot

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	1.85	-2.10	.53	-.28	.02
3	99.99	99.99	99.99	99.99	99.99	-.20	.03	.40	.05	-.28
4	99.99	99.99	99.99	99.99	99.99	.13	-.87	.03	1.26	-.55
5	99.99	99.99	99.99	99.99	99.99	-.08	-.16	.26	.41	-.44
6	99.99	99.99	99.99	99.99	99.99	-.18	.19	.18	.03	-.21
7	99.99	99.99	99.99	99.99	99.99	.60	-1.25	-.12	-.25	1.03
8	99.99	99.99	99.99	99.99	99.99	-.60	.00	1.29	-.84	.14
9	99.99	99.99	99.99	99.99	99.99	-.03	.05	-1.64	1.07	.54
10	99.99	99.99	99.99	99.99	99.99	-.82	.24	-1.94	.54	1.95
11	99.99	99.99	99.99	99.99	99.99	-.32	-1.35	-.15	-.87	2.67
12	99.99	99.99	99.99	99.99	99.99	.35	.26	-.64	-1.93	1.97
13	No data for this fleet at this age									
14	No data for this fleet at this age									
15	No data for this fleet at this age									
16	No data for this fleet at this age									
17	No data for this fleet at this age									
18	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	2	3	4	5	6	7	8	9	10	11
Mean Log q	-5.9697	-3.4244	-3.9227	-4.4087	-4.4939	-5.3003	-5.2615	-6.6385	-6.2951	-7.2232
S.E(Log q)	1.4265	.2660	.8203	.3419	.1925	.8733	.8297	1.0184	1.4692	1.5719

Age	12
Mean Log q	-6.3902
S.E(Log q)	1.4361

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.74	.443	7.26	.49	5	1.18	-5.97
3	.98	.122	3.55	.95	5	.30	-3.42
4	.98	.051	4.08	.66	5	.93	-3.92
5	.74	1.099	6.30	.86	5	.25	-4.41
6	.76	1.284	6.23	.91	5	.14	-4.49
7	.77	.277	6.71	.33	5	.77	-5.30
8	1.47	-.330	2.50	.14	5	1.38	-5.26
9	.40	.796	9.24	.37	5	.42	-6.64
10	-4.44	-.369	30.79	.00	5	7.37	-6.30
11	-.33	-1.376	11.85	.26	5	.48	-7.22
12	-.21	-2.472	11.46	.58	5	.20	-6.39

Table 6.9 (continued)

Fleet : FLT04: RUSSIAN PST-T

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986
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	-.70	-1.23	-1.05	-.25	-1.48
10	99.99	99.99	99.99	99.99	-.18	-.91	-.80	.39	-.63
11	99.99	99.99	99.99	99.99	-.34	-.45	-.17	.43	-.10
12	99.99	99.99	99.99	99.99	-.52	-.15	.41	.48	.05
13	99.99	99.99	99.99	99.99	-.62	-.08	.78	.61	.41
14	99.99	99.99	99.99	99.99	-.97	-.10	.78	.00	.40
15	99.99	99.99	99.99	99.99	-.68	.29	.91	.18	-.12
16	99.99	99.99	99.99	99.99	-.50	.47	1.10	.40	-.35
17	99.99	99.99	99.99	99.99	-.16	.92	.88	.84	.33
18	99.99	99.99	99.99	99.99	-.15	.36	.42	.15	-.12

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	-.30	-1.52	.91	1.18	.82	.65	.08	.16	.13	.10
10	.09	-.84	.39	.69	.45	-.29	.39	.59	-.52	.04
11	-.09	-.39	-.16	.34	.25	-.42	.53	.05	-.09	.08
12	.12	-.23	-.32	.32	.08	-.62	.47	-.05	-.25	.14
13	.22	.26	.32	.51	.01	-.76	.08	-1.01	.30	-.56
14	-.07	.10	.53	.40	.21	-.93	.12	-.28	.32	-.66
15	.19	.01	-.29	-.08	-.08	-.33	.14	-.04	.25	-.15
16	-.21	.60	-.25	-.97	-.58	-.33	.57	.69	.25	-.43
17	-.16	.32	1.00	-1.88	-1.37	-.17	.68	.90	-.39	-.43
18	-.32	.13	.12	-1.74	-.98	.23	.29	.19	.31	.37

