Advisory Committee on Fishery Management

ICES CM1997/Assess:4

REPORT OF THE ARCTIC FISHERIES WORKING GROUP

ICES Headquarters, Copenhagen, Denmark

21-29 August 1996

Part 1 of 2

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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

Working Group Blues

Goin' down to Copenhagen,
feelin' confident and well.
In the friggin' ICES quarters
I will calculate like hell!
Oh-wow-wow-wow-ohoy!
This time I'm gonna make it, oh boy!
You either win, or you lose
and experience the Working Group blues!

I'm responsible for haddock,
that's the message from the "chair".
It's a bloody awful species,
I'm beginning to despair!
Oh-wow-wow-wow-ohoy!
A victim of the chairman's ploy!
I'll give him some word of abuse
and sink into the Working Group blues!

Yet another day is finished,
it is getting late at night.
I'll find comfort in a bottle
and perhaps I'll pick a fight!
Oh-wow-wow-wow-ohoy!
I'm feelin' like a broken toy!
I'm close to blowing my fuse
because I have the Working Group blues!

I shall make a new assessment
'cause the last one went astray,
and if all the gods are smiling
I will finish it to-day!
Oh-wow-wow-wow-ohoy!
Then I'm gonna jump for joy!
I'd rather eat my old shoes
than experience the Working Group blues!

When the working group is over
I'll go home a broken man,
when my "supers" see the numbers,
then the shit will hit the fan!
Oh-wow-wow-wow-ohoy!
I'm gonna need a life saving buoy!
So maybe it's better to choose
the sad and dreary Working Group blues!

Tore Jakobsen
Copenhagen
August 1996

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2 INTRODUCTION

2.1 Terms of reference

In the 83rd statutory meeting of ICES in 1995 it was decided that:

"2:13:2 The **Arctic Fisheries Working Group** (Chairman: Mr. Knut Sunnanå, Norway) will meet at ICES Headquarters from 21-29 August 1996 to:

a) assess the status of and provide catch options for 1997 for the stocks of cod, haddock, saithe, redfish and Greenland halibut in Sub-area I and II taking into account interactions with other species;

b) provide estimates of the minimum biologically acceptable level of spawning stock biomass (MBAL) for as many stocks as possible, with an explanation of the basis on which the estimates are obtained;

c) prepare medium-term forecasts under different management scenarios, taking into account uncertainties in data and assessments and possible stock-recruitment relationships, and indicate the associated probability of the stocks falling or remaining below MBAL within a stated period.

The above terms of reference are set up to provide the Advisory Committee on Fishery Management with the information required to respond to the requests for advice from the Northeast Atlantic Fisheries Commission and the European Commission."

To answer the terms of reference as they are set up, some changes to the report have been necessary. The Working Group have included sections on MBAL and medium term projections for each stock in the report.

2.2 ACFM Minutes

At the October-November 1995 meeting, ACFM has provided some comments on the work of the Arctic Fisheries Working Group. We appreciate the positive comments on our effort to improve the assessments. It will always be the first aim of this Working Group to improve our assessments at any opportunity.

The Working Group noted that special concern should be given as to how MBAL is defined and to give a clear description of the estimation and what factors have been taken into account when defining MBAL. The Working Group also noted that ACFM would consider how the precautionary approach would relate to the advised levels of exploitation of the various stocks.

The Working Group noted that ACFM recognises that available documentation on agreed TACs and distributed quotas is necessary for the work of the working groups. Our working group has this year tried to compile an account of the distributed quotas, but the available data were not complete and the account is not presented in the Working Group-report.

The Working Group also notes the concern of ACFM as to the use of the stock dependant q model in the XSA tuning. The Working Group paid special attention to this problem and decided to make some changes compared to earlier years. The arguments for doing so is given in the different stock sections.

The Working Group appreciate the positive comments regarding including cannibalism and predation in the tuning of the assessments. The Working Group notes the various comments given by ACFM. This work is continued this year by including predation of cod on haddock in the haddock assessment. Special concern is given to the way the final VPA is presented.

This year we also started using the RISK analysis in the medium term projections of some of the stocks.

2.3 Comprehensive Fisheries Evaluation Working Group (COMFIE)

A draft report of the work of this WORKING GROUP was available at the meeting of our Working Group. We feel that the topics dealt with by COMFIE are very relevant to our group and some of the considerations are used in this report. In particular, we found the review on biological reference points, harvesting strategies and the conclusions concerning choices of limit and target F's and stock biomasses, very useful.

The guidelines given on performing the medium term forecasts using RISK analysis were very useful to our work and where RISK has been applied, those guidelines have been followed. However, calculations of MSY, F_{MSY} and B_{MSY} will have to be performed at a later stage for the stocks in our Working Group.

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 have increased rapidly from 1991 onwards, and the total catch in 1994-1995 was the highest since 1977. The 1994-1995 catch were also above the long-term mean for the period 1946-1995.

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 areal restrictions.

3.1.2 Landings prior to 1996 (Tables 3.1-3.3 and 9.1, Figure 3.1A)

Final reported landings for 1994 amount to 771,086 t (Table 3.1), excluding 47,251 t of Norwegian coastal cod (Table 9.1), from the total landings reported. The provisional figures for 1995 are 739,958 t excluding 39,736 t of Norwegian coastal cod. This is close to the estimate of 750,000 t used by the Working Group last year. The agreed TAC on North-East Arctic cod was exceeded by 39,958 t and the total quota, including 40,000 t of Norwegian coastal cod, was exceeded by 39,694 t. Catches in excess of the agreed TAC in 1995 are mainly catches by countries without a quota (Iceland and other non-quota countries). The catch by other non-quota countries was estimated to 9,149 t in 1995 based on data from Norwegian authorities. When added to the Icelandic catch this gives a total catch by countries with no quota of 43,348 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. Catches have increased in ICES Division IIb, but decreased in the other areas.

3.1.3 Expected landings in 1996

The mixed Norwegian-Russian fisheries commission agreed on a TAC for North-East Arctic cod and Norwegian coastal cod combined for 1996 of 740,000 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 1996, 88,000 t was allocated to third countries and 8,000 t transferred from Russia to Norway, giving a Norwegian TAC of 334,000 t (coastal cod included) and a Russian TAC of 318,000 t. Of the Norwegian TAC, 223,780 t (67%) was allocated to the fishery with conventional gears and 110,220 t (33%) to the trawl fishery.

Based on information about the fishery in 1996, the catches in the international area in the Barents Sea by countries with no quota are expected to be somewhat higher than in 1995, i.e. 50,000 t. The Working Group has no information on the size of expected unreported landings in 1996, but believes this problem will continue. The Working Group assumes that there will be no reported landings in excess of the TAC for countries with a quota. The total landings of North-East Arctic cod and Norwegian coastal cod combined in 1996 will thus be 790,000 t. Of this, 40,000 t are expected to be Norwegian coastal cod, giving a catch of North-East Arctic cod of 750,000 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 (1996). 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)

In order to obtain CPUE indices for tuning of the older age groups in the VPA, CPUE series of the Norwegian and Russian trawl fisheries were updated and are given in Table A1. The figures show a decrease in CPUE in most areas. The data reflect the total trawl effort, both for Norway and Russia.

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 1996 are described by Mehl and Nakken (1996). Tables A2 and A3 shows the time series of abundance estimates (acoustic and bottom trawl, respectively) from these surveys.

For the Norwegian Barents Sea survey it should be noted that the same age-length keys were used to calculate the age distribution for both the acoustic and the bottom trawl abundance estimate. It should also 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.

Abundance estimates at age from the Norwegian acoustic survey on the spawning stock in the Lofoten area in March/April are given in Table A4.

Abundance estimates at age from the Norwegian bottom trawl survey in the Svalbard area in the autumn are given in Table A5.

In 1995, Norway started a new survey in August which covers the entire cod stock. No data from this survey were used for this assessment.

The trawl/acoustic estimates from the October-December 1995 Russian survey are given in Table A10 and the bottom trawl abundance estimate in Table A11. Results of the Russian survey of demersal fish in the Barents Sea in late autumn (1977-1993) are described in greater detail by Lepesevich *et al.* (1994).

The abundance of 0-group cod, as estimated in the International 0-group survey (ICES C.M. 1996/G:30) are provided in Tables A14 and A15.

The Norwegian bottom trawl and acoustic surveys in the winter of 1996 both indicated that the abundance of 1-group cod (the 1995 year class) was about the same as last year and that these two year classes are the strongest in the time series (1981-1996). The Russian surveys in late autumn 1995 and the International 0-group survey confirmed that this year class is stronger than average. The 1994 year class is also strong, according to all the surveys.

All surveys indicate that the total mortality on age 2 and older fish has increased in recent years. The 1991-1993 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 Barents Sea surveys and the Norwegian Barents Sea surveys indicate that this is the strongest year class at age 6 in the time series. The 1989 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. The Svalbard survey indicates a more optimistic development than the Barents Sea surveys, which is consistent with the increased catches in the Svalbard area (IIb) mentioned in Section 3.1.2

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. Length at age and weight at age from the Lofoten survey are given in Tables A8 and A9, respectively. Length at age and weight at age from the Russian survey in October-December are given in Tables A12 and A13, respectively.

There was a large discrepancy between the length and weight at age data from the Russian survey in autumn 1994 and the Norwegian survey in winter 1995 for age groups 3-7 (age at January 1 1995). However, when comparing the data on size at age from the autumn 1995 Russian survey and the winter 1996 Norwegian survey, the data showed reasonable agreement.

The size at age in 1996 differs little from the 1995 values, but is still at a low level for ages 1-7. Older age classes show an increase in size at age.

3.2.5 Maturity at age (Table 3.5)

As in previous assessments, Russian maturity ogives were used to estimate spawning stock biomass from 1984-1995. For comparison, size and maturity composition data from Norwegian surveys of the Barents Sea and Lofoten were combined to construct maturity ogives for 1985-96. With the exception of 1995, the Russian and Norwegian ogives were in close correspondence for 1991-1996. For these years, using the Norwegian ogives instead of the Russian ogives varied the estimate of spawning stock biomass by less than 10% (WD 2). Differences were more pronounced for the period 1985-1990. This could be due to: (1) greater discrepancies in the age readings for the earlier time period; (2) the reduced number of observations due to decreased stock abundance; and/or (3) more complex maturation dynamics resulting from reduced condition (e.g., higher incidence of artresia). Future work is planned to improve the time series of maturity ogives (e.g., WD1).

3.3 Data used in the assessment

3.3.1 Catch at age (Table 3.8)

For 1994, 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 1994 landings. For 1995, 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 the UK (England & Wales) and Germany. 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 1994 and 1 % for 1995. The number at age was adjusted to make the SOP fit exactly to the nominal catch for these years.

The age composition of cod in 1995 was made up of several year classes, mainly 1988-1991. The 1989 and 1990 year classes (ages 5 and 6) together contributing 71% of the catch in numbers. Comparing the catch in numbers at age to the values predicted in last year's assessment, the catch of ages 6 and 7 was lower than predicted while the catch of age 8 was higher than predicted. For older age groups the catch in number was lower than predicted.

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

For 1994 and 1995, 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 (1995 only) 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 1995 was lower than what was assumed by the Working Group last year for ages 3-4 and higher for age groups 5-8.

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.

The stock weights at age in 1996 are in good agreement with the prognosis made by the Working Group last year.

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 (Table 3.5)

As mentioned in section 3.2.4, Russian and Norwegian data on maturity ogive were found to be very similar for the recent time period (1991-1996). Thus, Russian maturity ogives were used in the assessment to be consistent with what was done in previous years.

3.3.5 Tuning data (Table 3.11)

The following surveys and commercial CPUE data were considered for use in the tuning:

Name	Place	Season	Age	Years
Russian bottom trawl	Total area	Autumn	1-8	1981-1995
Russian acoustic	Total area	Autumn	1-8	1985-1995
Norwegian bottom trawl	Svalbard	Autumn	1-8	1983-1995
Norwegian trawl fleet	Total area	All year	9-14	1985-1995
Russian trawl fleet	Total area	All year	9-14	1985-1995
Norwegian bottom trawl	Barents Sea	Winter	1-8	1980-1995
Norwegian acoustic	Barents Sea	Winter	1-8	1980-1995
Norwegian acoustic	Lofoten	Winter	7-11	1989-1995

Surveys that were conducted during winter were allocated to the end of the previous year. This was done so that data from the 1996 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 five indices of recruitment available for the 1995 year class: the Russian bottom trawl index by area, 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 was given in last year's report and is described in Bogstad and Mehl (in prep.).

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.

Consumption was calculated mainly in the same way as in Bogstad and Mehl (1992), but the stomach evacuation rate model was revised using the model of dos Santos and Jobling (1995) instead of the one of dos Santos and Jobling (1992). A discussion of the problems related to the use of evacuation rate models when calculating the consumption from field samples can be found in a recent report of the Multispecies Assessment Working Group (ICES C.M. 1996/Assess:3).

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 1995, not all the data collected were available for analysis. Thus, calculations for this year should be considered preliminary.

The number 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 (1996-1998) are given in Table 3.21.

The stock number at age in 1996 was taken from the final VPA (Table 3.17) for ages 4 and older. The number at age 3 was taken from the XSA (Table 3.13). The recruitment at age 3 in 1997 (951 million) was calculated by applying the average natural mortality at age 2 for the 1993-1995 period, to the XSA estimate of age 2 fish in 1996. The recruitment in 1998, i.e. the abundance of the 1995 year class at age 3 was estimated using RCT3

(Section 3.5.2). The fishing pattern was the average of the last 3 years from the final VPA, scaled to the 1995 level. The average maturity ogive for the years 1994-1996 was used for 1997 onwards. The weight at age in the catch in 1996 for ages 3-8 was calculated assuming the same ratio between weight at age in the catch and in the stock as the average ratio for 1993-1995. The weight at age in the stock and in the catch in 1997 and later years was set equal to the average of the period 1994-1996, which is a low level. This assumption is based on knowledge about the development of the capelin stock (which will be at a very low level for at least 1-2 years).

The natural mortality on ages 3-5 is set equal to the 1993-1995 estimate from the VPA with cannibalism.

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 was repeated. In that assessment, 1994 was the last year and the Lofoten survey was not included. 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, and (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 1994 (F_{94}) of 0.52, compared to 0.50 in last year's assessment. Including the Lofoten survey in the tuning gave F_{94} = 0.55, i.e. a slight increase. When 1995 data were included in the assessment, the Lofoten data used in the tuning and catchability was set to be stock size dependent for ages younger than 4, F_{94} and F_{95} were estimated to be 0.68 and 0.59, respectively. This was adopted as the final non-cannibalism VPA.

3.4.2 Recruitment (Table 3.7)

The only year class which needs to be estimated by the RCT3 program is the 1995 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 3.12-3.15, Fig. 3.2 A-H)

Cannibalism in North-East Arctic cod 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. At the last meeting of the Multispecies Assessment Working Group (ICES C.M. 1996/Assess:3), a multispecies VPA for the Barents Sea for the period 1980-1993, including cod as predator and cod, herring, capelin and shrimp as prey, was presented. 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. In September/October 1996, a meeting between Russian and Norwegian scientists will address these questions. 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.

As it was not possible to run the XSA with cannibalism included directly, the following approach was taken in order to include cannibalism in the assessment.

1. The consumption in tonnes of each prey length group (5 and 10 cm length categories for fish <30cm and >30cm, respectively, by each predator age group for each half-year and area is calculated. As a starting point, the number of cod (as predator) at age from last year's assessment was used, later the number at age from the XSA was used to update the consumption figure.

2. Convert consumption on length groups to consumption in numbers by prey age group, using age-length keys and weight at age data from Norwegian surveys. Consumption of cod by cod has been calculated for prey age groups 0-6, but only predation on age groups 1-5 was included in this analysis.

3. Consumption by cod was treated as an additional catch in the VPA.

XSA was run iteratively until convergence.

This iteration procedure seemed to converge rather quickly, as $F_{5\text{-}10}$ in 1994 only changed by < 0.001 from the third to the fourth iteration and the fishing mortalities on the younger age groups also seemed to be converging rapidly. Thus, the procedure was stopped after four iterations.

The tuning diagnostics from VPA with cannibalism, are given in Table 3.12 and the total fishing mortalities (true fishing mortality plus mortality induced from cannibalism) and population numbers in Tables 3.13 and 3.14. 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 1995 was small (a change of 0.01). The abundance of age groups 4-6 in 1996 was, however, somewhat changed when cannibalism is included in the analysis.

The total number of cod ages 0-6 (million) consumed is given 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	1479	379	71	+	0	0	0
1986	53	418	392	99	0	0	0
1987	654	176	275	14	0	0	0
1988	29	422	23	2	0	0	0
1989	967	143	+	0	0	0	0
1990	0	65	30	0	0	0	0
1991	141	156	221	2	0	0	0
1992	4250	1101	153	4	0	0	0
1993	4635	23241	615	61	2	+	0
1994	9899	9273	813	148	57	9	+
1995	5370	26625	858	289	53	3	+

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 and 1995 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 1993-1995 are high (1.0-2.5).The figures vary somewhat from those obtained last year due to the use of more accurate age-length keys for fish > 20 cm and the inclusion of new data for 1992-1994.

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, despite the large numbers of age 1 cod consumed. Figure 3.2 A-H shows plots of the indices versus stock numbers from the 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 (M) to the predation mortality (M2). This new M matrix (Table 3.15) 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.

3.5 Results of the assessment

3.5.1 Fishing mortalities and VPA (Tables 3.16-3.20, 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 0.67 in 1994 but dropping again to 0.58 in 1995. F_{5-10} in 1991-1995 was higher than calculated in last year's assessment. However, the assumed fishing mortality in 1996 is lower than assumed last year (0.41 vs. 0.51). The reason for this is that the 1991 and 1990 year classes are much stronger than estimated in last year's assessment.

The fishing mortalities and stock numbers are given in Tables 3.16-3.17, while the stock biomass at age and the spawning stock biomass at age are given in Tables 3.18-3.19. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1946 is given in Table 3.20 and Figures 3.1A and 3.1B. Due to the large SOP discrepancies, the SOP corrected values are given.

3.5.2 Recruitment (Table 3.7)

The results of the RCT3 analysis are given in Table 3.7. The 1995 year class estimate at age 3 is 1410 million individuals.

3.5.3 Biological reference points (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 $F_{0.1} = 0.12$ and $F_{max} = 0.26$ which is slightly higher than 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 $F_{95} = 0.58$ (*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 3.22)

The management option table (Table 3.22) shows that the expected catches in 1996 will give a decrease in F_{5-10} from 0.58 in 1995 to 0.42 in 1996. Fishing at F_{max}, F_{low} and F_{med} in 1997 gives catches of 610,000 , 740,000 and 990,000 t, respectively, compared to the expected catch in 1996 of 750,000 t. All these fishing levels will result in an increase in the spawning stock biomass to the highest level since the late 1940s.

In Figure 3.1D the catch level in 1997 and spawning stock biomass level in 1998 are plotted against the fishing mortality in 1997.

3.5.5 Consumption by cod (Table A16)

Table A16 shows the consumption by cod of various prey species in 1984-1995. Consumption of capelin decreased sharply from approximately 3 million tonnes in 1991-1993 to approximately 1 million tonnes in 1994-1995. However, consumption in 1994-1995 was high compared to the acoustic abundance estimate for capelin in the autumn 1993-1995 (796, 199 and 194 thousand tonnes, respectively). A similar phenomenon was observed in 1986 when the capelin stock also was low. The annual consumption of shrimp by cod more than doubled from 1992 to 1994, but dropped somewhat from 1994 to 1995. The consumption of cod by cod (cannibalism) showed a large increase from 1992 to 1993-1994 and increased further in 1995. The consumption of haddock also increased sharply from 1994 to 1995. The fraction of cod in the diet is, however, comparable to values observed in the 1950's (Ponomarenko *et al.* 1978; Bogstad *et al.* 1994). It should also be taken into account that the fraction of cod in cod diet generally increases with increasing cod size (Bogstad *et al.* 1994) and that the biomass of old cod has increased strongly in the most recent years. The amount of redfish consumed dropped from 1992 to 1993-1994, but increased again in 1995. Since 1993, the amount of amphipods consumed has shown a large increase, and has now reached the level observed during the previous capelin stock collapse in 1986-1989, when the cod switched from capelin to amphipods as prey. The fraction of herring in the diet seems low but stable. 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. Consumption of Greenland halibut is very small in all years.

It seems that cod in 1994-1995 were able to compensate for the decrease in the capelin stock, which is a preferred prey item for cod, to a greater degree than in the late 1980's. The capelin stock will be at a very low level for at least the next 2-3 years. It is unknown whether the cod will continue to be able to compensate for the scarcity of capelin by consuming other prey species.

3.6 MBAL level and advised exploitation rates

3.6.1 Minimum biological acceptable level (MBAL) (Figure 3.3)

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 3.3.

3.6.2 Advised exploitation rates

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 (Anon. *op.cit.*). F_{max} for cod is presently 0.26, which means that there is a potential for increased yields by lowering the fishing mortality from $F_{status\ quo}$ (0.58) to F_{max} (0.26). The catch corresponding to F_{max} in 1997 is about 610,000 t, which is somewhat below the present catch. Keeping the fishing mortality well 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 3.21)

The input data were the same used as for the short term predictions (Table 3.21). The recruitment at age 3 of the 1996 and later year classes was set equal to the long-term average of 623 million, adjusted upwards to account for increased mortality at ages 3-5 due to cannibalism, i.e. 870 million individuals.

3.7.2 Methods

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

3.7.3 Results (Tables 3.22-3.23 and Figure 3.1D)

In Table 3.23, the results of the medium-term prediction are given, for the biological reference points for 0.4,0.6, 0.8 (=F_{med}),1.0 and 1.2*$F_{status\ quo}$. Detailed output of the prediction for F_{med} (=0.8* $F_{status\ quo}$) is also given. In the medium term, the stock will stabilize at a level of about 3 million t when fishing at F_{med}, and the catches will be between 800,000 t and 1 million t, which is above the present level. The spawning stock biomass will stabilize at about 1.2 million t, which is a very high level.

3.8 Comments to the assessment and the forecasts

As was observed last year, including cannibalism in the assessment improved the fit to the survey data. However, the estimate of ages 4 and older did not change much when cannibalism was included. It was also attempted to include cannibalism in the prediction, but due to the variable level of cannibalism, such predictions are uncertain. It should be possible to improve the predictions of cod cannibalism by taking stock sizes of other major prey species into account using multispecies models. Computer programs that make it possible to easily combine XSA and VPA with cannibalism should be developed.

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 mentioned in Section 3.5.1, but has turned out to be a more complicated task than expected.

From an average level of about 1 million t in the 1980s, the total stock biomass increased rapidly to 2.7 million tonnes in 1993, then stabilized around 2.5 million. Total biomass is currently similar to that of the mid-1970s and close to the long-term average value for this stock.

The spawning stock in 1996 is 832 thousand tonnes, which is a substantial increase from 1995.

Growth rates appear to have stabilized at a low level, although it is still above the very low level experienced in 1987-1988.

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. Some haddock is taken by conventional gear in the first half of the year in connection with the spawning fisheries for cod in Lofoten. A long-line fishery in early autumn also gives substantial landings. The fishery is restricted by quotas for the traditional gears. It is also regulated by a minimum landing and catching 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 area restrictions.

Historical landings of the fishery show a cyclical pattern (Figure 4.1A). The historical record 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 a peak in 1973 down to the historically low level of only 17,700 t in 1984. Afterwards, landings increased to 151,000 t before declining to 26,000 t per year in 1990. Landings have been increasing since then.

In periods of low abundance, haddock is often exploited at very high F levels. This partly is the result of the by-catch in the cod fishery. However, the stock very often produces a good year class in periods of low abundance and frequently coincides with strong cod year classes. These good year classes result in an increase in directed effort.

4.1.2 Landings prior to 1996 (Tables 4.1-4.3, Figure 4.1)

Final reported landings in 1994 are 121,365 t (Table 4.1) which is very close to the figure used in last year's assessment. The provisional landings for 1995 are 138,323 t which is slightly above the agreed TAC of 130,000 t. Catches substantially increased in Sub-area II.

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.

Norwegian landings of coastal haddock were first noted in 1970, and were reported as: "All landings south of Lofoten are excluded ...from the Arcto-Norwegian haddock stock". The first landings table for the years 1960-70 for coastal haddock were given in Anon. (1971/F:3) (Table B7). The definition of the Norwegian catches is given as the total annual catches in ICES Division IIa and Norwegian statistical areas 06 and 07 (Figure 9.1) (Anon. 1971/F:3; Anon. 1975/F:6). Unlike the definition of the catches for Norwegian coastal cod, landings of haddock in the Norwegian statistical areas 00 and 05 were excluded when defining the statistical areas for the coastal haddock catches. No specific reason for this was given. In the period 1974 to 1995, the reported Norwegian average catches of coastal haddock were about 4,500 t per year.

The Russian data on coastal haddock were taken from Anon.(1975/F:6) (Table B7). The average Russian/USSR reported catches were approximately 20,000 t of coastal haddock for the period 1960-1974.

4.1.3 Expected landings in 1996

Given previous experience and provisional reports, it is expected that the TAC of 170,000 t will be taken.

4.2 Status of Research

4.2.1 Fishing effort and CPUE (Tables 4.4)

After a period of very little trawl fishery directed for haddock, it has increased in recent years (Table 4.2). In order to obtain CPUE indices for tuning of the older ages in the VPA, the CPUE series of Norwegian trawl fisheries was updated (Table 4.4). The CPUE in all areas continues to increase, as was noted in last year's assessment. This increase is particularly noticeable in Sub-area I and Division IIb. The data series uses the total effort in the Norwegian trawl fishery, which is mainly directed to cod.

4.2.2 Survey results (Tables B1-B6)

Norway provided indices from the 1996 Barents Sea bottom trawl and acoustic survey in January-March. The results of this survey are described by Mehl and Nakken (1996). Tables B1 and B3 show the time series of abundance estimates (acoustic and bottom trawl, respectively) from this survey. Both the Norwegian bottom trawl and acoustic surveys in the winter (Tables B1 and B3) confirm the good recruitment in the haddock stock in the 1990's, especially the first part. The 1990 year class appears as the strongest in both surveys for age groups 3-6, and the survival rate appears to have been much higher than for the 1983 year class, which was stronger at age 1-2. The indices of the 1990 year class at age 6 are almost 10 times higher than those of the 1983 year class. The 1991 year class also seems to be strong.

Russia provided indices from 1995 trawl and acoustic survey (autumn) in the Barents Sea (Tables B2 and B4) The Russian surveys of demersal fish in the Barents Sea in autumn 1977-1993 are described in Lepesevich *et al.* (1994). The Russian surveys in 1995 show that the 1995 year class is at the same level as the 1993-94 year classes. The most abundant year class in the past 10 years is the 1990 year class, which is comparable in some respects to the 1983 year class.

Estimates of the abundance of 0-group haddock from the International 0-group survey (Anon. 1996/G:30) are presented in Tables A14 and A15. Both series show good recruitment for haddock since 1990.

Haddock on the Norwegian coast has been scrutinised for its distribution from the Russian border in Varangerfjord to Stadt at 62° N during the Norwegian coastal cruises in the period 1992-1995 (Anon. 1994, 1995,1996; Eliassen et al. 1993, 1994, *in prep.a & b*). The main purpose was to give estimates of the biomass, migration pattern and to determine if there was a coastal haddock stock. There have also been some investigations on the Kola coast concerning the distribution of haddock (Isaev et al. 1996).

A tagging experiment on coastal haddock has been performed with tagging 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 indicates local recaptures and that the recaptures are found throughout the year.

The length at age 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, there were some variations in the age of 50 % maturity between 4 and 6 years, and the estimated average was about 5 years (Table B10). In 1995, the age of 50 % maturity for North-East Arctic haddock was larger and above 6 years of age (Anon. 1996/Assess:4).

The haddock biomass along the Norwegian coast was calculated on the basis of the data from an acoustic/trawl cruise in the autumn 1995. The total biomass of haddock along the coast were calculated to be 196,000 t (305 million fish) and most of this is considered to be North-East Arctic haddock. The corresponding spawning biomass were 60,000 t (49 million fish) in 1995 (Tables B11 to B14). The larger part of the biomass of haddock (65 %) was distributed in the northern areas, but 69,000 t was found in the statistical areas 06 and 07. These are the same areas as the landings of coastal haddock is given for. A more detailed analysis of the haddock tagging data will be presented to the Arctic Fisheries Working Group in 1997.

4.2.3 Weight at age (Table B6)

The weight at age in the stock has declined from last year in the age range from 2 to 6 year older and increased in age 7 according to Norwegian surveys (Table B6). The weight at age from the Russian survey is in accordance with the weights found in the Norwegian survey. However, some discrepancies were observed in the age range from 4 to 7 year older. The Russian weights remained similar from last year in the range from 1 to 4 years and above 8 years, but decreased from 5 to 7 years (Table B6).

4.3 Data Used in the Assessment

4.3.1 Catch at age (Table 4.13)

A revised age composition in the Norwegian landings, with final total landings from all countries, were used to revise the number at age in the 1994 landings.

Age compositions of the catches for 1995 were available from Norway and Russia in Sub-area I, from Norway, Russia, Germany and UK (England and Wales) in Division IIa, and from Norway, Germany, UK (England and Wales) 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.

A SOP check gave a deviation of 2 % and 0.2 % from the nominal catch for 1994 and for 1995, respectively. The number at age was adjusted to make the SOP fit to the nominal catch for these years.

4.3.2 Weight at age (Tables 4.5-4.7 and 4.18)

The mean weights at age in the catch (Table 4.7) were calculated as weighted averages of the weights in the catch of Norway, Russia, Germany and UK (England & Wales) (Table 4.5).

The general decline in weight at age in the catch reported from 1992 to 1994 continues for ages 4 and 5. Those ages experienced the strongest decline in previous years. However, some discrepancies were observed in the trends shown by the different series. The Russian series shows slight but consistent weight increases in most ages. The Norwegian series show substantial declines in the age range below 6. Similarly, the German series shows clear declines in the age range from 3 to 8.

The weight at age in the catch in 1995 is higher in the age range below 8 than the weights used for prediction in 1995 AFWG report and lower in the remaining ages.

Stock weights used from 1985 to 1996 for ages 3-7 are averages of values derived from Norwegian surveys in January-February for each of the years 1985-1996 and Russian surveys in autumn for each of the years 1984-1995 (Table B6). These averages give representative values for the beginning of the year for ages 3-7 (Table 4.6). For the older age classes, the time series weights have been used, except for the year classes of 1982 and later, where the survey weights have been derived in the same way for ages 8 and older as was the case for the younger ages. For some of the years only Russian data were available. The stock weight at age in 1996 (Table 4.22) is slightly lower in ages 3 to 6 and similar in above ages than the growth used in the prognosis given by the Working Group in the last year's (1995) report.

4.3.3 Natural mortality.

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

4.3.4 Maturity at age (Table 4.8)

A maturity ogive was available from Russia for 1996 (Table 4.8). This ogive indicates a similar maturation pattern as in 1995. The proportion of mature 5 and 6 year old fish is the lowest in the time series (1981-1995).

4.3.5 Data for tuning (Table 4.9)

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	1983-1995
Russian acoustic	Total area	Autumn	1-7	1985-1995
Norwegian bottom trawl	Barents Sea	Winter	1-7	1980-1995
Norwegian acoustic	Barents Sea	Winter	1-7	1980-1995
Norwegian trawl fleet	Total area	All year	8-13	1985-1995

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

4.3.6 Recruitment indices (Table 4.10).

Four recruitment indices were updated with data from 1995 and are given in the Table 4.10. These are from the autumn Russian bottom trawl survey (age 0+), International 0-group survey (age 0), and the winter Norwegian bottom trawl and acoustic surveys (age 1 for both).

4.3.7 Prediction data (Table 4.22)

The input data to the short-term prediction with management option table (1996-1998) are given in Table 4.22. The data used for 1996-1998 in the short-term prediction were also used for these years in the medium-term prediction (1996-2000), whereas, the 1998 data was extended forward to 1999 and 2000 for this purpose.

The stock number at age is taken from the final VPA (Table 4.18) and the recruitment of the 1995 year class from the RCT3 analysis (Table 4.11). The recruitment of the 1996 and later year classes is set as the long-term geometric mean of 95 million individuals at age 3.

The fishing pattern is the average of the last 5 years from the final VPA, scaled to the 1995 F_{4-7} level. The reasoning for taking such a long time span was to remove the noise coming from the high mortalities given to the 1987 and 1988 year classes in the last two years of the assessment.

The maturity ogive of 1996 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 1996 was calculated assuming the same ratio between weight at age in the catch and weight at age in the stock as the average ratio for 1993-1995. The weight at age in the stock and in the catch in 1997 and later years was set equal to the average for the period 1994-1996, which is a low level. However, because of lack of consistency in the data series of weight at age in the stock, the values for ages 8 and older were set equal to the weight at age in the catch.

The natural mortality on ages 3-5 was set equal to the 1993-1995 average from the VPA with predation.

4.4 Methods Used in the Assessment

4.4.1 VPA and tuning (Figure 4.2).

The extended Survivors Analysis (XSA) was used to tune the VPA to the available indices series (Table 4.9). The XSA was initially run on the updated 1994 data in the same way as last year, i.e., shrinkage to 2 years and 5 ages, using a SE of 1.0 for the mean. Catchability was set to be dependent on stock size for ages younger than 8, and to be independent of age for ages older than 11. The whole age span (ages 1-14+) was used. Results were comparable to those obtained last year. However, VPA numbers at older ages (>8) were higher. This was caused by the revision of the 1994 CPUE data from the Norwegian fleet which gave higher catch numbers at older ages than last years provisional figures (Table 4.9).

A similar XSA run was performed once the 1995 figures were incorporated to the assessment data set. Fishing mortality (F_{4-7}) decreased from 0.65 in 1994 to 0.5 in 1995 in combination with slight reductions in numbers at age and total biomass and a noticeable increase in total spawning biomass.

Following recommendations from the ACFM, the WG decided to carry out the tuning VPA runs using a constant catchability model for all ages. This was different from the catchability model dependent on stock abundance for ages younger than 8 year old. The use of a constant q model gave the tuning indices more influence on the final VPA results and consequently raised the VPA population numbers.

When the constant q model was used, the VPA results changed dramatically. The size of the population increased twofold, which was mainly due to the increased abundance of the 1990 year class. The size of this cohort at age 5 increased to 500 million individuals in this analyses compared to 166 million in the assessment which used a catchability model dependent on stock size (for ages <8). Fishing mortalities decreased correspondingly.

The WG discussed the "real" level of the 1990 year class. Comparing the various 1995 survey indices for cod and haddock indicated consistently higher abundance of the 1990 haddock year class relative to the 1990 year class of cod (Tables 3.11 and 4.9). However, previous assessments showed much higher abundance for the 1990 year class of cod relative to haddock. In addition, the 1990 year class of haddock appeared at age 1 at a similar magnitude as the very abundant 1983 year class. The abundance level of this cohort has increased in the surveys relatively to other year classes from year to year. It currently is the most abundant cohort at age 5 in all survey index series and has dominated the catches since reaching age 4.

The WG felt that the surveys reflect the actual abundance of 1990 year class as well as the strong 1991 year class. Consequently, the constant catchability model was applied to haddock. However, the WG felt that the assumption of a constant catchability model for pre-recruit ages was too strong for this haddock stock. It was therefore decided to run the tuning VPA (XSA) setting the catchabilities dependent on stock abundance for ages less than 4. The remaining settings were maintained as before. This run gave lower abundance for the 1990 year class, on the order of 300 million individuals at age 5.

In order to use the data on predation (see section 3.4.3 on cod cannibalism) the estimated consumption of haddock by cod was incorporated into the XSA analysis. A new catch numbers at age matrix was constructed by adding the numbers of haddock at age (1-5) eaten by cod for the years where such data were available (1984-1995) (Table A16). The consumption of haddock by cod for the period 1984-1995 is given below:

Consumption by cod at age (in thousands individuals)					
Year	Age				
	1	2	3	4	5
1984	1011436	15628	87	0	0
1985	1197311	5144	0	0	0
1986	558284	242003	165434	0	0
1987	758811	0	0	0	0
1988	15816	504	9171	0	223
1989	237604	0	0	0	0
1990	149250	41862	4062	0	0
1991	469643	15069	0	0	0
1992	2259570	136902	992	0	0
1993	1817441	178716	39728	3911	3322
1994	2008864	92849	28173	8893	1032
1995	4580324	253568	27411	43335	39712

In this analysis, the tuning data series was reduced to the same period 1984-1995 to be consistent with the predation data period.