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	15	16	17	18
Mean Log q	-13.5352	-12.7128	-12.3605	-12.0106	-11.6025	-11.3954	-11.4879	-11.6239	-11.8800	-11.8800
S.E(Log q)	.8568	.5466	.3094	.3398	.5417	.4924	.2927	.5828	.9107	.6400

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	2.72	-.733	17.70	.02	15	2.38	-13.54
10	2.11	-1.212	14.61	.11	15	1.13	-12.71
11	1.11	-.436	12.52	.62	15	.36	-12.36
12	.93	.277	11.93	.63	15	.33	-12.01
13	.62	1.219	11.22	.52	15	.33	-11.60
14	2.32	-.898	13.01	.05	15	1.15	-11.40
15	1.08	-.253	11.63	.50	15	.33	-11.49
16	1.38	-.728	12.55	.28	15	.82	-11.62
17	3.33	-2.059	19.38	.07	15	2.65	-11.88
18	.90	.498	11.56	.72	15	.59	-11.96

Table 6.9 (continued)

Fleet : FLT10: RUSSIAN SURVE

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	-3.01	99.99	-.53	-2.12	-.50	1.09	-.29	1.28	1.07
2	.77	-3.05	-1.52	-.87	-.55	.04	1.04	.19	-.37
3	-.85	-1.00	-2.91	-1.28	.21	-.19	1.81	1.31	.50
4	-1.16	-.40	-1.14	-2.28	-.54	-1.11	.79	-.26	1.26
5	-1.67	.38	-1.37	-.13	-.54	-.81	.26	-.18	.43
6	-1.51	.59	-1.08	-.89	-.36	-.77	-1.36	.56	.52
7	-.70	.73	-.81	-1.02	-.49	-.31	-2.04	.99	.97
8	.15	1.09	-.01	-.49	99.99	99.99	-1.20	1.63	.49
9	-.19	1.10	.39	-.28	99.99	99.99	99.99	1.66	-.37
10	-1.21	.60	.45	-.30	99.99	99.99	99.99	.79	99.99
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								
15	No data for this fleet at this age								
16	No data for this fleet at this age								
17	No data for this fleet at this age								
18	No data for this fleet at this age								

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	99.99	-.38	2.08	.63	.27	-.57	-1.49	-1.75	.36	.00
2	99.99	-1.03	2.12	-.56	1.23	.20	-1.30	-.84	.93	-.39
3	99.99	-.78	-.31	-1.12	.70	1.69	-1.47	-.06	-1.39	1.24
4	1.28	-.19	.00	.36	-.17	.50	-.81	-.88	-1.16	1.50
5	1.52	1.37	1.12	1.14	-.45	-.83	-1.38	-.64	-1.81	1.09
6	1.89	1.50	1.42	1.25	-1.00	-.87	-1.45	-.50	-.84	.20
7	1.38	.97	1.36	.57	-.79	-.91	-1.39	.26	-.19	-.30
8	-1.09	-.44	.65	.08	.17	.05	-1.24	.87	.88	-.86
9	99.99	99.99	99.99	-.39	.07	.48	-2.20	.55	1.49	-.80
10	99.99	99.99	99.99	-.03	-1.12	.83	-1.16	.27	1.14	-.42
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									
15	No data for this fleet at this age									
16	No data for this fleet at this age									
17	No data for this fleet at this age									
18	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	1	2	3	4	5	6	7	8	9	10
Mean Log q	-8.2763	-8.1403	-8.1747	-7.2043	-7.1102	-7.1035	-7.0380	-7.6460	-7.7725	-7.9384
S.E(Log q)	1.1422	1.0618	1.1963	.9404	1.1249	1.1384	1.0080	.8651	1.1636	.8756