A final tuning XSA was run with the predation data was incorporated. The catchability regression statistics did show a better general fit in this run for all the survey indices (Table 4.12 and Fig. 4.3).

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

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 predation by cod (M2) by using the proportion of fleet catch and predation catch to the total catch, respectively. The new natural mortality data set was prepared by adding 0.2 (M) to the predation mortality (M2). This new M matrix (Table 4.13) was used together with a new true Fs to run the final VPA on ages 3 to 14+.

4.4.2 Recruitment (Tables 4.11)

The strength of the 1993 year class at age 3 was estimated directly by the XSA as age 3 in 1996. The strength of the 1994 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 1995 year class at age 1. Only the age 1 survey indices and the indices from the International 0-group surveys were included in the estimation, together with estimates of year class strength at age 1 from the final XSA. The abundance of this year class at age 1 was reduced to the abundance at age 3 by the same average natural mortality (0.2 plus predation mortality) in 1996 and 1997.

4.5 Results of the Assessment

4.5.1 Fishing mortality and VPA (Tables 4.12–4.21 and Figures 4.1A and 4.1B)

The tuning diagnostics of the final XSA (predation included) are given in Table 4.12 and the fishing mortalities and population numbers of this analyses in Tables 4.14 and 4.15, respectively.

Figure 4.3 shows the plots of survey/CPUE abundance indices against VPA numbers for all the tuned ages used in the assessment. They all reflect a general good fit, with signals of some lack of relationship at low levels of stock abundance as reflected by the VPA.

The natural mortalities, fishing mortalities and stock numbers of the final VPA are given in Tables 4.13, 4.17 and 4.18, respectively, while the stock number at age and the spawning biomass at age are given in Tables 4.19 and 4.20. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1950 are given in Table 4.21 and Figures 4.1A and 4.1B.

The highest level of fishing mortality (F_{4-7}) since 1980 occurred in 1981 (0.62). F_{4-7} decreased to nearly half of the level in 1984 (0.33), increased again to 0.53 in 1987. After the historical low (0.17) produced by a period of fishing restriction around 1990, F_{4-7} increased to the current level of 0.33.

Fishing mortality was relatively high on the 1987 and 1988 cohorts at ages 5 to 8. These year classes have been consistently shown as weak in the surveys whereas they are occurring in relatively large numbers as 6, 7 and 8 year olds in 1993-1995, as was pointed out in last year's report. It was concluded that F_{4-7} was overestimated because the influence of these cohorts on the reference mean.

The VPA numbers at age matrix show a fairly high level of the 1990 year class in 1995 of 552 million. The abundance of this year classes at age 5 in last year's assessment was 292 million. The difference in the abundance estimates of this year class was even higher when a constant catchability model for all ages was tried. The use of a catchability model dependent on stock abundance for ages less than 4 year old gives a more conservative estimate of the year class abundance.

After a steady increase from 1985 to 1993, the spawning stock biomass slightly decreased in 1994 to 83,028 t then began to increase in 1995 to 157,508 tons, a level similar to the long term arithmetic average. This increase is in spite of a delayed maturation and a downwards revision of weight at age on the oldest groups. The total stock biomass is slightly increasing in the last year after a sudden increase from 1992 to 1993 as a consequence of the recruitment of the 1990 year class. Fishing mortality steadily increased from 0.17 in 1990 to 0.57 in 1994, then decreased to 0.33 in 1995, which is below F_{med} (0.35). As mentioned earlier, the Working Group considered the level of average F in 1994 as slightly overestimated due to the noise caused by the sudden occurrence of the 1987 and 1988 year classes in the catches of 1993 and 1994.

4.5.2 Recruitment (Tables 4.10–4.11)

The XSA estimate of the 1993 year class is 88 million of individuals at age 3 and the XSA estimate of the 1994 year class is 340 million of individuals at age 2 (Table 4.12). This year class will be reduced to a level of 132 million of individuals at age 3. The RCT3 estimate of the 1995 year class is 107 million at age 1 (Table 4.11), which will be reduced to 4 million individuals at age 3 by natural mortality (M+M2). The long term geometric mean is 95 millions individuals.

4.5.3 Biological reference points (Table 4.23)

The yield per recruit analysis using the fishing pattern and stock parameters for 1997 from the management option table gave estimates of $F_{0.1}$= 0.17 and F_{max}= 0.46. The latter differs slightly from the value of 0.52 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_{95} = 0.33 (*status quo*).

4.5.4 Catch options for 1997 (Table 4.24)

As the 1990 year class is estimated this year to be considerably stronger than last year and the catch of 170,000 t in 1996 is reflecting a low F (0.27). A *status quo* F in 1997 of F = 0.33, which is below F_{med}, will allow a catch of 240,000 t. In order to ensure a continued high level of the spawning stock and take a precautionary approach, catches in 1997 should be well below the F_{med} level.

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 a 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.

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 ensure that the spawning stock biomass remains above the MBAL 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 4.22)

The input data were the same used as for the short term predictions (Table 4.22). The recruitment at age 3 of the 1996 and later year classes was set equal to the long-term geometric average of 95 million.

4.7.2 Methods

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

4.7.3 Results (Table 4.25-4.26 and Figure 4.1D)

In Figure 4.1D the catch level in 1997 and spawning stock biomass level in 1998 are plotted against the fishing mortality, F, in 1997.

In Table 4.25, 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 $0.8*F_{status\ quo}$ is also given. In the medium term, the stock will decrease to a level of about 300,000 t when fishing at $F_{status\ quo}$ and the catches will be between 85,000 and 240,000 t. However, the spawning stock biomass will be reduced after the current very high level, and approach the long term arithmetic mean of 160,000 tons.

4.8 Comments to the assessment and forecasts

The retrospective analyses show consistent results for the last 3 years. However, the 1987 year class was caught in 1994 and in 1995 in greater than expected quantities which resulted in very high F values in 1994, that was included in the average $F_{4\text{-}7}$. From this, it is concluded that the F has been stable in the last three years.

The 1990 year class is determined to be a very strong year class and this dominates the recent and will dominate the near future stock situation. The estimation of the 1990 year class turned out to be very dependant on the choice of stock independent catchability regression in the tuning model. These unstable properties of the XSA module give reasons for concern.

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

5.1 Status of the Fishery

5.1.1 Historical development of the fisheries (Table 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. 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 1992-1994 and 13% in 1995, whereas, trawl landings accounts for more than half of the total. The decline in purse seine landings appears to have been caused predominantly by changing market conditions.

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

Landings of saithe were highest from 1970-1976 with an average of 238,000 t and a maximum of 262,000 t in 1975. 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 1994 the revised landings were 142,253 t. Provisional reports of landings in 1995 indicate an increase of about 27,000 t. This gives a total of 169,378 t compared to 165,000 t expected by last year's Working Group, which was the target set by Norwegian authorities.

5.1.3 Expected landings in 1996

Norwegian authorities set quotas for other countries and for Norwegian purse seine and trawl fisheries. The goal in 1996 is to limit Norwegian landings to 158,000 t. In addition, about 5,000 t can be expected from other countries, giving a target of 163,000 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). There is no basis for assuming a catch level other than 163,000 t in 1996. Thus, the catch in 1996 is expected to be approximately 163,000 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 presently accounts for approximately half of the purse seine landings (37% in 1995) and constitutes most of the specialised 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 1995 fishing effort increased by 15 % (Table C3).

Table C2 gives catch, effort and catch per unit effort for Norwegian trawlers since 1976. This summarises 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 1995 and is presently at the maximum recorded level.

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 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). Since 1992, there has been an increasing trend in the total effort. The recent decline in purse seine effort is more than compensated for by an increase in trawl effort.

A group of Norwegian scientists and administrators are currently examining the management of saithe and, in particular, the minimum landing size regulations. The results of this work might create a need for additional calculations at next years WG meeting.

5.3 Data used in the Assessment

5.3.1 Catch at Age (Table 5.6)

The numbers at age increased slightly in 1993 due to revised Russian landings. The age composition of Norwegian landings in 1994 was revised, resulting in a substantial decrease for age 2, 3 and 4 and a corresponding increase for age 5 and 6. Age composition data for 1995 was available from Norway, accounting for 98% of the landings. A Russian length composition was also available and an age-length key for the Norwegian trawl fishery was applied to this. 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 in 1994 and 1995. This may have given underestimates of the catch at age 2.

5.3.2 Weight at Age (Tables 5.7 and 5.13)

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.

For the prediction, the average weight at age in the catch and stock for the last three years in the VPA has normally been used. However, there was a decline in weight at age in 1994 for the three abundant year classes 1988-1990. Using the recent average in the prediction would likely certainly give overestimates of weights for these year classes. This weight reduction could be caused by density dependent growth or environmental variation. Reduced weight at age was observed in 1986-1987, but in the following year growth was average. It was assumed that the present situation will also be short-lasting and that the year classes 1988-1990 will have approximately average growth up to age 7, i.e., increasing by an increment of 0.6 kg per year. Otherwise, average values for 1993-1995 were used. Table 5.13 summarises recent developments in weight at age and the weights used for the prediction period.

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 the 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 3 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). All series were revised at last years meeting. 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 satisfactory.

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 in 1995 there are conflicting results between the catch and survey data.

5.3.7 Prediction data (Table 5.14)

The input data to the prediction are given in Table 5.14. For the exploitation pattern the average of 1993-1995 has been used, scaled to the 1995 level. The long-term geometric mean recruitment of 210 million was used for the 1993 and subsequent year classes.

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 is the inclusion of purse seine cpue at that age, which performed badly assuming dependence on catchability. The tuning diagnostics are given in Table 5.5. Figure 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 reduced the estimates of the 1991 and 1992 year classes very much compared to the results 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 the survey at age 2 seems to be caused by the very low and probably underestimated catch figure at age 2 in 1995. Although the estimate for the 1992 year class is uncertain, a 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 year class was poorly represented both in the Norwegian acoustic survey and in the purse seine fishery in 1995 (Table 5.3). The acoustic index of the 1993 year class at age 2 was 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 similar to that of the 1992 year class for the 1993 year class.

5.5 Results of the Assessment

5.5.1 Fishing mortalities and VPA (Tables 5.8-5.12, Figure 5.1A-B)

The XSA-estimates of the youngest age groups in the two last years (1995-96) 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 1995 was 0.49 which agrees well with last year's assessment in the development of the stock up to the beginning of 1994, as shown by the retrospective analysis (Figure 5.3A). However, fishing mortality in 1995 was somewhat higher than expected last year.

There was a marked change in the exploitation pattern with reduced mortality on the youngest ages in the last years. This was caused mainly by the decrease in the purse seine fishery which has been responsible for most of the catches of immature saithe. The 1989 and 1990 year classes are still abundant, while the following year classes seem to be weaker.

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 5.10-12). 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 128 million individuals. The RCT3 estimate of the 1993 year class is 191 million individuals, which is close to the long-term geometric mean of 210 million. It was decided to use the latter for the 1993 and subsequent year classes.

5.5.3 Biological reference points (Figures 5.4 and 5.1C)

Yield and SSB per recruit were based on the parameters in Table 5.14, except that the 1993-1995 average of weights at age (Table 5.13) were used for all age groups. $F_{0.1}$ was estimated to be 0.09 which is the same as what was obtained last year. F_{max} was estimated as 0.16 (Figure 5.1C) which is also close to the result from last year (0.19). 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 0.18, 0.33 and 0.62, respectively, which are slightly below the estimates from last year. These minor changes may be caused by the changes in exploitation pattern and growth.

5.5.4 Catch options for 1997 (Table 5.15)

The management option table (Table 5.15) shows that the expected catch of 163,000 t in 1996 will give a slight increase in fishing mortality from F_{95} (*status quo*) of 0.49 to 0.50. The *status quo* catch in 1997 is 145,000 t compared to a catch at F_{med} of about 107,000 t. SSB will decrease to 167,000 t in 1997 which is below both the old and the recomended new MBAL (170,000 t and 200,000 t, respectively). SSB will continue to decrease in 1998 if fishing mortalities are higher than about $0.8F_{status\ quo}$ (0.39) in 1997. A *status quo* catch in 1997 would reduce the SSB to 150,000 t in 1998, while an F_{med} catch gives an increase in the SSB to about 187,000 t. The F_{max} catch for 1997 is 58,000 t, and the corresponding SSB in 1998 would be about 236,000 t.

5.6 MBAL level and advised exploitation rates (Figures 5.4 and 5.1C)

5.6.1 Minimum biological acceptable level (MBAL)

In the 1994 WG report (Anon.1995/Assess:3) an 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 represents a less restrictive MBAL and 170,000 t was found to correspond better with the arguments used in 1994 (Anon. 1996/Assess:4). The updated stock and recruitment plot (Fig. 5.4) shows that 70% of the year classes less than the long-term geometric mean of 210 million have been produced by spawning stocks below 200,000 t and almost 70% of the year classes above the long-term geometric mean are produced by spawning stocks well above 200,000 t. It is therefore recommended to increase the MBAL for saithe to 200,000 t.

5.6.2 Advised exploitation rates

The Comprehensive Fishery Evaluation Working Group (Anon. 1996/Assess:20) suggested an 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 0.16, which means that there is a large potential for increased yields by lowering the fishing mortality from $F_{status\ quo}$ (0.49) to F_{max} (0.16) (Figure 5.1C). The corresponding catch in 1997 is 58,000 t, which would be a drastic reduction from the present TAC. The F_{med} catch of 107,000 t is perhaps more acceptable, and with this level of fishing mortality the predictions show that both catches and spawning stock biomasses will increase towards the present level.

5.7 Medium-term forecasts and management scenarios (Tables 5.16-5.17, Figure 5.1D)

5.7.1 Input data

The input data were the same as used for the short term predictions (Table 5.14)

5.7.2 Methods

Single option predictions were run up to year 2000 using IFAP and following standard procedures.

To do a few initial risk analyses, a spreadsheet reproducing the single option prediction was constructed and run under the program @RISK, using 100 iterations and fixed seed for the random 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 (3-11) from the 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 1966-1994, and the corresponding values were 210, 100, 77 and 420 million.

5.7.3 Results

Single option predictions for $F_{0.1}$, F_{max}, F_{med}, $0.8F_{status\ quo}$, $F_{status\ quo}$ and F_{high} up to 2000 are given in Table 5.16 and Figures 5.5A-F and 5.6A-F show the corresponding SSB and catch distributions with quantiles from the @RISK simulations. The *status quo* catch in 2000 is 142,000 t, but this level of F would keep the SSB below the MBAL in the whole period. A fishing mortality of $0.8F_{status\ quo}$ (0.39) will give just a little lower average catch for the period, but the SSB will be close to the MBAL in 2000. At F_{med} (details in Table 5.17) the SSB will increase to 239,000 t in 2000 and the catches will increase from 107,000 t in 1997 to 144,000 t in 2000. The "COMFIE-recommended" F_{max} = 0.16 would increase the SSB to 400,000 t in 2000. With this fishing mortality the catch would be reduced to 58,000 t in 1997, increasing to about 117,000 t in 2000.

In the @RISK simulations the probability of getting below the "old" and the recommended MBAL for the SSB (170,000 t and 200,000 t, respectively) was analysed using the "set target value" option. The text table below presents the percent chances of getting an SSB at or below the MBAL level in year 2000.

Fishing mortality	MBAL (tonnes)	
	170,000	200,000
$F_{0.1} = 0.09$	0	0
$F_{max} = 0.16$	0	0
$F_{med} = 0.33$	2	22
$0.8F_{s.q.} = 0.39$	22	55
$F_{status\ quo} = 0.49$	75	93
$F_{high} = 0.62$	100	100

With $F_{status\ quo}$ the chances of getting below both MBAL levels are very high. Also for $0.8F_{status\ quo}$ the probability of "overfishing" the recomended MBAL (200,000 t) is too high. F_{med} seems to be a more appropriate level of fishing mortality, but F_{max} is best.

5.8 Comments on the assessment and the forecast

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 rather high level in the 1995 and some reduction in fishing mortality is advisable to prevent the SSB from being reduced to previous low levels. Reduction in the fishing mortality might improve the stability in the fishery and increase the long-term yield.

The quality of the present assessment seems to be comparable to the previous assessment. Prediction of growth is a small problem in some periods, especially for abundant year classes. 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 reduced this dependence will be less and multi-year TAC advice should be considered.

6 *SEBASTES MENTELLA* (BEAKED 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* (beaked redfish) are trawl fisheries. By-catches are taken in the cod and especially the shrimp trawl fisheries. 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. In the mid-1980s Norwegian trawlers started fishing further south, along the continental slope at approximately 500 m depth, on grounds never harvested before and nearly only inhabited by mature fish. This resulted in a new peak of 115,000 t in the landings in 1982, but in 1987 they were reduced to 10,500 t. After an increase to 49,000 t in 1991, the landings have been at a level of 10,000-15,000 t, showing a declining trend. Since 1991 the fishery has been dominated by Norway and Russia.

6.1.2 Landings prior to 1995 (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 separately are shown in Tables 6.2-6.4. The total landings decreased from 48,735 t in 1991 to 15,587 t in 1992 and have continued to decline. The provisional landings figure in 1995 is 10,359 t which is the lowest on record and 1,880 t less than in 1994. The landings in 1995 are more than 3,000 t lower than the 13,500 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 statistics 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 DGR have been added and are given under Germany.

Most of the reduction in landings of *S. mentella* during the last four years have been in Sub-area I and Division IIb, while the landings in Division IIa have been more stable and in 1995 represent nearly 90% of the total.

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 2,599 t due to an increase in the French fishery, but decreased again to 1,780 t in 1993. For 1994 and 1995 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 1996

The Russian fishery for *S. mentella*, accounting for more than half of the landings in 1995, has been poor and a reduction of nearly 5,000 t is expected in 1996. The Norwegian landings of redfish halfway through the year was 40% higher than at the same time in 1995. Although breakdown on species is not yet available, the increase seems to be distributed on both species. On this basis, and assuming unchanged catch level for other countries, the landings of *S. mentella* for 1996 are expected to be 7,000 t, which is a reduction of approximately 30% from 1995.

6.2 Status of Research

6.2.1 Fishing effort and catch-per-unit-effort (Table D4)

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 64% of the total international trawl catch. (Table D4). The cpue has been fluctuating about the 1995-level since 1985 with no clear trend.

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

6.2.2 Survey results (Tables D4-D8)

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 autumn.
2. Russian bottom trawl survey in the Svalbard and Barents Sea areas in October-December from 1978-94 in fishing depths of 100-900m (Table D5).
3. Norwegian Barents Sea bottom trawl survey (winter) from 1986-95 in fishing depths of <100-500m. Data disaggregated only on length (Table D7).
4. Russian acoustic survey in April-May from 1992-95 (except 1994) on spawning grounds in the western Barents Sea (Table D8).

The Norwegian Svalbard survey in autumn (Table D6), with age disaggregated data from 1992 onwards, was intended to be 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 the data on *S. mentella* from this survey in 1995 were not finalised in time for the Working Group meeting, but are expected to be used in future meetings.

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, down to only 1/4 of the 1979-1990 average. With the exception of an abundance index of twice the 1991-level in 1994, the indices have remained low.

In the Russian bottom trawl survey the most recent estimates are among the lowest observed. (Table D5). The area outside Spitsbergen was not properly covered in 1993, and this may account for the generally low values this year.

The results from this survey are the only age disaggregated survey data used in the VPA-tuning and is also the basis for estimating the recruitment in the assessment in recent years.

Since 1981, a stratified random bottom trawl survey, aimed at cod and haddock, has been carried out by Norway in February in the Barents Sea. The results for *S.mentella* are only available on length (Table D7). Based on the length frequencies, the year classes 1987-1990 are the strongest in the time series, the 1991-1993 year classes are poor, while the 1994 and 1995 year classes are at a medium level.

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 and 1995 (except 1994). Table D8 shows a rather stable spawning stock biomass (90,000 - 114,000 t) during the three survey years, and the strong 1982 year class can clearly be traced.

6.2.3 Age readings

As a result of the process on harmonising the international age readings on redfish, all catches of redfish in 1992-1995 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, 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 1993 was revised according to new catch data. Catch at age for 1994 were revised according to new catch data and an updated catch at age distribution from Norway. Data for 1995 for *S. mentella* were available from Norway and Russia (Division IIa), corresponding to 84% of the total landings. For Division IIa, a German length distribution was available, and was converted to age using a Norwegian age-length key. 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 1995 were available from Norway and Russia (Division IIa). These weight-at-age data weighted by the numbers caught at age 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 1992-1994 (Table 6.15). As in previous assessments weight at age in the stock was taken to be the same as the weight at age in the catch.

6.3.3 Natural mortality (Table 6.15)

A constant natural mortality of 0.1 is used.

6.3.4 Maturity at age (Tables 6.7, 6.15 and D3)

Age based maturity ogives for *S.mentella*, sexes combined, are available for 1987-1993 and 1995 from Russian research vessel observations in spring (Table D3). There were no new data and the same input as in last year's assessment was used both for the VPA (Table 6.7) and in the prediction (Table 6.15).

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. For 1994, the converted Russian catch-at-length data were used. The data were used as tuning input for ages 9-18.

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 tuning data for 1989-1993 based on estimates of total Norwegian trawl effort was not updated and was removed from the tuning input.

6.4 Methods used in the Assessment

6.4.1 VPA and tuning (Tables 6.9, Figure 6.2)

The Extended Survivors Analysis (XSA) was used with the same settings as last year, except that catchability was set independent on stock size also for ages younger than 7 (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. The retrospective analysis showed consistent estimates of fishing mortality (Figure 6.2).

6.5 Result 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_{10-16}) in 1995 is 0.076 and has been nearly constant the last three years. The spawning stock has decreased since 1993, but this could be caused by a change in the maturity ogive which is based only on the curve estimated for 1995 since data for 1994 and 1996 are missing..

The average fishing mortalities for the years 1993-1995, scaled to the 1995 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 appear to be at a similar level as the 1982-1983 ones. This confirms what is indicated by the length data from Norwegian acoustic and bottom trawl surveys. Russian qualitative observations of young redfish in cod stomachs indicate, however, that the 1988-1989 year classes may be slightly weaker than the 1982-1983 ones.

In the catch projection, the VPA results have been used for the year classes up to 1990. 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 (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}=0.38, in spite of being reduced by half from 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}=0.020, F_{med}=0.077, and F_{high}=0.176 were calculated.

6.5.4 Catch options for 1997 (Table 6.16)

If catches in 1996 are as expected, the fishing mortality will be considerably reduced (Table 6.16). Some increase in SSB from 1996 to 1997 is predicted, and will continue in 1997 for moderate levels of fishing mortality. *Status quo* fishing mortality (=F_{95}) in 1996 will yield a catch in excess of 12,000 t in 1997, approximately 2,000 t more than in 1995, and will lead to a slight increase in SSB. Table 6.17 shows predictions up to 1998 with no fishing and the options F_{low}, F_{med}, and F_{high}. $F_{0.1}$ and F_{95} are both very close to F_{med}. The catch in 1997 and SSB in 1998 for various levels of F in 1997 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 MBAL seems to be to use the plot without assuming any particular relationship. In that case, the statement made in last year's report, that an 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.

With MBAL at 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. In order to rebuild the stock to MBAL, 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.

6.6.2 Advised exploitation rates

F_{max}=0.38 is too high to be considered as realistic. The values of $F_{0.1}$=0.082 and F_{med}=0.077 are for all practical purposes the same and close to the current (1995) level of fishing mortality. Fishing mortalities should in general not exceed F_{med} and rebuilding requires that it 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 now are 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 year's assessment, and removing the stock dependence of young year classes in the tuning gives a better correspondence between the VPA and the observed indices. The results 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 mentella* (golden redfish) is mainly conducted by Norway accounting for 80-90% of the total catch. Germany also has long traditions in 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 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 at Sleppen outside Finnmark. Traditionally, this is the most popular and best paid redfish species.

7.1.2 Landings prior to 1996 (Tables 7.1-7.4, D1)

Nominal catches of *S. marinus* by country for Sub-areas I and II combined are presented in Table 7.1, and total for both redfish species in Table D1. Landings of *S. marinus* showed a decrease in 1991 from a level of 23,000-30,000 t in 1984-1990 to less than 20,000 t in 1991-1994. The provisional total landings figure for *S. marinus* in 1995 is 14,885 t. This is 1,615 t less than expected by last year's Working Group, and a reduction of more than 2,000 t from 1994.

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

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7.1.3 Expected landings in 1996

On the basis of reports of landings from the first half of 1996, Norwegian landings of redfish have increased by 40% compared to the first half of 1995. Species breakdown is yet not available, and it is assumed that both species will show the same rate of increase. Also Russian catches are expected to increase. On this basis landings of 19,000 t are expected in 1996. which is approximately 4,000 t more than in 1995.

7.2 Status of Research

7.2.1 Fishing effort and catch-per-unit-effort (Tables D12)

Data for *S. marinus* were available for Norwegian freshfish trawlers since 1981 (Table D12) from which the total international effort was estimated. This series is based on GLIM analysis on monthly data from five Norwegian statistical areas along the Norwegian coast. Difficulties related to the splitting of the redfish species in the catches may still be the reason for big fluctuations in the series, although typical *S. mentella* grounds have been sorted out. A somewhat lower effort is observed since 1991, and except for a few years with high catch-rates and a low catch-rate in 1989 (very high effort), the CPUE has been rather stable. Provisional figures for 1992 -1994 are close to the long-term average of 0.42 t/hour. The series has not been updated to include 1995.

7.2.2 Survey results (Tables D9-D11)

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

1. Norwegian Svalbard bottom trawl survey (autumn) from 1986-94 in fishing depths of <100-500m. Data disagregated on age only for the years 1992-94 (Table D9). This survey covers the northernmost part of the species' distribution.
2. Norwegian Barents Sea bottom trawl survey (winter) from 1986-95 in fishing depths of <100-500m, and an acoustic survey at the same time. This survey covers important nursery areas for the stock. Data disagregated on age for the years 1992-94 are shown in Table D10, and on length for the years 1986-95 in Table D11.

These surveys were also described in chapter 6.

Both surveys show a fairly stable stock situation, but data needed for updating the series were because of special circumstances not available for the Working Group.

7.2.3 Age readings

An ICES Workshop on harmonising the international age readings on redfish, incl. *S.marinus,* was held in Bremerhaven 4-8 December 1995, and the effort to harmonise age readings will continue.

7.3 Data Used in the Assessment

7.3.1 Catch at Age

Catch at age for 1993 was revised according to new catch data. Catch at age for 1994 were revised according to new catch data and an updated catch at age distribution from Norway. Age composition data for 1995 (based on otoliths) 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. In Division IIb, German and Russian for trawl catch-at-length were converted to age by using the Norwegian age-length key. 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

Weight-at-age data for ages 7-24+ were available from the Norwegian landings in 1995.

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

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 D9-D10).

On the basis of catch-per-unit-effort from Norwegian freshfish trawlers since 1981 (Table D12), total Norwegian trawl effort was calculated, and corresponding catch-at-age data were used for ages 9-23.

The tuning series were not updated, but are expected to be used in the future.

7.4 Comments on the Stock Assessment

Lacking data for updating the tuning files, the Working Group were not in a position to attempt any analytical assessment.

7.5 State of the stock and management considerations

Modal length data from surveys available for an 11-year period show no indication of recruitment failure or changes in the overall stock level in the area surveyed. Landings declined in 1995, but this is not sufficient evidence of a stock decline. The Working Group therefore advises that a precautionary TAC based on recent catch levels should be the basis for the management advice.

7.6 Special note

The fact that the Norwegian data on redfish were only partly updated in time for the meeting was due to special circumstances and does not reflect a reduced effort from Norway in redfish research.

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 into 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 a directed fishery for Greenland halibut. Trawl catches were limited to bycatch at a level of 10% in weight in each haul up to the autumn of 1994. A level of 5% bycatch of Greenland halibut onboard at any time has been put into effect for all vessels in 1995 and 1996. These regulations reduced the total landings of Greenland halibut to about 10,000 t. In the Russian trawl fishery for cod and redfish, the bycatch of Greenland halibut is less than 1,000 t.

8.1.2 Landings prior to 1996 (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. For most countries the catches listed in the table are similar to those officially reported to ICES. For Norway the values in the table 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 nominal catches by country for Sub-area I and Divisions IIa and IIb separately are shown in Tables 8.2-8.4. The revised total catch for 1994 is 9,151 t which is virtually unchanged from that used in the previous assessment. The preliminary estimate of total catch for 1995 is 11,028 t. This is somewhat higher than the projected catch of 9,000 t estimated by the Working Group during its 1995 meeting. The discrepancy is partly due to a marked increase in Norwegian long-line catches (Table 8.5). In the area IIb, nominal catches increased from about 1,000 t in 1994 to nearly 3,000 t in 1995. No such increase was seen in the Divisions I and IIa.

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 gradually from 267 t in 1991 to 1503 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 Subareas 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. Jan Mayen is within Division 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 1996

Fishery for Greenland halibut is regulated by a TAC of 2500 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 catches onboard the vessel at any time. Neither of these measures function as intended. When the gillnet and longline fishery was closed for 1996, just as last year the quotas were severely overfished resulting in a catch of approximately 4,000 t. The bycatch in the trawl fishery has also increased and it is expected that a total of about 12,000 t will be caught by Norway. An additional 1,000 t is expected to be caught by Russian vessels.

The catches from Division IVa is 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 8.2D)

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 8.2D). This comprises fishing during two weeks in May-June and October, representing an effort somewhat less than 20% of the 1991 level. 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. Although it is difficult to fully reconcile this 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 1995 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.

The increase in catch rates in this time series seems to be associated with a narrowing of the age composition. While 6 and 7 year olds made up 46-53 % of the catches in 1992-1995, the contribution of these age groups in 1996 increased to 67 %. Both older and younger fish were relatively less abundant. In the period 1992-1996 the relative contribution of age 8 and older was 27, 25, 22, 24, and 13 % respectively. This narrowing may be attributable to an overexploitation of the stock.

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 stabilising 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-E4, Figures 8.2A-C and 8.4)

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

1. Norwegian Svalbard bottom trawl survey (autumn) from 1984-95 in fishing depths of <100-500m. (Table E1, Figure 8.2A).

2. Russian bottom trawl survey in the Barents Sea from 1990-95 in fishing depths of 100-900m. This series was revised considerably since its use in the 1995 assessment. (Table E3, Figure 8.2B).

3. Norwegian Svalbard shrimp trawl survey from 1988-95 in fishing depths of 200-600m. (Table E4, Figure 8.2C).

4. Norwegian Barents Sea bottom trawl survey (winter) from 1989-96 in fishing depths of <100-500m. In order to utilise the 1996 values, 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.

The Norwegian Svalbard bottom trawl survey caught Greenland halibut mainly in the range of ages 1-8, although in most cases age 1 was poorly represented. The age distribution in the earlier period was highly variable, however, for the period 1984-91 the overall abundance in most years was relatively high compared to 1992-95. Beginning 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 Russian Barents Sea bottom trawl survey series was revised considerably since the 1995 assessment. The current series now includes age compositions from 1991 by adjusting length frequencies collected in the 1991 survey with the combined age length keys from the adjacent surveys in 1990 and 1992. Further revisions to the data set were made by using data from the Russian trawl-acoustic surveys conducted following the Greenland halibut surveys thus expanding the areal coverage. The details of the methodology, however, 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 recommends that a detailed explanation of the revisions be made available at next year's meeting for review.

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 since about 1989. All subsequent year-classes and these cohorts at older ages were estimated to be in extremely low abundance with the 1995 survey estimates about the lowest in the time series.

The Norwegian bottom trawl surveys during winter in the Barents Sea (adjusted to autumn of the previous year) caught Greenland halibut up to 12 years and older, but was not particularly effective at 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 catch 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 1990 and by 1994-95 the catches of these cohorts were the lowest observed.

8.2.3 Age readings

Considerable concern has been raised both in the current and previous meetings of the Working Group regarding the age interpretations of Greenland halibut. It was noted in last year's assessment 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 order to correct the problem some steps have already been taken including otolith exchanges among various countries. The group was informed that an ICES/NAFO workshop on Greenland halibut ageing is being held at Reykjavik, Iceland in November of this year to address ongoing problems with age interpretation of the species throughout the North Atlantic.

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 1994 were updated using revised catch figures and revised Norwegian age composition. Catch-at-age data for 1995 were available from both the Norwegian and Russian fisheries. Russian age data were only available from Subarea II and the Norwegian age distribution was used to calculate Russian catch-at-age in Subarea I. The combined Norwegian and Russian catch-at-age was used to allocate catches from other countries on age groups. Total international catch-at-age are given in Table 8.7 and for the recent years also in Figure 8.3.A. 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 years 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 (Figure 8.3B). 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 1995 (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 and E6)

An average maturity ogive derived from Russian data (Table E6) 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. No new maturity data were available this year and the same ogive was therefore also used for 1995.

8.3.5 Tuning data (Table 8.10)

The following abundance indices were used for tuning the VPA:

1. Norwegian Svalbard bottom trawl survey (autumn) from 1984-95 for ages 1-8.
2. Russian bottom trawl survey in the Barents Sea from 1990-95 for ages 4-9.
3. Norwegian Svalbard shrimp trawl survey from 1988-95 for ages 1-8.
4. Experimental commercial fishery from 1992-95 for ages 5-14.
5. Norwegian bottom trawl survey in the Barents Sea (conducted in winter and adjusted to the autumn the year before) from 1988-95 for ages 1-12.

8.3.6 Recruitment indices (Tables A14, E1-E4)

In addition to the indices mentioned in section 8.3.4, the 0-group indices from the International 0-group survey (Table A14) were available for recruitment estimation. All the indices seem to indicate extremely low recruitment in the last few years. All year classes after 1989 show consistently very poor 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 latest eight years (Tables A14 and E2). However, further observations at older ages are needed before the strength of this 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 1996-1998 are shown in Table 8.17. Population numbers in 1996 are taken from the VPA.

Recruitment of 3-year olds in 1997 was calculated as the VPA estimate at age 2 allowing for natural mortality. Information of recruitment in 1998 was limited to the 0-group index in 1995 (Table A14) and the I-group survey index from the Norwegian bottom trawl survey in the Barents Sea in 1996 (Table E2). The correlation between the 0-group indices and VPA estimates is very weak and in the short term prediction the recruitment in 1998 was equalled to the 1997 recruitment.

The exploitation pattern used in the short term prediction is the average of 1993-1995 scaled to give an F-factor of 1.0 corresponding to the 1995 fishing level. The maturity ogive is the average of the 1993-1995 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 1993-1995.

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 represents a change from last years assessment and reflects the confidence the Working Group now has to the very clear recruitment failure that is seen in all the surveys. This way of increasing the influence of the survey results to 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.

8.5 Results of the Assessment

8.5.1 Fishing mortalities and VPA (Tables 8.13-8.16, Fig 8.1A, 8.6)

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 gillneters 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 $F_{(6\text{-}10)}$ 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 0.57. Following the drop in the catches and effort in 1992, the $F_{(6\text{-}10)}$ dropped to 0.18 and has stayed below 0.20 since then.

The fishing mortality levels estimated in the current assessment are consistently somewhat lower than those presented by the working group in 1995. A summary of the historical series of landings, fishing mortalities, stock biomasses and recruitment from 1970-1995 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 and since 1992 it has been below 50,000 t. 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 level. 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 120,000 t) in the period 1976-1991, but the recent low recruitment has led to a decrease to about 65,000 t in 1995.

8.5.2 Recruitment (Table A14)

Setting catchability independent on stock size for all ages made this years assessment reflect the recruitment failure seen in the surveys to a much greater extent than earlier assessments. Recruitment of Greenland halibut at age 3 seems to have been quite stable at 25-35 million individuals but it has virtually collapsed in recent years. The figures for the 1988 - 1993 year classes were estimated to be 18.7, 11.0, 4.9, 1.9, 0.7 and 0.4 million three-year-olds respectively. The 1994 year class was estimated to 1.7 million at age 2. Allowing for natural mortality this gives 1.5 million at age 3.