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
1	.52	3.183	9.81	.83	17	.43	-8.28
2	.80	.628	8.80	.52	18	.88	-8.14
3	.85	.412	8.67	.44	18	1.06	-8.17
4	1.71	-1.049	4.16	.18	19	1.60	-7.20
5	-1.23	-2.461	17.02	.11	19	1.14	-7.11
6	1.41	-.261	5.31	.04	19	1.67	-7.10
7	.65	.612	8.57	.23	19	.67	-7.04
8	.92	.127	7.94	.21	17	.84	-7.65
9	1.01	-.011	7.73	.12	13	1.27	-7.77
10	1.19	-.194	7.37	.15	12	1.12	-7.94

Table 6.9 (continued)

Fleet : FLT14: Norw bottom B

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	.15	-1.07	-1.38	2.15	.13
3	99.99	99.99	99.99	99.99	99.99	-.51	.11	-.60	.14	.86
4	99.99	99.99	99.99	99.99	99.99	-1.26	-.46	.08	.26	1.35
5	99.99	99.99	99.99	99.99	99.99	-1.04	-.08	.09	.42	.58
6	99.99	99.99	99.99	99.99	99.99	-1.51	-.53	.75	1.15	.10
7	99.99	99.99	99.99	99.99	99.99	-1.46	-.14	.95	.37	.24
8	99.99	99.99	99.99	99.99	99.99	-2.07	-.09	1.12	.54	.46
9	99.99	99.99	99.99	99.99	99.99	-1.28	-.01	.74	.01	.51
10	99.99	99.99	99.99	99.99	99.99	.24	.01	-1.08	-.13	.97
11	99.99	99.99	99.99	99.99	99.99	-.06	-.78	.34	.16	.34
12	99.99	99.99	99.99	99.99	99.99	.14	-.13	-.69	.48	.20
13	99.99	99.99	99.99	99.99	99.99	.50	-.57	.60	-.18	-.35
14	99.99	99.99	99.99	99.99	99.99	-1.06	-.96	1.49	.56	-.06
15	No data for this fleet at this age									
16	No data for this fleet at this age									
17	No data for this fleet at this age									
18	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	2	3	4	5	6	7	8	9	10	11
Mean Log q	-4.1190	-3.6758	-3.8988	-4.3669	-4.6689	-4.7453	-5.4169	-5.3492	-6.1473	-5.4945
S.E(Log q)	1.3928	.5912	.9585	.6328	1.0530	.8962	1.2233	.7773	.7430	.4639

Age	12	13	14
Mean Log q	-5.7481	-5.9676	-6.0037
S.E(Log q)	.4416	.5212	1.0713

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.09	-.103	3.50	.30	5	1.75	-4.12
3	1.44	-1.233	.50	.73	5	.80	-3.68
4	4.70	-4.241	-23.59	.31	5	1.96	-3.90
5	1.94	-.753	-2.52	.18	5	1.30	-4.37
6	.29	2.467	9.61	.81	5	.21	-4.67
7	.43	1.692	8.58	.75	5	.31	-4.75
8	.55	.589	7.99	.37	5	.74	-5.42
9	6.43	-.549	-25.01	.00	5	5.51	-5.35
10	.63	.347	7.86	.23	5	.53	-6.15
11	-5.09	-1.416	37.12	.02	5	2.11	-5.49
12	25.26	-.870	******	.00	5	11.52	-5.75
13	24.50	-.734	-98.29	.00	5	13.59	-5.97
14	.64	.167	7.49	.07	5	.79	-6.00

Table 6.9 (continued)

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	38907.,	1.192,	.000,	.00,	1,	1.000,	.000
FLT14: Norw bottom B,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	0.,	2.00,,,,				.000,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
38907.,	1.19,	.00,	1,	.000,	.000

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

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	87573.,	1.564,	.000,	.00,	1,	.174,	.000
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	82026.,	.811,	.378,	.47,	2,	.644,	.000
FLT14: Norw bottom B,	97425.,	1.527,	.000,	.00,	1,	.182,	.000
F shrinkage mean ,	0.,	2.00,,,,				.000,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
85602.,	.65,	.18,	4,	.275,	.000