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 8.1C. The values of $F_{0.1}$ and F_{max} are 0.04 and 0.08, respectively. Using the stock-recruitment relationship shown in Figure 8.1C the values of F_{med} and F_{high} were calculated as 0.13 and 0.20, respectively. Due to the extremely low recruitment in resent years, the F_{low} was not possible to calculate and it is then effectively zero.

8.5.4 Catch options for 1997 (Table 8.18)

The expected catch in 1996 is close to the total catch in 1995. Therefore, *status quo* F=0.17 is used in 1996 in the management option table. Expected catches in 1996 will cause the spawning stock biomass to decrease during this year from 48,000 to 42,000 t, and the total stock biomass will decrease from 59,000 to 49,000 t.

If the same fishing mortality is applied in 1997, it is expected a further reduction of total and spawning biomass to 39,000 and 34,000 t respectively. If there is no fishing on this stock in 1997, 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 8.6)

Considering the spawning stock- recruitment relationship (Figure 8.6) 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. However, the value of F_{low}=0.0 is clearly unrealistic to achieve for Greenland halibut, as some bycatch can not be avoided whatever restrictive regulatory regime that may be enforced.

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 advice that measures are taken to reduce the fishing pressure on this stock as much as possible.

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 8.5.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 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. A Russian working document was presented to the working group giving maturity data for each sex separately for the years 1984-1995. Such data are potentially important for the assessment. However, the data showed considerable between-year variation and the working group feel that the data should be further analysed before inclusion in the assessment. Maturity data on Greenland halibut vary throughout the distribution area and it is therefore important to look at the geographical coverage and sample size in more detail.

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 1996 assessment, the main conclusions are consistent with earlier 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 that the assessment is reliable and consistent and could form the basis of management advice .

9 COASTAL COD IN SUB-AREAS I AND II

9.1 Landings prior to 1996 (Table 9.1)

The catch of Norwegian coastal cod in sub-areas I and II was 39,736 t in 1995 (Table 9.1). 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 9.1) (Anon. 1970/F:2; Anon.1975/F:6; Anon.1994/Assess:2; Anon.1996/Assess:4). For the period 1960-70, landings of Norwegian coastal cod are available in Anon. (1971/F:3). Landings for the period 1971-79 were unavailable. The average landings for the 27 years of statistics is 36,000 t.

The first notations about the coastal cod in Russian/USSR waters were published in Anon (1970/F:2): "The Group also noted that although coastal cod populations do occur along the Russia/USSR coast of Sub-area I, their catches are included in the statistics for the Arcto-Norwegian stock". In Anon. (1971/F:3) it was written: "Landings for USSR exclude catches of coastal cod, provisionally estimated to be 40,000 t per year. The USSR is preparing statistics for this fishery". In Anon. (1975/F:6) the first Russian/USSR statistics on Murman cod were provided for the years 1960-74 (Table 9.1). The catch statistics of Murman cod was estimated to be on average 86,000 t (landed) per year, and this table was divided in statistics for fishery for offshore (average 68,000 t) and *inshore* (18,000 t) *areas*. After 1974, no landing statistics on the Murman cod are available.

9.2 Status of research

In the period 1992-1994, annual acoustic/trawl surveys were conducted at different parts of the distribution area of the Norwegian coastal cod (Anon. 1994/Assess:2; 1995/Assess:3; 1996/Assess:4; Eliassen *et al.* 1993; 1994; *in prep.* a, b). Those surveys had a detailed survey track covering most of the Norwegian fjords and the coast from Varangerfjord to Stadt at 62° N in the period 1992-1994. The Norwegian 1995 acoustic/trawl survey on coastal cod was carried out from the Russian border in Varangerfjord to Stadt to cover the whole distribution area for the Norwegian coastal cod stock. In 1995, many fjords and coastal regions were omitted from coverage during the survey due to the larger area under consideration using the same amount of ship time. Knowledge of the fish distribution from the first three surveys were used in planning the 1995 survey. The intention was to cover most of the important regional distributions of the Norwegian coastal cod, as well as covering the whole area from the Russian border in Varangerfjord to 62° N.

The sum of the biomasses of the Norwegian coastal cod was estimated to 201,000 t in this area based on the data from 1992-1994. All the data from 1992-1994 was given by local areas along the coast (Anon. 1994/Assess: 2; Anon. 1995/Assess:3; Anon. 1996/Assess:4; Eliassen *et al.* 1993; 1994). The 1995 data will be presented for areas (00, 03, 04, 05, 06 and 07) defined by the Norwegian Directorate for Fisheries inside Sub-areas I and II (Anon. 1996/Assess:4).

A detailed breakdown of the catches of Norwegian coastal cod for the period 1984 to 1995 is presently being conducted to form the basis of a VPA. This will be done by analysing Norwegian statistical landings of cod by vessel size, area caught, landed as given by the Norwegian Directorate for Fisheries. In addition, cod samplings done by the Institute for Marine Research, Bergen separate coastal cod and North-East Arctic cod by otolith type. The results will be presented for the Arctic Fisheries Working Group in 1997.

A tagging experiment on coastal cod has been conducted in November-December 1993, 1994 and 1995 - in the County of Nordland in Norway (Norwegian statistical areas 00, 05 and 06). A total of about 5,000 specimens were tagged, and the preliminary results indicated local recaptures. These results will be presented to the Arctic Fisheries Working Group in 1997.

Scientists from Norway and Russia are co-operating in the research on the Norwegian coastal cod and the Murman cod, and two joint cruises have been made to the Northern coast of the Kola Peninsula from the coast out to 50 nautical miles in 1994 and 1995.

9.2.1 Age readings

A total of 2525 cod otoliths were sampled during 1995 cruise, and those were separated into coastal cod type and North-East Arctic cod type (Rollefsen, 1933, Anon.1994/Assess:2). As in previous years, coastal cod were found throughout the survey area. Age readings of the coastal cod are done the same way as for the North-East Arctic cod.

9.2.2 Weight and length at age (Tables 9.2 and 9.3)

The 1995 data from the trawl-acoustic cruise 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 9.2 and 9.3). The same tendency was found for the combined material from 1992-1994 (Anon. 1996/Assess:4). There were fewer samples of cod ages 9+. Therefore, abundance indices for fish older than 8 years are not given.

9.2.3 Maturity at age (Table 9.4)

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 9.4). 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 1995 data show that the average M_{50} is 0.5 years more compared to that found for the 1992-1994 data for the coastal cod (Anon. 1996/Assess:4). The average M_{50} for the North-East Arctic cod in 1995 is close to 7 years old (Anon. 1996/Assess:4).

9.3 Methods used in the assessment

A Norwegian acoustic/trawl survey was conducted along the coast from Varanger to Stadt September-October 1995 using RV *Michael Sars*. A total of 199 trawl hauls, each lasting for 30 minutes, were made: 134 on the bottom and 65 in the pelagic zone.

9.4 Results of the assessment (Tables 9.5 to 9.9)

The results from the acoustic/trawl coastal cruise in 1995 estimated a total biomass of about 144,000 t (112 million fish) for the coastal area from Varanger to Stadt at 62° N (Tables 9.5 and 9.6). The spawning biomass accounted for 75,000 t (22 million fish) of this biomass (Tables 9.7 and 9.8). Thus, spawners make up about 52 % of the total biomass. Seventy percent of the total coastal biomass was distributed from the Russian border to 67° N and 30 % in areas 06 and 07 (Table 9.6). About 50 % of the biomass is located from the Cape North to Lofoten. The bulk of the biomass was comprised of age classes 4, 5 and 6.

The data indicated higher coastal cod proportion in the fjords and to the South. In the Norwegian statistical areas 06 and 07 close to all otoliths found were of the coastal cod type, similar to results of the 1993 and 1994 cruises (Anon. 1994/Assess:2; 1996/Assess:4).

The numbers of coastal cod per year class is given in Table 9.9 and the data for the different areas and years are showed in separate tables. In the data for Nordland (Table 9.9) the material from 1993 was pooled with the 1994 data.

9.5 Comments to the assessment

It must be emphasised that data from the acoustic/trawl survey may estimate a different biomass compared to a VPA-based assessment of a stock, but it is usually of the same magnitude (Anon. 1996). The estimated biomass of Norwegian coastal cod calculated for 1995 (144,000 t) is considerably less than the sum of the biomasses (201,000) calculated for the same area in the period 1992-1994 (Anon. 1996/Assess:4). A similar tendency was observed between 1995 and 1994 in the joint Norwegian/Russian cruises to the Kola-coast (Isaev *et al.* 1995). This difference in the estimated biomass of Norwegian coastal cod from 1992-1994 to 1995 may also represent a fluctuation of this biomass due to effects of the recruitment or the fisheries, although this is still not understood.

The 1995 data show that the proportion of the coastal cod increases going from North to south along the Norwegian coast. The coastal cod type otoliths dominated south of 67° N, that is 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 coastal cod cruises were 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. The Arctic Fisheries Working Group has previously pointed out the importance of sampling the landings in those Southern areas for analysing the proportion of Norwegian coastal cod to North-East Arctic cod (Anon. 1994/Assess:2).

The Norwegian 1996 coastal cruise (September-October) will be conducted in a similar way as the 1995 cruise, to build up a time series for coastal cod over its distribution area. The intention is to develop a VPA analysis for this stock.

The working group encourages research on distribution, migration, stock size, genetics as well as landing statistics of both the Murman cod and the Norwegian coastal cod as important components of the total cod biomass and yields in Sub-areas I and II. The importance of the two stocks is shown by the sum of the quotas for the Murman cod and the Norwegian coastal cod (80,000 t allocated per year for the period 1975-1996) that was about 15 % of the average landings (534,000 t for the period 1975-1995) from this area (Anon.1996/ Assess:2).

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WD1. Albert, O.T. Maturation model for Northeast Arctic cod.

WD2. Marshall, C.T. Maturity ogives for Northeast Arctic cod (1985-96).

WD3. Smirnov, O. An account of Russian data on maturity and sex composition of Greenland halibut.

WD4. Durán, P. and X. Paz. Pilot experimental fishing in the Barents Sea (6th June to 8th July 1995) targetting long rough dab.

WD5. Sunnanå, K. Quotas and catch allocation.

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	Unreported catches	Total catch
1961	409,694	153,019	220,508		783,221
1962	548,621	139,848	220,797		909,266
1963	547,469	117,100	111,768		776,337
1964	206,883	104,698	126,114		437,695
1965	241,489	100,011	103,430		444,983
1966	292,253	134,805	56,653		483,711
1967	322,798	128,747	121,060		572,605
1968	642,452	162,472	269,254		1,074,084
1969	679,373	255,599	262,254		1,197,226
1970	603,855	243,835	85,556		933,246
1971	312,505	319,623	56,920		689,048
1972	197,015	335,257	32,982		565,254
1973	492,716	211,762	88,207		792,685
1974	723,489	124,214	254,730		1,102,433
1975	561,701	120,276	147,400		829,377
1976	526,685	237,245	103,533		867,463
1977	538,231	257,073	109,997		905,301
1978	418,265	263,157	17,293		698,715
1979	195,166	235,449	9,923		440,538
1980	168,671	199,313	12,450		380,434
1981	137,033	245,167	16,837		399,037
1982	96,576	236,125	31,029		363,730
1983	64,803	200,279	24,910		289,992
1984	54,317	197,573	25,761		277,651
1985	112,605	173,559	21,756		307,920
1986	157,631	202,688	69,794		430,113
1987	146,106	245,387	131,578		523,071
1988	166,649	209,930	58,360		434,939
1989	164,512	149,360	18,609		332,481
1990	62,272	99,465	25,263	25,000	212,000
1991	70,970	156,966	41,222	50,000	319,158
1992	124,219	172,792	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 [1]	256,855	312,137	170,966		739,958

[1] Provisional figures.

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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	84.8	38.7	90	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	-
1973	459	33.7	39.4	172.4	88.2	-
1974	677	46.5	41	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	-
1978	360.4	57.9	117	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	21	-
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	88	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	84	40	1.2
1992	103.7	20.5	80	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 [1]	215.6	41.3	168.7	143.4	160.3	10.7

[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 [1]	22,954	4,912	7,061	7,550	319,536	15,505	16,329	296,155	34214	15,742	739,958

[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

	Age													
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	0.60	0.74	1.25	1.82	2.82	4.22	5.48	6.39	7.77	9.12	9.15	12.53	17.36	21.11

Russia (trawl only)

	Age													
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	-	-

Germany

	Age													
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	1.53	2.84	4.12	5.24	5.67	7.37	8.16	8.96	8.90	-	-

Spain

	Age													
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	-	-

Iceland

	Age													
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	-	-	-

UK (England & Wales)

	Age													
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1995	-	-	1.47	2.11	3.47	5.57	6.43	7.17	8.12	8.05	10.17	10.08	-	-

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

Norway

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

Russia

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

Table 3.6

```
NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,
5,39,2                   (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
1963,1582, -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, 525,   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, 272,   1,    1,  155,  51.5,   108
1985, 207,   3,   10,  246, 741.8,  1302
1986, 162,   1,    2,  137,  33.4,     3
1987, 214,   1,    1,   17,   5.0,     2
1988, 450,   1,    1,   33,   9.4,     9
1989, 870,   1,    1,   38, 161.0,   350
1990,1283,   6,    1,  123, 470.8,   187
1991, 924,   3,    6,  230, 131.6,   348
1992, 718,  10,   60,  294, 534.1,  1686
1993, 453,   2,    5,  209, 861.8,  1083
1994, -11,  16,    3,  227,4892.4,  2644
1995, -11,  25,   36,  240,5788.8,  2404
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

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Table 3.7

Analysis by RCT3 ver3.1 of data from file :

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

Data for 5 surveys over 39 years : 1957 - 1995

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 = 1993

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	2.10	3.70	1.15	.326	23	1.10	6.01	1.314	.161
R-2B-1	2.62	2.30	2.86	.073	23	1.79	7.00	3.279	.026
INTOGP	2.03	-2.74	2.20	.118	27	5.35	8.12	2.589	.041
N-BST1	.62	3.32	1.17	.305	13	6.76	7.54	1.421	.137
N-BSA1	.51	3.82	1.08	.358	12	6.99	7.40	1.319	.159
					VPA Mean =		6.05	.764	.475

Yearclass = 1994

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	2.11	3.70	1.08	.332	24	2.83	9.68	1.597	.114
R-2B-1	2.76	1.99	2.98	.062	24	1.39	5.82	3.397	.025
INTOGP	2.14	-3.44	2.30	.100	28	5.43	8.17	2.702	.040
N-BST1	.64	3.10	1.22	.269	14	8.50	8.57	1.585	.116
N-BSA1	.52	3.68	1.11	.321	13	7.88	7.75	1.377	.154
					VPA Mean =		6.09	.728	.550

Yearclass = 1995

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	2.09	3.72	1.08	.330	24	3.26	10.54	1.821	.093
R-2B-1	2.97	1.65	3.31	.050	24	3.61	12.36	4.422	.016
INTOGP	2.32	-4.32	2.49	.085	28	5.48	8.39	2.979	.035
N-BST1	.66	3.00	1.24	.263	14	8.66	8.74	1.664	.111
N-BSA1	.52	3.65	1.12	.317	13	7.79	7.71	1.403	.156
					VPA Mean =		6.13	.722	.590

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1993	715	6.57	.53	.32	.38	454	6.12
1994	1238	7.12	.54	.59	1.18		
1995	1410	7.25	.55	.70	1.61		

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Table 3.8

Run title : Arctic Cod (run: SVPBB03/V03)

At 28-Aug-96 20:15:32

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	55937,	34467,	3709,	2307,	7164,	7754,	35536,	294262,	91855,	45282,
4,	55644,	160048,	174585,	24545,	10792,	13739,	45431,	131493,	437377,	59798,
5,	34676,	69235,	267961,	238511,	25813,	11831,	26832,	61000,	203772,	226646,
6,	42539,	22061,	107051,	181239,	137829,	9527,	12089,	20569,	47006,	118567,
7,	37169,	26295,	26701,	79363,	96420,	59290,	7918,	7248,	12630,	29522,
8,	18500,	25139,	16399,	26989,	31920,	52003,	34885,	8328,	4370,	9353,
9,	5077,	11323,	11597,	13463,	8933,	12093,	22315,	19130,	2523,	2617,
10,	1495,	2329,	3657,	5092,	3249,	2434,	4572,	4499,	5607,	1555,
11,	380,	687,	657,	1913,	1232,	762,	1215,	677,	2127,	1928,
12,	403,	316,	122,	414,	260,	418,	353,	195,	322,	575,
13,	77,	225,	124,	121,	106,	149,	315,	81,	151,	231,
14,	9,	40,	70,	23,	39,	42,	121,	59,	83,	15,
+gp,	70,	14,	46,	46,	35,	25,	40,	55,	62,	37,
TOTALNUM,	251976,	352179,	612679,	574026,	323792,	170067,	191622,	547596,	807885,	496126,
TONSLAND,	483711,	572605,	1074084,	1197226,	933246,	689048,	565254,	792685,	1102433,	829377,
SOPCOF %,	94,	88,	96,	87,	97,	112,	108,	114,	103,	90,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	85337,	39594,	78822,	8600,	3911,	3407,	8948,	3108,	7027,	19282,
4,	114341,	168609,	45400,	77484,	17086,	9466,	20933,	19594,	14165,	38322,
5,	79993,	136335,	88495,	43677,	81986,	20803,	19345,	20473,	18839,	27216,
6,	118236,	52925,	56823,	31943,	40061,	63433,	28084,	17656,	20350,	20342,
7,	47872,	61821,	25407,	16815,	17664,	21788,	42496,	17004,	15415,	13588,
8,	13962,	23338,	31821,	8274,	7442,	9933,	8395,	18329,	8359,	4385,
9,	4051,	5659,	9408,	10974,	3508,	4267,	2878,	2545,	6054,	1904,
10,	936,	1521,	1227,	1785,	3196,	1311,	708,	646,	764,	1062,
11,	558,	610,	913,	427,	678,	882,	271,	229,	221,	163,
12,	442,	271,	446,	103,	79,	109,	260,	74,	153,	59,
13,	139,	122,	748,	59,	24,	37,	27,	58,	56,	51,
14,	26,	92,	48,	38,	26,	3,	5,	20,	12,	45,
+gp,	53,	54,	51,	45,	8,	1,	5,	5,	12,	38,
TOTALNUM,	465946,	490951,	339609,	200224,	175669,	135440,	132355,	99741,	91427,	126457,
TONSLAND,	867463,	905301,	698715,	440538,	380434,	399038,	363730,	289992,	277651,	307920,
SOPCOF %,	102,	99,	100,	107,	97,	110,	108,	98,	95,	99,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	16942,	5570,	3988,	3874,	1541,	4927,	23082,	10706,	5848,	2982,
4,	55859,	100391,	21234,	19833,	5171,	8489,	37919,	46750,	63180,	35194,
5,	75486,	97318,	144215,	28126,	10615,	15565,	25781,	63886,	108060,	115986,
6,	27772,	62371,	59397,	83802,	15467,	18995,	21304,	32692,	58302,	95252,
7,	13337,	12901,	21302,	23501,	31161,	20909,	18390,	14562,	23735,	31716,
8,	4587,	3942,	3415,	4943,	6665,	27404,	13199,	9418,	9019,	7552,
9,	1082,	1021,	1200,	917,	830,	4193,	18518,	6359,	6154,	3314,
10,	559,	435,	320,	321,	163,	410,	2282,	12920,	4040,	1943,
11,	455,	140,	67,	46,	41,	32,	185,	1931,	7822,	1402,
12,	124,	233,	60,	8,	14,	8,	73,	394,	967,	2312,
13,	29,	17,	51,	1,	9,	1,	3,	59,	102,	250,
14,	32,	21,	7,	9,	5,	1,	8,	23,	15,	46,
+gp,	1,	8,	15,	7,	2,	5,	4,	2,	4,	1,
TOTALNUM,	196265,	284368,	255271,	165388,	71684,	100939,	160748,	199702,	287248,	297950,

Table 3.9

Run title : Arctic Cod (run: SVPBB03/V03)

At 28-Aug-96 20:15:32

Table 2 Catch weights at age (kg)

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
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,	.9415,	.8787,	.9561,	.8743,	.9734,	1.1182,	1.0788,	1.1430,	1.0271,	.9007,

Table 2 Catch weights at age (kg)

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.9000,	1.3500,	1.2500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.4600,	1.8400,	1.5600,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	2.1900,	2.4300,	2.1400,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.7800,	3.1100,	3.1900,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.8400,	4.1800,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	5.0600,
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,	1.0236,	.9928,	1.0037,	1.0713,	.9731,	1.1050,	1.0767,	.9837,	.9538,	.9936,

Table 2 Catch weights at age (kg)

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	.9700,	.6500,	.5200,	.5200,	1.1000,	.9800,	1.0100,	.7400,	.6400,	.5200,
4,	1.6100,	1.1000,	.8200,	.9000,	1.5300,	1.4900,	1.5500,	1.4800,	1.2000,	.9500,
5,	2.2100,	1.9200,	1.3400,	1.2700,	1.8900,	1.9800,	2.3000,	2.1500,	2.0700,	1.7300,
6,	2.9900,	2.5600,	2.2700,	1.9100,	2.3600,	2.6300,	3.2600,	2.9000,	3.0400,	2.6600,
7,	4.3100,	3.4400,	3.4800,	3.0100,	3.3800,	3.4500,	4.5100,	4.2200,	3.8300,	4.1300,
8,	5.7300,	5.4100,	5.3800,	4.8900,	4.7500,	4.6700,	5.6000,	5.6400,	5.5600,	5.5800,
9,	6.8200,	6.6900,	7.0600,	7.6800,	7.8900,	6.3000,	6.5800,	6.5100,	7.0400,	6.6900,
10,	7.7000,	7.7000,	8.9000,	9.3600,	10.1400,	9.6200,	8.8600,	7.3000,	7.7500,	8.1800,
11,	9.2500,	9.2500,	9.2500,	10.5700,	13.2400,	11.7500,	12.2100,	8.3000,	8.2000,	9.3700,
12,	10.8500,	10.8500,	10.8500,	10.8500,	16.9400,	17.3200,	11.7200,	10.3600,	9.4100,	9.5300,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	19.2000,	12.5000,	14.7100,	10.8000,	12.2100,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	15.4000,	14.6600,	12.8000,	9.5600,	17.1900,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	19.4000,	20.5800,	11.7500,	19.8900,	21.1100,
SOPCOFAC,	.9390,	.9670,	.9588,	1.0344,	.9984,	.9690,	1.0008,	1.0013,	1.0005,	1.0010,

Table 3.10

Run title : Arctic Cod (run: SVPBB03/V03)

At 28-Aug-96 20:15:32

Table 3 Stock weights at age (kg)

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
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,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.3600,	.5300,	.4600,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0100,	1.2000,	.9100,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.6300,	1.9000,	1.7100,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.5300,	2.9100,	2.9400,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.9700,	4.1700,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	5.0400,
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,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	.3200,	.2100,	.1900,	.3000,	.3930,	.4750,	.4500,	.3500,	.2360,	.2020,
4,	.9300,	.5000,	.3600,	.5100,	.7160,	1.1390,	.9300,	1.1800,	.7570,	.4960,
5,	1.5700,	1.2500,	.7000,	.8600,	1.2030,	1.7310,	1.7500,	1.8300,	1.4100,	1.1400,
6,	2.5200,	2.1200,	1.5800,	1.4700,	1.7000,	2.4570,	2.7850,	2.8400,	2.4500,	2.1000,
7,	3.8300,	3.4600,	2.7000,	2.6200,	2.4800,	3.1940,	3.8850,	4.1300,	3.8100,	3.4400,
8,	5.3000,	5.2200,	4.3000,	4.7000,	3.4370,	4.3900,	5.0660,	5.4900,	5.6100,	5.1300,
9,	6.1700,	6.1700,	6.1700,	6.1700,	4.7840,	6.8310,	6.7540,	6.7800,	6.7000,	7.2200,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.9110,	10.2340,	9.3260,	8.4700,	7.4600,	8.8100,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	11.1150,	11.7120,	10.6800,	8.0400,	9.4800,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	8.6000,	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

COD-ARCT: Cod in the North-East Arctic (Fishing 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

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

FLT44: 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	Catch, age 7	Catch, age 8
1985	1	1050.0	8950.0	4220.0	2550.0	830.0	440.0	500.0	210.0
1986	1	530.0	1410.0	9800.0	4440.0	1830.0	560.0	620.0	190.0
1987	1	150.0	1700.0	1700.0	7380.0	990.0	670.0	420.0	200.0
1988	1	5.0	430.0	1610.0	1060.0	2450.0	340.0	100.0	20.0
1989	1	10.0	40.0	170.0	440.0	560.0	990.0	820.0	200.0
1990	1	220.0	570.0	290.0	350.0	520.0	460.0	890.0	140.0
1991	1	440.0	750.0	890.0	510.0	530.0	610.0	450.0	430.0
1992	1	610.0	3330.0	3170.0	1100.0	450.0	370.0	380.0	290.0
1993	1	100.0	450.0	2150.0	2430.0	1360.0	430.0	140.0	140.0
1994	1	580.0	1100.0	2080.0	2820.0	2770.0	1200.0	440.0	80.0
1995	1	3310.0	750.0	1120.0	1500.0	1800.0	810.0	200.0	60.0

COD-ARCT: Cod in the North-East Arctic (Fishing 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	122.3	120.9	148.6	65.6	29.6	3.4	3.8	2.4
1994	1	68.6	166.5	102.4	56.4	54.1	25.9	5.9	2.3
1995	1	350.3	62.8	115.7	101.3	93.6	46.9	16.0	3.9

COD-ARCT: Cod in the North-East Arctic (Fishing 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	0.57	269	84	13	18	25	9
1986	0.57	93	100	44	21	3	0
1987	0.93	277	121	25	70	7	13
1988	1.01	167	73	13	14	33	0
1989	0.66	156	73	20	0	0	4
1990	0.56	34	16	0	0	0	0
1991	0.61	149	5	1	0	0	0
1992	0.39	1506	185	34	17	0	2
1993	0.41	814	2060	466	58	5	1
1994	0.83	744	453	932	138	10	0
1995	1.06	398	146	75	272	14	2

Table 3.11 (Cont'd)

COD-ARCT: Cod in the North-East Arctic (Fishing 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

COD-ARCT: Cod in the North-East Arctic (Fishing 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

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

FLT55: Norwegian Barents Sea acoustic survey (swept area corrected) (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	820.0	400.0	630.0	1060.0	1030.0	160.0	30.0	10.0
1981	1	50.0	490.0	430.0	400.0	260.0	280.0	20.0	3.0
1982	1	190.0	130.0	230.0	270.0	140.0	70.0	40.0	10.0
1983	1	1500.0	310.0	110.0	70.0	50.0	20.0	3.0	3.0
1984	1	7680.0	1790.0	1270.0	210.0	90.0	60.0	3.0	3.0
1985	1	5900.0	5950.0	1240.0	560.0	70.0	20.0	3.0	3.0
1986	1	720.0	960.0	2560.0	460.0	120.0	10.0	10.0	3.0
1987	1	290.0	640.0	420.0	750.0	90.0	20.0	3.0	3.0
1988	1	90.0	200.0	430.0	270.0	570.0	80.0	10.0	3.0
1989	1	450.0	160.0	240.0	270.0	220.0	400.0	30.0	10.0
1990	1	2340.0	550.0	310.0	270.0	250.0	140.0	160.0	10.0
1991	1	5790.0	1820.0	480.0	180.0	110.0	80.0	40.0	20.0
1992	1	4320.0	3000.0	1630.0	800.0	140.0	70.0	30.0	10.0
1993	1	6860.0	3580.0	3430.0	1590.0	430.0	90.0	20.0	10.0
1994	1	2800.0	1810.0	1610.0	2140.0	690.0	180.0	20.0	10.0
1995	1	3350.0	960.0	700.0	860.0	750.0	210.0	30.0	3.0

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

FLT56: Norwegian Lofoten acoustic survey (Catch: Number)

Year	Fishing effort	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11
1989	1	67	7	4	1	1
1990	1	248	28	8	1	1
1991	1	207	601	34	1	1
1992	1	186	221	400	51	9
1993	1	73	79	39	148	24
1994	1	35	23	28	17	83
1995	1	36	7	3	7	11

Table 3.12

Lowestoft VPA Version 3.1

28-Aug-96 19:31:19

Extended Survivors Analysis

Arctic Cod (run: XSABB20/X20)

CPUE data from file /users/fish/ifad/ifapwork/afwg/cod_arct/FLEET.X20

Catch data for 30 years. 1966 to 1995. Ages 1 to 15.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT43: Russian Trawl,	1984,	1995,	1,	8,	.900,	1.000
FLT44: Russian acous,	1985,	1995,	1,	8,	.900,	1.000
FLT45: Norwegian Sva,	1984,	1995,	1,	8,	.750,	.850
FLT52: Norwegian tra,	1985,	1995,	9,	14,	.000,	1.000
FLT53: Russian trawl,	1985,	1995,	9,	14,	.000,	1.000
FLT54: Norwegian Bar,	1984,	1995,	1,	8,	.990,	1.000
FLT55: Norwegian Bar,	1984,	1995,	1,	8,	.990,	1.000
FLT56: Norwegian Lof,	1989,	1995,	7,	11,	.250,	.300

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

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 100 iterations

Total absolute residual between iterations
99 and 100 = .00683

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9,	10
Iteration 99,	2.4022,	.9969,	.5857,	.1699,	.2066,	.3938,	.6036,	.9448,	.8632,	.4549
Iteration **,	2.4031,	.9978,	.5862,	.1701,	.2069,	.3944,	.6044,	.9446,	.8621,	.4545

Age ,	11,	12,	13,	14
Iteration 99,	.7858,	.8933,	.9163,	1.0359
Iteration **,	.7856,	.8935,	.9163,	1.0354

Table 3.12 (Cont'd)

Regression weights

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

Fishing mortalities

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.517	.533	.892	.198	.043	.078	.439	2.549	1.885	2.403
2	.830	.784	.120	.002	.057	.207	.103	.471	.702	.998
3	.133	.082	.030	.026	.008	.017	.035	.064	.202	.586
4	.171	.164	.120	.142	.045	.055	.122	.080	.144	.170
5	.478	.506	.375	.232	.105	.184	.234	.312	.283	.207
6	.779	.965	.676	.390	.193	.277	.413	.524	.520	.394
7	1.025	1.105	1.132	.629	.244	.432	.473	.556	.945	.604
8	1.180	1.036	1.057	.906	.361	.352	.539	.476	.827	.945
9	.946	.948	1.127	.957	.360	.407	.429	.545	.666	.862
10	1.030	1.484	.929	1.145	.428	.303	.406	.609	.826	.454
11	.739	.801	1.026	.314	.407	.137	.217	.728	.969	.786
12	1.448	1.154	1.029	.303	.147	.128	.527	.995	1.065	.894
13	.530	.788	.868	.037	.665	.014	.064	1.155	.775	.916