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	13742.,	.295,	.001,	.00,	2,	.699,	.000
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	21242.,	.681,	.936,	1.37,	3,	.131,	.000
FLT14: Norw bottom B,	52418.,	.597,	.465,	.78,	2,	.170,	.000
F shrinkage mean ,	0.,	2.00,,,,				.000,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
18277.,	.25,	.29,	7,	1.190,	.000

Table 6.9 (continued)

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	12940.,	.280,	.143,	.51,	3,	.649,	.000
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	9229.,	.559,	.748,	1.34,	4,	.163,	.000
FLT14: Norw bottom B,	16596.,	.519,	.551,	1.06,	3,	.189,	.000
F shrinkage mean ,	0.,	2.00,,,,				.000,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
12838.,	.23,	.22,	10,	.985,	.000

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	50684.,	.225,	.335,	1.49,	4,	.666,	.003
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	28294.,	.506,	.434,	.86,	5,	.131,	.005
FLT14: Norw bottom B,	42502.,	.416,	.346,	.83,	4,	.194,	.003
F shrinkage mean ,	173257.,	2.00,,,,				.008,	.001

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
45846.,	.18,	.19,	14,	1.011,	.003

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

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	119309.,	.180,	.156,	.87,	5,	.731,	.002
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	62984.,	.467,	.368,	.79,	6,	.109,	.003
FLT14: Norw bottom B,	138988.,	.392,	.073,	.19,	5,	.154,	.001
F shrinkage mean ,	40428.,	2.00,,,,				.006,	.005

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
113231.,	.15,	.11,	17,	.727,	.002

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

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	100861.,	.179,	.155,	.87,	5,	.711,	.005
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	105135.,	.429,	.382,	.89,	7,	.123,	.005
FLT14: Norw bottom B,	96451.,	.376,	.257,	.68,	5,	.160,	.006
F shrinkage mean ,	84082.,	2.00,,,,				.006,	.006

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
100548.,	.15,	.11,	18,	.754,	.005

Table 6.9 (continued)

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

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	143310.,	.215,	.084,	.39,	5,	.641,	.010
FLT04: RUSSIAN PST-T,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT10: RUSSIAN SURVE,	121067.,	.390,	.356,	.91,	8,	.195,	.012
FLT14: Norw bottom B,	135288.,	.435,	.314,	.72,	5,	.157,	.011
F shrinkage mean ,	103627.,	2.00,,,,				.008,	.014

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
137100.,	.17,	.12,	19,	.695,	.011

Age 9 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
FLT03: Norwegian bot,	75689.,	.218,	.134,	.62,	5,	.594,	.018
FLT04: RUSSIAN PST-T,	80749.,	.893,	.000,	.00,	1,	.036,	.017
FLT10: RUSSIAN SURVE,	69382.,	.376,	.362,	.96,	9,	.200,	.020
FLT14: Norw bottom B,	67090.,	.417,	.406,	.97,	5,	.163,	.020
F shrinkage mean ,	69598.,	2.00,,,,				.007,	.020

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
73063.,	.17,	.13,	21,	.801,	.019

Age 10 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
FLT03: Norwegian bot,	37715.,	.264,	.340,	1.29,	5,	.447,	.030
FLT04: RUSSIAN PST-T,	40432.,	.480,	.044,	.09,	2,	.142,	.028
FLT10: RUSSIAN SURVE,	32915.,	.365,	.311,	.85,	9,	.236,	.034
FLT14: Norw bottom B,	45329.,	.439,	.416,	.95,	5,	.167,	.025
F shrinkage mean ,	26832.,	2.00,,,,				.008,	.042

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
37929.,	.18,	.16,	22,	.881,	.030

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	33180.,	.514,	.581,	1.13,	5,	.111,	.030
FLT04: RUSSIAN PST-T,	28040.,	.268,	.179,	.67,	3,	.427,	.035
FLT10: RUSSIAN SURVE,	27790.,	.373,	.343,	.92,	9,	.204,	.035
FLT14: Norw bottom B,	31993.,	.347,	.308,	.89,	5,	.250,	.031
F shrinkage mean ,	21849.,	2.00,,,,				.008,	.045

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
29413.,	.17,	.15,	23,	.845,	.034

Table 6.9 (continued)