14	.860	.964	.924	.354	.264	.137	.147	.973	1.123	1.035

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8		
1986	1.14E+06	7.68E+05	1.02E+06	3.92E+05	2.19E+05	5.67E+04	2.30E+04	7.32E+03	1.96E+03	9.61E+02
1987	4.70E+05	5.58E+05	2.74E+05	7.33E+05	2.71E+05	1.11E+05	2.13E+04	6.75E+03	1.84E+03	6.22E+02
1988	7.91E+05	2.26E+05	2.09E+05	2.07E+05	5.10E+05	1.34E+05	3.47E+04	5.78E+03	1.96E+03	5.84E+02
1989	8.75E+05	2.66E+05	1.64E+05	1.66E+05	1.50E+05	2.87E+05	5.57E+04	9.17E+03	1.65E+03	5.20E+02
1990	1.68E+06	5.88E+05	2.17E+05	1.31E+05	1.18E+05	9.76E+04	1.59E+05	2.43E+04	3.03E+03	5.17E+02
1991	2.30E+06	1.32E+06	4.54E+05	1.76E+05	1.02E+05	8.68E+04	6.59E+04	1.02E+05	1.39E+04	1.73E+03
1992	3.43E+06	1.75E+06	8.76E+05	3.66E+05	1.37E+05	6.96E+04	5.39E+04	3.50E+04	5.87E+04	7.56E+03
1993	2.79E+07	1.81E+06	1.29E+06	6.93E+05	2.65E+05	8.85E+04	3.77E+04	2.75E+04	1.67E+04	3.13E+04
1994	1.21E+07	1.78E+06	9.25E+05	9.91E+05	5.23E+05	1.59E+05	4.29E+04	1.77E+04	1.40E+04	7.94E+03
1995	3.24E+07	1.50E+06	7.23E+05	6.19E+05	7.02E+05	3.23E+05	7.73E+04	1.37E+04	6.34E+03	5.88E+03

Estimated population abundance at 1st Jan 1996

.00E+00	2.39E+06	4.53E+05	3.29E+05	4.27E+05	4.67E+05	1.78E+05	3.45E+04	4.35E+03	2.19E+03

Taper weighted geometric mean of the VPA populations:

2.35E+06	7.54E+05	4.27E+05	3.04E+05	2.00E+05	1.06E+05	4.60E+04	1.67E+04	6.12E+03	2.19E+03

Standard error of the weighted Log(VPA populations) :

1.5128	.8258	.7636	.7467	.7303	.5986	.5685	.8220	1.1002	1.3100

YEAR	AGE 11	12	13	14
1986	9.62E+02	1.79E+02	7.79E+01	6.13E+01
1987	2.81E+02	3.76E+02	3.45E+01	3.75E+01
1988	1.15E+02	1.03E+02	9.71E+01	1.28E+01
1989	1.89E+02	3.39E+01	3.02E+01	3.34E+01
1990	1.35E+02	1.13E+02	2.05E+01	2.38E+01
1991	2.76E+02	7.38E+01	7.99E+01	8.63E+00
1992	1.05E+03	1.97E+02	5.32E+01	6.45E+01
1993	4.13E+03	6.91E+02	9.52E+01	4.09E+01
1994	1.39E+04	1.63E+03	2.09E+02	2.46E+01
1995	2.85E+03	4.33E+03	4.60E+02	7.88E+01

Estimated population abundance at 1st Jan 1996

3.06E+03	1.06E+03	1.45E+03	1.51E+02

Taper weighted geometric mean of the VPA populations:

7.26E+02	2.74E+02	8.41E+01	3.17E+01

Standard error of the weighted Log(VPA populations) :

1.4523	1.3361	.8855	.8041

Table 3.12 (Cont'd)

Log catchability residuals.

Fleet : FLT43: Russian Trawl

Age	1984	1985
1	1.16	1.15
2	.53	.62
3	.20	.39
4	.21	.97
5	.00	1.20
6	.07	.57
7	-.09	.45
8	-.33	.60
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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.75	-.39	-.62	-1.88	.28	.54	.68	-.58	-.15	-.15
2	.57	.25	.34	-.95	.18	-.35	.32	-.27	-.16	-.49
3	.17	-.11	.31	-.01	-.23	-.23	.15	-.02	-.12	-.24
4	-.17	.17	-.30	.06	-.49	-.43	-.02	.49	-.04	-.12
5	-.05	-.91	-.41	.14	-.26	-.01	-.24	.75	.44	-.48
6	.14	-.32	-.99	-.20	-.26	.18	.16	.57	.66	-.53
7	-.34	-.47	-.94	1.06	-.36	-.01	.16	.17	.99	-.73
8	-.04	-1.19	-1.02	1.63	-.23	-.73	.38	.37	.28	.09
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	4	5	6	7	8
Mean Log q	-7.2781	-6.9387	-6.7595	-6.4635	-6.4498
S.E(Log q)	.3886	.5532	.4995	.6408	.7782

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	.718	11.48	.74	12	.91	-10.90
2	.74	1.193	10.08	.71	12	.51	-8.79
3	.69	3.019	9.41	.92	12	.23	-7.76

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
4	.84	1.128	8.16	.85	12	.32	-7.28
5	1.21	-.700	5.79	.55	12	.69	-6.94
6	1.56	-1.433	4.03	.43	12	.74	-6.76
7	1.05	-.134	6.24	.44	12	.71	-6.46
8	1.04	-.112	6.33	.54	12	.85	-6.45

Table 3.12 (Cont'd)

Fleet : FLT44: Russian acous

Age	1984	1985
1	99.99	1.69
2	99.99	1.42
3	99.99	.87
4	99.99	.75
5	99.99	.67
6	99.99	.62
7	99.99	1.25
8	99.99	1.56
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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	1.40	1.24	-1.85	-1.92	-.10	.19	.36	-1.57	.21	1.10
2	1.00	1.44	.60	-1.73	-.16	-.61	.32	-1.15	-.17	-.08
3	.95	.72	.91	-.78	-.62	-.39	.06	-.64	-.22	-.19
4	1.10	.97	.26	-.38	-.46	-.38	-.28	-.16	-.31	-.45
5	.78	-.01	.14	-.26	-.21	.03	-.38	.14	.14	-.65
6	.93	.61	-.53	-.49	-.37	.11	-.04	-.02	.42	-.81
7	1.54	1.30	-.60	.56	-.77	-.40	-.33	-.89	.50	-1.20
8	1.51	1.51	-.62	1.08	-.77	-1.09	-.24	-.78	-.57	-.49
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	4	5	6	7	8
Mean Log q	-5.2256	-4.9266	-4.6163	-3.9887	-3.8547
S.E(Log q)	.5776	.4081	.5430	.9522	1.0338

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	.84	.521	9.51	.57	11	1.37	-8.48
2	.87	.284	7.38	.38	11	1.05	-6.45
3	.85	.459	6.66	.56	11	.70	-5.56

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
4	.85	.600	6.32	.68	11	.51	-5.23
5	1.13	-.558	3.99	.71	11	.48	-4.93
6	2.61	-2.619	-6.74	.25	11	1.10	-4.62
7	-8.91	-2.715	71.16	.01	11	6.49	-3.99
8	4.82	-2.644	-18.47	.06	11	3.86	-3.85

Table 3.12 (Cont'd)

Fleet : FLT45: Norwegian Sva

Age	1984	1985
1	1.85	1.68
2	.53	.68
3	-1.42	.38
4	-1.12	-.03
5	-.59	.34
6	-.88	.26
7	-1.26	-.34
8	-.64	-.10
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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.29	1.21	-1.49	-1.97	.06	.25	-.10	-.33	-.55	.40
2	1.04	1.01	.40	-.96	-.95	-.18	-.36	-.25	.08	-.22
3	.58	1.28	.39	.03	-.72	-.61	-.14	-.24	-.11	.47
4	.16	.61	.47	-.20	.09	-.74	.46	-.05	-.51	.57
5	-.24	-.31	-.28	-.31	.51	.20	.10	.10	.00	.19
6	-.43	-.23	-.08	-.37	.40	.56	.10	-.81	.63	.41
7	-.27	-.82	-1.11	-.31	.17	.81	.18	.20	.82	.95
8	-.35	-1.48	.48	-.50	-.30	.51	-.03	-.15	.52	1.41
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	4	5	6	7	8
Mean Log q	-8.9911	-8.7915	-8.7736	-8.7942	-8.6521
S.E(Log q)	.5247	.3075	.5117	.7306	.7374

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	.94	.218	10.20	.64	12	1.15	-9.92
2	.63	1.221	10.80	.56	12	.70	-9.10
3	.78	.690	9.75	.54	12	.70	-8.83

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
4	.82	.950	9.68	.76	12	.43	-8.99
5	1.05	-.344	8.61	.84	12	.34	-8.79
6	.82	.765	9.27	.69	12	.43	-8.77
7	.59	2.031	9.59	.74	12	.37	-8.79
8	.81	.862	8.85	.70	12	.60	-8.65

Table 3.12 (Cont'd)

Fleet : FLT52: Norwegian tra

Age	1984	1985
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	.87
10	99.99	-.10
11	99.99	-.17
12	99.99	.10
13	99.99	.99
14	99.99	.08

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	.29	.95	.37	.84	-1.39	-1.50	-.17	.47	-.09	-.09
10	1.10	1.41	.67	1.30	-.35	-2.86	-.23	.80	.04	-1.19
11	.23	.43	.68	.74	99.99	-2.64	.03	1.46	.33	-.92
12	.52	.38	-.07	99.99	99.99	99.99	.22	.34	-.33	-.94
13	-.62	.66	1.13	99.99	99.99	99.99	99.99	.27	-.68	-1.32
14	99.99	1.27	99.99	.29	99.99	99.99	-.64	-.56	99.99	-1.45

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	-2.2528	-2.2511	-2.3194	-1.3874	-1.7275	-1.7275
S.E(Log q)	.8438	1.2831	1.1731	.4937	.9568	.9784

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	1.32	-1.051	.17	.57	11	1.11	-2.25
10	1.18	-.486	1.27	.48	11	1.58	-2.25
11	.89	.456	2.82	.70	10	1.10	-2.32
12	1.38	-2.494	-.41	.90	8	.50	-1.39
13	4.57	-1.920	-9.33	.07	7	3.54	-1.73
14	61.35	-1.037	******	.00	6	57.33	-1.96

Table 3.12 (Cont'd)

Fleet : FLT53: Russian trawl

Age	1984	1985
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	.72
10	99.99	.52
11	99.99	-.98
12	99.99	-.64
13	99.99	99.99
14	99.99	.06

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	.46	.01	.32	.68	.72	-.11	-1.16	-.13	-.40	-.64
10	99.99	.10	.40	1.02	.97	-.72	-1.02	-.42	.16	-.68
11	.09	99.99	99.99	.54	1.42	-1.63	99.99	.20	-.40	.52
12	99.99	99.99	99.99	.40	.17	-.85	99.99	.25	99.99	.48
13	99.99	99.99	99.99	.07	99.99	.08	99.99	-.14	99.99	99.99
14	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.06	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	-2.7261	-2.9184	-3.5804	-3.7385	-4.1076	-4.1076
S.E(Log q)	.6206	.7312	.9707	.5655	.1250	.0932

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	1.73	-4.062	-1.65	.79	11	.65	-2.73
10	1.49	-2.399	.51	.77	10	.87	-2.92
11	1.06	-.244	3.37	.74	8	1.12	-3.58
12	.89	.864	3.94	.94	6	.52	-3.74
13	1.13	-.650	4.10	.97	3	.17	-4.11
14	.00	.000	.00	.00	0	.00	.00

Table 3.12 (Cont'd)

Fleet : FLT54: Norwegian Bar

Age	1984	1985
1	.75	.88
2	.09	.52
3	.16	.19
4	-.44	.33
5	-.45	.73
6	-.36	.47
7	-1.20	-.12
8	-.92	.29
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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	1.18	.44	-1.27	-.81	-.27	.22	-.28	-.13	.12	-.08
2	.87	.98	.15	-.44	-.95	-.48	-.28	-.13	.09	.12
3	.36	.52	.43	.03	-.65	-.59	-.29	-.10	.14	.13
4	-.37	.41	-.05	.15	-.36	-.60	.06	.13	.37	.26
5	-.67	-.32	.32	.02	-.06	-.15	-.21	.40	.10	.15
6	-.82	-.37	.05	.01	-.05	-.07	.20	.32	.45	-.08
7	-.44	.12	-.06	-.54	.04	.22	.51	.35	.56	-.09
8	-.34	-.40	.46	.55	-.75	-.50	.55	.12	.37	.19
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	4	5	6	7	8
Mean Log q	-6.0095	-6.2293	-6.5109	-6.9954	-7.1837
S.E(Log q)	.3475	.3615	.3544	.4607	.5113

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	.90	.657	6.94	.82	12	.71	-6.01
2	.76	.957	7.76	.65	12	.59	-5.87
3	.83	.936	7.11	.78	12	.40	-5.89

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	.74	3.001	7.73	.94	12	.19	-6.01
5	.89	.746	6.89	.85	12	.33	-6.23
6	.93	.381	6.87	.78	12	.35	-6.51
7	.85	.655	7.54	.70	12	.41	-7.00
8	1.16	-.693	6.79	.69	12	.61	-7.18

Table 3.12 (Cont'd)

Fleet : FLT55: Norwegian Bar

Age	1984	1985
1	1.02	1.33
2	.42	.51
3	.49	.23
4	-.04	.15
5	.04	-.33
6	.53	-.52
7	-.87	-.89
8	-.13	.38
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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	-.15	-.02	-1.23	-.55	.06	.54	.20	.27	-.21	-.61
2	.35	.36	.04	-.35	-.28	-.18	-.19	.13	-.15	-.21
3	.19	-.03	.22	-.02	-.10	-.47	-.11	.14	-.04	-.16
4	-.25	-.40	-.20	.05	.19	-.51	.32	.33	.33	-.09
5	-.47	-.94	.15	.27	.52	-.08	-.08	.46	.22	-.07
6	-1.14	-.94	-.02	.54	.37	.01	.23	.36	.46	-.22
7	.40	-.65	.09	.22	.46	.14	.10	.13	.39	-.13
8	.44	.38	.56	1.15	-.37	-1.12	-.56	-.38	.41	-.41
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	4	5	6	7	8
Mean Log q	-6.1249	-6.3699	-6.5269	-6.9195	-6.8697
S.E(Log q)	.2970	.4062	.5509	.4467	.6477

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	.979	7.63	.83	12	.70	-6.30
2	.67	2.463	8.60	.87	12	.31	-6.11
3	.82	1.569	7.29	.90	12	.25	-6.05

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
4	.91	.735	6.73	.88	12	.28	-6.12
5	1.00	-.004	6.37	.76	12	.43	-6.37
6	.82	.727	7.44	.66	12	.46	-6.53
7	.71	1.914	8.03	.83	12	.28	-6.92
8	2.69	-4.538	2.09	.46	12	1.00	-6.87

Fleet : FLT56: Norwegian Lof

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	99.99	99.99	99.99	-.18	-.03	.73	.83	.28	-.48	-1.14
8	99.99	99.99	99.99	-.79	-.53	1.10	1.22	.42	-.28	-1.18
9	99.99	99.99	99.99	.21	.13	.07	1.10	.05	-.06	-1.45
10	99.99	99.99	99.99	.06	-.13	-1.37	1.12	.82	.08	-.60
11	99.99	99.99	99.99	-.10	.26	-.53	.36	.11	.20	-.29
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	7	8	9	10	11
Mean Log q	-6.3152	-6.0821	-5.9109	-5.9489	-4.9980
S.E(Log q)	.6957	.9385	.7594	.8407	.3214

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
7	1.28	-.332	4.99	.22	7	.97	-6.32
8	.50	3.305	8.11	.90	7	.28	-6.08
9	.79	.973	6.58	.82	7	.61	-5.91
10	.80	1.140	6.40	.87	7	.65	-5.95
11	.96	.491	5.07	.97	7	.33	-5.00

Terminal year survivor and F summaries :

Age 1 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	2069385.	1.024	.000	.00	1	.030	2.537
FLT44: Russian acous	7191918.	1.646	.000	.00	1	.011	1.470
FLT45: Norwegian Sva	3570240.	1.333	.000	.00	1	.017	2.047
FLT52: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT53: Russian trawl	1.	.000	.000	.00	0	.000	.000
FLT54: Norwegian Bar	2202078.	.812	.000	.00	1	.047	2.480
FLT55: Norwegian Bar	1303961.	.778	.000	.00	1	.051	2.969
FLT56: Norwegian Lof	1.	.000	.000	.00	0	.000	.000
P shrinkage mean	753832.	.83				.502	3.495
F shrinkage mean	13797945.	1.00				.342	1.010

Weighted prediction :

Survivors, at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2393665.	.54	.54	7	1.003	2.403

Table 3.12 (Cont'd)

Age 2 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,	282313.,	.515,	.070,	.14,	2,	.138,	1.322
FLT44: Russian acous,	426633.,	1.026,	.078,	.08,	2,	.034,	1.037
FLT45: Norwegian Sva,	359045.,	.704,	.074,	.10,	2,	.073,	1.151
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	509563.,	.575,	.003,	.00,	2,	.106,	.926
FLT55: Norwegian Bar,	366902.,	.318,	.000,	.00,	2,	.368,	1.137
FLT56: Norwegian Lof,	1.,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean ,	426548.,	.76,,,,				.177,	1.037
F shrinkage mean ,	2139647.,	1.00,,,,				.103,	.310

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
453093.,	.24,	.18,	12,	.755,	.998

Age 3 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,	262189.,	.270,	.023,	.09,	3,	.284,	.694
FLT44: Russian acous,	269659.,	.630,	.088,	.14,	3,	.050,	.680
FLT45: Norwegian Sva,	461167.,	.561,	.139,	.25,	3,	.058,	.451
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	370784.,	.365,	.020,	.05,	3,	.149,	.536
FLT55: Norwegian Bar,	281023.,	.233,	.019,	.08,	3,	.347,	.660
FLT56: Norwegian Lof,	1.,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean ,	303899.,	.75,,,,				.071,	.623
F shrinkage mean ,	3890187.,	1.00,,,,				.040,	.065

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
329303.,	.15,	.14,	17,	.913,	.586

Table 3.12 (Cont'd)

Age 6 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,	194619.,	.192,	.166,	.87,	6,	.200,	.367
FLT44: Russian acous,	142834.,	.269,	.180,	.67,	6,	.110,	.472
FLT45: Norwegian Sva,	190015.,	.223,	.087,	.39,	6,	.157,	.374
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	167948.,	.181,	.082,	.45,	6,	.239,	.414
FLT55: Norwegian Bar,	184381.,	.159,	.098,	.62,	6,	.279,	.384
FLT56: Norwegian Lof,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	181837.,	1.00,,,,				.015,	.388

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
178017.,	.09,	.05,	31,	.597,	.394

Age 7 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,	33498.,	.196,	.220,	1.12,	7,	.185,	.619
FLT44: Russian acous,	30531.,	.271,	.228,	.84,	7,	.100,	.663
FLT45: Norwegian Sva,	44857.,	.226,	.227,	1.00,	7,	.145,	.495
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	35951.,	.183,	.168,	.92,	7,	.242,	.587
FLT55: Norwegian Bar,	33779.,	.163,	.147,	.90,	7,	.278,	.615
FLT56: Norwegian Lof,	11109.,	.745,	.000,	.00,	1,	.025,	1.276
F shrinkage mean ,	40623.,	1.00,,,,				.025,	.534

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
34520.,	.09,	.08,	37,	.927,	.604

Table 3.12 (Cont'd)

Age 8 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,	4421.,	.234,	.192,	.82,	8,	.167,	.934
FLT44: Russian acous,	3222.,	.325,	.150,	.46,	8,	.090,	1.138
FLT45: Norwegian Sva,	5682.,	.273,	.333,	1.22,	8,	.142,	.790
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	4506.,	.217,	.157,	.73,	8,	.251,	.923
FLT55: Norwegian Bar,	3720.,	.193,	.130,	.67,	8,	.249,	1.043
FLT56: Norwegian Lof,	1785.,	.665,	.344,	.52,	2,	.040,	1.575
F shrinkage mean ,	10140.,	1.00,,,,				.062,	.515

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4348.,	.12,	.09,	43,	.780,	.945

Age 9 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,	2225.,	.203,	.097,	.48,	8,	.142,	.853