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

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	21016.,	.569,	.541,	.95,	5,	.068,	.049
FLT04: RUSSIAN PST-T,	30080.,	.214,	.127,	.59,	4,	.515,	.035
FLT10: RUSSIAN SURVE,	26540.,	.379,	.340,	.90,	9,	.141,	.039
FLT14: Norw bottom B,	24910.,	.295,	.292,	.99,	5,	.269,	.042
F shrinkage mean ,	18758.,	2.00,,,,				.006,	.055

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
27329.,	.15,	.12,	24,	.803,	.038

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

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	22317.,	.725,	.476,	.66,	4,	.039,	.057
FLT04: RUSSIAN PST-T,	32144.,	.200,	.155,	.77,	5,	.529,	.040
FLT10: RUSSIAN SURVE,	47721.,	.377,	.283,	.75,	10,	.127,	.027
FLT14: Norw bottom B,	35911.,	.267,	.260,	.97,	5,	.299,	.036
F shrinkage mean ,	15632.,	2.00,,,,				.006,	.081

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
34301.,	.14,	.11,	25,	.744,	.038

Age 14 Catchability constant w.r.t. time and dependent on age

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	12060.,	.949,	.211,	.22,	3,	.022,	.136
FLT04: RUSSIAN PST-T,	32638.,	.188,	.196,	1.04,	6,	.587,	.052
FLT10: RUSSIAN SURVE,	73508.,	.391,	.181,	.46,	10,	.111,	.024
FLT14: Norw bottom B,	19021.,	.274,	.175,	.64,	5,	.274,	.088
F shrinkage mean ,	13534.,	2.00,,,,				.006,	.122

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
29964.,	.14,	.12,	25,	.852,	.057

Age 15 Catchability constant w.r.t. time and dependent on age

Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	17918.,	1.172,	.291,	.25,	2,	.012,	.045
FLT04: RUSSIAN PST-T,	16939.,	.162,	.191,	1.18,	7,	.707,	.047
FLT10: RUSSIAN SURVE,	22035.,	.409,	.320,	.78,	10,	.073,	.037
FLT14: Norw bottom B,	20549.,	.292,	.190,	.65,	4,	.202,	.039
F shrinkage mean ,	5796.,	2.00,,,,				.006,	.132

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
17858.,	.13,	.11,	24,	.798,	.045

Table 6.9 (continued)

Age 16 Catchability constant w.r.t. time and dependent on age

Year class = 1980

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	18612.,	1.593,	.000,	.00,	1,	.007,	.031
FLT04: RUSSIAN PST-T,	13160.,	.159,	.151,	.95,	8,	.781,	.044
FLT10: RUSSIAN SURVE,	14772.,	.458,	.258,	.56,	9,	.060,	.039
FLT14: Norw bottom B,	13177.,	.356,	.427,	1.20,	3,	.146,	.044
F shrinkage mean ,	2985.,	2.00,,,,				.007,	.180

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
13153.,	.14,	.10,	22,	.751,	.044

Age 17 Catchability constant w.r.t. time and dependent on age

Year class = 1979

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: RUSSIAN PST-T,	9304.,	.161,	.123,	.76,	9,	.870,	.049
FLT10: RUSSIAN SURVE,	7453.,	.567,	.326,	.58,	8,	.042,	.061
FLT14: Norw bottom B,	11278.,	.520,	.596,	1.15,	2,	.079,	.041
F shrinkage mean ,	3197.,	2.00,,,,				.009,	.137

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9269.,	.15,	.10,	20,	.651,	.050

Age 18 Catchability constant w.r.t. time and age (fixed at the value for age) 17

Year class = 1978

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT03: Norwegian bot,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: RUSSIAN PST-T,	8094.,	.165,	.148,	.90,	10,	.938,	.077
FLT10: RUSSIAN SURVE,	7277.,	.634,	.367,	.58,	7,	.032,	.085
FLT14: Norw bottom B,	2766.,	1.189,	.000,	.00,	1,	.018,	.210
F shrinkage mean ,	13549.,	2.00,,,,				.011,	.047

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
7960.,	.16,	.11,	19,	.718,	.078