FLT44: Russian acous,	1695.,	.282,	.151,	.54,	8,	.075,	1.019
FLT45: Norwegian Sva,	2794.,	.233,	.070,	.30,	8,	.118,	.729
FLT52: Norwegian tra,	2005.,	.885,	.000,	.00,	1,	.039,	.915
FLT53: Russian trawl,	1159.,	.651,	.000,	.00,	1,	.072,	1.277
FLT54: Norwegian Bar,	2468.,	.186,	.100,	.54,	8,	.201,	.795
FLT55: Norwegian Bar,	2483.,	.169,	.057,	.34,	8,	.208,	.792
FLT56: Norwegian Lof,	877.,	.562,	.511,	.91,	3,	.073,	1.486
F shrinkage mean ,	4804.,	1.00,,,,				.072,	.485

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2195.,	.12,	.07,	46,	.597,	.862

Table 3.12 (Cont'd)

Age 4 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
FLT43: Russian Trawl,	378665.,	.221,	.072,	.32,	4,	.256,	.190
FLT44: Russian acous,	283396.,	.428,	.162,	.38,	4,	.071,	.247
FLT45: Norwegian Sva,	547427.,	.379,	.211,	.56,	4,	.088,	.135
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	503234.,	.252,	.087,	.35,	4,	.204,	.146
FLT55: Norwegian Bar,	418235.,	.184,	.050,	.27,	4,	.363,	.174
FLT56: Norwegian Lof,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	847852.,	1.00,,,,				.018,	.089

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
427032.,	.11,	.06,	21,	.502,	.170

Age 5 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,	452472.,	.204,	.117,	.58,	5,	.203,	.213
FLT44: Russian acous,	286161.,	.300,	.138,	.46,	5,	.102,	.319
FLT45: Norwegian Sva,	459139.,	.243,	.148,	.61,	5,	.158,	.210
FLT52: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT53: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT54: Norwegian Bar,	534277.,	.206,	.105,	.51,	5,	.209,	.183
FLT55: Norwegian Bar,	517408.,	.163,	.108,	.66,	5,	.315,	.189
FLT56: Norwegian Lof,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	426596.,	1.00,,,,				.012,	.225

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
467020.,	.09,	.06,	26,	.636,	.207

Table 3.12 (Cont'd)

Age 10 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,	3666.,	.202,	.070,	.34,	8,	.133,	.392
FLT44: Russian acous,	2719.,	.274,	.179,	.65,	8,	.076,	.499
FLT45: Norwegian Sva,	4127.,	.227,	.121,	.53,	8,	.115,	.355
FLT52: Norwegian tra,	1684.,	.781,	.549,	.70,	2,	.042,	.715
FLT53: Russian trawl,	1738.,	.524,	.138,	.26,	2,	.102,	.699
FLT54: Norwegian Bar,	3636.,	.181,	.097,	.54,	8,	.192,	.394
FLT55: Norwegian Bar,	3439.,	.169,	.094,	.56,	8,	.191,	.413
FLT56: Norwegian Lof,	2662.,	.501,	.296,	.59,	4,	.094,	.507
F shrinkage mean ,	2587.,	1.00,,,,				.055,	.519

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
3059.,	.12,	.06,	49,	.519,	.454

Age 11 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,	1024.,	.209,	.099,	.47,	8,	.070,	.806
FLT44: Russian acous,	941.,	.279,	.140,	.50,	8,	.041,	.854
FLT45: Norwegian Sva,	1273.,	.232,	.185,	.80,	8,	.061,	.692
FLT52: Norwegian tra,	740.,	.753,	.439,	.58,	3,	.050,	.999
FLT53: Russian trawl,	1340.,	.523,	.189,	.36,	3,	.092,	.666
FLT54: Norwegian Bar,	1296.,	.184,	.102,	.55,	8,	.103,	.682
FLT55: Norwegian Bar,	1072.,	.175,	.117,	.67,	8,	.100,	.781
FLT56: Norwegian Lof,	859.,	.307,	.121,	.40,	5,	.394,	.907
F shrinkage mean ,	1978.,	1.00,,,,				.089,	.496

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1063.,	.17,	.06,	52,	.343,	.786

Table 3.12 (Cont'd)

Age 12 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,	1275.,	.223,	.146,	.65,	8,	.050,	.971
FLT44: Russian acous,	1250.,	.300,	.283,	.94,	7,	.029,	.983
FLT45: Norwegian Sva,	1545.,	.245,	.161,	.66,	8,	.045,	.856
FLT52: Norwegian tra,	662.,	.468,	.245,	.52,	4,	.212,	1.426
FLT53: Russian trawl,	1712.,	.465,	.308,	.66,	4,	.188,	.798
FLT54: Norwegian Bar,	1510.,	.195,	.125,	.64,	8,	.077,	.870
FLT55: Norwegian Bar,	1504.,	.185,	.214,	1.15,	8,	.074,	.872
FLT56: Norwegian Lof,	1952.,	.296,	.139,	.47,	5,	.199,	.728
F shrinkage mean ,	2678.,	1.00,,,,				.126,	.577

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1449.,	.19,	.09,	53,	.441,	.894

Age 13 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
FLT43: Russian Trawl,	151.,	.283,	.283,	1.00,	7,	.033,	.914
FLT44: Russian acous,	137.,	.376,	.281,	.75,	6,	.019,	.974
FLT45: Norwegian Sva,	124.,	.308,	.085,	.28,	7,	.030,	1.039
FLT52: Norwegian tra,	77.,	.485,	.336,	.69,	5,	.276,	1.370
FLT53: Russian trawl,	107.,	.476,	.369,	.78,	3,	.058,	1.137
FLT54: Norwegian Bar,	99.,	.240,	.132,	.55,	7,	.056,	1.190
FLT55: Norwegian Bar,	138.,	.233,	.155,	.66,	7,	.050,	.969
FLT56: Norwegian Lof,	176.,	.293,	.150,	.51,	5,	.197,	.825
F shrinkage mean ,	317.,	1.00,,,,				.283,	.539

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
151.,	.32,	.11,	48,	.349,	.916

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

Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT43: Russian Trawl,	41.,	.402,	.462,	1.15,	6,	.012,	.699
FLT44: Russian acous,	44.,	.537,	.286,	.53,	5,	.007,	.660
FLT45: Norwegian Sva,	14.,	.428,	.143,	.33,	6,	.012,	1.395
FLT52: Norwegian tra,	11.,	.510,	.372,	.73,	6,	.280,	1.586
FLT53: Russian trawl,	26.,	.417,	.342,	.82,	3,	.101,	.949
FLT54: Norwegian Bar,	28.,	.318,	.182,	.57,	6,	.023,	.904
FLT55: Norwegian Bar,	37.,	.333,	.292,	.88,	6,	.018,	.757
FLT56: Norwegian Lof,	27.,	.302,	.290,	.96,	4,	.182,	.931
F shrinkage mean ,	35.,	1.00,,,,				.366,	.790

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
23.,	.40,	.12,	43,	.297,	1.035

Table 3.13

Run title : Arctic Cod (run: XSABB20/X20)

At 28-Aug-96 19:32:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0001,	.0000,
2,	.0006,	.0008,	.0000,	.0013,	.0013,	.0019,	.0023,	.0140,	.0302,	.0017,
3,	.0394,	.0296,	.0242,	.0228,	.0406,	.0212,	.0390,	.1949,	.2125,	.0829,
4,	.1028,	.1515,	.2057,	.2209,	.1416,	.1022,	.1661,	.1981,	.4952,	.2086,
5,	.2103,	.1797,	.4073,	.4798,	.3821,	.2277,	.2965,	.3516,	.5356,	.5202,
6,	.3781,	.2007,	.4649,	.5367,	.5703,	.2355,	.3844,	.3903,	.5050,	.7002,
7,	.4655,	.4261,	.3984,	.7676,	.6192,	.5174,	.3140,	.4205,	.4432,	.7012,
8,	.5652,	.6729,	.5186,	.9268,	.8375,	.8320,	.6674,	.6424,	.4861,	.7020,
9,	.6965,	.8392,	.7784,	1.1442,	.9598,	.9326,	1.1402,	1.0097,	.4055,	.6122,
10,	.7255,	.8304,	.7309,	.9990,	.9964,	.7684,	1.2436,	.7421,	.9799,	.4724,
11,	.4685,	.9118,	.5904,	1.1652,	.7073,	.6722,	1.2207,	.5912,	1.0088,	1.2006,
12,	.6208,	.9341,	.3900,	.9659,	.4561,	.5555,	.7818,	.6319,	.6318,	.8564,
13,	.6567,	.8836,	1.3487,	.8623,	.7110,	.5185,	1.1510,	.4038,	1.7923,	1.4780,
14,	.6393,	.8893,	.7754,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,
+gp,	.6393,	.8893,	.7754,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,
FBAR 1- 3,	.0134,	.0101,	.0081,	.0080,	.0140,	.0077,	.0138,	.0696,	.0810,	.0282,
FBAR 5-10,	.5069,	.5248,	.5497,	.8090,	.7276,	.5856,	.6743,	.5928,	.5592,	.6180,

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.0008,	.0000,	.0000,	.0000,	.0001,	.0000,	.0000,	.0000,	.2619,	.3689,
2,	.0049,	.0157,	.0036,	.0014,	.0023,	.0012,	.0005,	.0002,	.0421,	.0620,
3,	.1647,	.1330,	.1449,	.0484,	.0309,	.0238,	.0640,	.0203,	.0210,	.0439,
4,	.3098,	.5658,	.2223,	.2072,	.1282,	.0973,	.1994,	.1945,	.1213,	.1467,
5,	.4763,	.7527,	.6689,	.3460,	.3532,	.2273,	.2945,	.3060,	.2905,	.3605,
6,	.5706,	.6793,	.8475,	.5443,	.6218,	.5114,	.5462,	.4809,	.5702,	.5882,
7,	.6935,	.6759,	.8446,	.6579,	.6706,	.8506,	.7903,	.7710,	1.0743,	.9857,
8,	.8843,	.9060,	.9344,	.7504,	.6995,	1.0677,	.9974,	1.0061,	1.1962,	1.1084,
9,	.7731,	1.2159,	1.2944,	1.0530,	.8649,	1.2352,	1.1252,	1.0041,	1.2036,	1.0272,
10,	.4603,	.7656,	.9903,	.9514,	1.0902,	.9875,	.6818,	.8451,	1.0054,	.6925,
11,	.3074,	.6260,	1.8533,	1.2703,	1.3369,	1.0957,	.5540,	.4880,	.8097,	.6007,
12,	1.0504,	.2401,	1.5004,	1.3528,	.8477,	.8013,	1.2623,	.2835,	.7202,	.5220,
13,	.5108,	.9852,	2.4658,	.8275,	1.6942,	1.4830,	.4647,	1.1722,	.3609,	.5611,
14,	.6259,	.7742,	1.6429,	1.1039,	1.1810,	1.1340,	.8260,	.7661,	.8284,	.5561,
+gp,	.6259,	.7742,	1.6429,	1.1039,	1.1810,	1.1340,	.8260,	.7661,	.8284,	.5561,
FBAR 1- 3,	.0568,	.0496,	.0495,	.0166,	.0111,	.0083,	.0215,	.0068,	.1083,	.1583,
FBAR 5-10,	.6430,	.8326,	.9300,	.7172,	.7167,	.8133,	.7392,	.7355,	.8900,	.7937,

Run title : Arctic Cod (run: XSABB20/X20)

At 28-Aug-96 19:32:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
1,	.5171,	.5333,	.8915,	.1982,	.0433,	.0779,	.4386,	2.5492,	1.8848,	2.4031,	2.2790,
2,	.8296,	.7844,	.1205,	.0018,	.0572,	.2066,	.1026,	.4708,	.7020,	.9978,	.7235,
3,	.1335,	.0821,	.0301,	.0265,	.0079,	.0169,	.0352,	.0637,	.2022,	.5862,	.2840,
4,	.1711,	.1640,	.1203,	.1418,	.0447,	.0547,	.1217,	.0802,	.1441,	.1701,	.1315,
5,	.4783,	.5062,	.3750,	.2318,	.1049,	.1842,	.2339,	.3124,	.2826,	.2069,	.2673,
6,	.7787,	.9649,	.6758,	.3900,	.1926,	.2768,	.4128,	.5243,	.5204,	.3944,	.4797,
7,	1.0250,	1.1047,	1.1321,	.6285,	.2441,	.4319,	.4734,	.5562,	.9449,	.6044,	.7018,
8,	1.1796,	1.0361,	1.0572,	.9058,	.3610,	.3524,	.5388,	.4759,	.8274,	.9446,	.7493,
9,	.9458,	.9481,	1.1272,	.9572,	.3600,	.4066,	.4289,	.5449,	.6663,	.8621,	.6911,
10,	1.0302,	1.4840,	.9293,	1.1454,	.4282,	.3030,	.4057,	.6094,	.8259,	.4545,	.6299,
11,	.7393,	.8010,	1.0262,	.3135,	.4071,	.1371,	.2170,	.7281,	.9694,	.7856,	.8277,
12,	1.4483,	1.1539,	1.0292,	.3026,	.1472,	.1275,	.5269,	.9954,	1.0648,	.8935,	.9845,
13,	.5302,	.7880,	.8682,	.0373,	.6647,	.0139,	.0643,	1.1545,	.7751,	.9163,	.9486,
14,	.8599,	.9637,	.9237,	.3539,	.2641,	.1371,	.1474,	.9733,	1.1228,	1.0354,	1.0438,
+gp,	.8599,	.9637,	.9237,	.3539,	.2641,	.1371,	.1474,	.9733,	1.1228,	1.0354,	
FBAR 1- 3,	.4934,	.4666,	.3474,	.0755,	.0361,	.1005,	.1921,	1.0279,	.9297,	1.3290,	
FBAR 5-10,	.9063,	1.0073,	.8828,	.7098,	.2818,	.3258,	.4156,	.5039,	.6779,	.5778,	

Table 3.14

Run title : Arctic Cod (run: XSABB20/X20)

At 28-Aug-96 19:32:02

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	25566,	16843,	29709,	61125,	153495,	274668,	80226,	96775,	92824,	52662,
2,	159562,	20932,	13789,	24323,	50045,	125671,	224876,	65683,	79233,	75987,
3,	159837,	130560,	17124,	11290,	19889,	40919,	102691,	183687,	53028,	62939,
4,	62968,	125802,	103775,	13684,	9035,	15636,	32800,	80861,	123765,	35104,
5,	20208,	46519,	88517,	69166,	8983,	6420,	11558,	22744,	54305,	61754,
6,	14932,	13407,	31822,	48225,	35047,	5019,	4186,	7035,	13102,	26023,
7,	11036,	8377,	8981,	16367,	23084,	16223,	3247,	2333,	3899,	6473,
8,	4736,	5673,	4479,	4937,	6219,	10175,	7918,	1942,	1255,	2049,
9,	1118,	2203,	2370,	2183,	1600,	2204,	3625,	3326,	836,	632,
10,	320,	456,	779,	891,	569,	502,	710,	949,	992,	456,
11,	112,	127,	163,	307,	269,	172,	190,	168,	370,	305,
12,	96,	58,	42,	74,	78,	108,	72,	46,	76,	110,
13,	18,	42,	19,	23,	23,	41,	51,	27,	20,	33,
14,	2,	8,	14,	4,	8,	9,	20,	13,	15,	3,
+gp,	16,	3,	9,	8,	7,	5,	6,	12,	11,	7,
TOTAL,	460530,	371009,	301590,	252608,	308352,	497774,	472177,	465602,	423729,	324538,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	97965,	30130,	21234,	23935,	23830,	25494,	57765,	77938,	211165,	135714,
2,	43116,	80143,	24668,	17384,	19596,	19507,	20873,	47294,	63809,	133047,
3,	62106,	35127,	64594,	20124,	14213,	16007,	15952,	17081,	38713,	50087,
4,	47433,	43127,	25177,	45753,	15698,	11283,	12797,	12251,	13703,	31038,
5,	23330,	28488,	20053,	16505,	30448,	11306,	8381,	8584,	8257,	9938,
6,	30052,	11863,	10988,	8410,	9561,	17511,	7374,	5111,	5175,	5056,
7,	10578,	13906,	4924,	3855,	3996,	4203,	8597,	3497,	2587,	2396,
8,	2629,	4329,	5792,	1732,	1635,	1673,	1470,	3193,	1324,	723,
9,	832,	889,	1432,	1863,	670,	665,	471,	444,	956,	328,
10,	280,	314,	216,	321,	532,	231,	158,	125,	133,	235,
11,	233,	145,	120,	66,	102,	146,	70,	66,	44,	40,
12,	75,	140,	63,	15,	15,	22,	40,	33,	33,	16,
13,	38,	22,	90,	12,	3,	5,	8,	9,	20,	13,
14,	6,	19,	7,	6,	4,	0,	1,	4,	2,	12,
+gp,	12,	11,	7,	7,	1,	0,	1,	1,	2,	10,
TOTAL,	318685,	248653,	179365,	139989,	120304,	108055,	133959,	175630,	345926,	368652,

Run title : Arctic Cod (run: XSABB20/X20)

At 28-Aug-96 19:32:02

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
1,	114394,	46980,	79092,	87498,	167816,	230430,	342683,	2786343,	1208412,	3235082,	0,	801
2,	76835,	55841,	22566,	26552,	58756,	131570,	174524,	180940,	178270,	150242,	239367,	529
3,	102376,	27443,	20865,	16378,	21700,	45431,	87617,	128954,	92512,	72334,	45309,	400
4,	39245,	73345,	20698,	16577,	13059,	17627,	36572,	69254,	99068,	61875,	32930,	302
5,	21944,	27077,	50966,	15025,	11778,	10224,	13664,	26512,	52330,	70227,	42703,	199
6,	5674,	11136,	13363,	28679,	9756,	8682,	6962,	8854,	15881,	32298,	46702,	113
7,	2299,	2132,	3474,	5566,	15897,	6588,	5390,	3773,	4291,	7727,	17802,	57
8,	732,	675,	578,	917,	2431,	10196,	3502,	2749,	1771,	1366,	3452,	24
9,	196,	184,	196,	165,	303,	1387,	5868,	1673,	1398,	634,	435,	9
10,	96,	62,	58,	52,	52,	173,	756,	3129,	794,	588,	219,	2
11,	96,	28,	12,	19,	14,	28,	105,	413,	1393,	285,	306,	
12,	18,	38,	10,	3,	11,	7,	20,	69,	163,	433,	106,	
13,	8,	3,	10,	3,	2,	8,	5,	10,	21,	46,	145,	
14,	6,	4,	1,	3,	2,	1,	6,	4,	2,	8,	15,	
+gp,	0,	1,	3,	3,	1,	4,	4,	0,	1,	0,	2,	
TOTAL,	363919,	244950,	211894,	197440,	301577,	462357,	677678,	3212675,	1656310,	3633141,	429494,	

Table 3.15

Run title : Arctic Cod (run: XSABB21/X21)

At 28-Aug-96 22:51:05

Table 4 Natural Mortality (M) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
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,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.4619,	.5689,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2405,	.2605,
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2007,	.2004,
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,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
1,	.7171,	.7331,	1.0915,	.3982,	.2433,	.2779,	.6382,	2.7492,	2.0847,	2.6031,
2,	1.0295,	.9838,	.3198,	.2012,	.2569,	.4056,	.3019,	.6701,	.9014,	1.1969,
3,	.3140,	.2587,	.2086,	.2000,	.2000,	.2048,	.2056,	.2542,	.3945,	.7802,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2026,	.2684,	.3020,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2024,	.2206,	.2049,
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 3.16

Run title : Arctic Cod (run: SVPBB03/V03)

At 28-Aug-96 20:15:32

Traditional vpa using screen input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	.0398,	.0298,	.0244,	.0230,	.0409,	.0213,	.0393,	.1960,	.2135,	.0836,
4,	.1036,	.1525,	.2069,	.2218,	.1422,	.1028,	.1672,	.1995,	.4961,	.2098,
5,	.2117,	.1811,	.4088,	.4809,	.3829,	.2286,	.2977,	.3533,	.5373,	.5215,
6,	.3797,	.2024,	.4671,	.5384,	.5713,	.2368,	.3853,	.3919,	.5072,	.7015,
7,	.4673,	.4284,	.4012,	.7688,	.6214,	.5195,	.3159,	.4217,	.4455,	.7035,
8,	.5672,	.6742,	.5221,	.9271,	.8390,	.8338,	.6701,	.6437,	.4875,	.7042,
9,	.6973,	.8395,	.7795,	1.1416,	.9599,	.9343,	1.1369,	1.0102,	.4089,	.6136,
10,	.7263,	.8296,	.7333,	.9966,	.9938,	.7720,	1.2387,	.7436,	.9818,	.4778,
11,	.4721,	.9097,	.5924,	1.1604,	.7081,	.6731,	1.2199,	.5939,	1.0065,	1.1997,
12,	.6223,	.9372,	.3923,	.9634,	.4587,	.5585,	.7819,	.6391,	.6365,	.8546,
13,	.6584,	.8824,	1.3452,	.8615,	.7109,	.5224,	1.1459,	.4069,	1.7817,	1.4679,
14,	.6390,	.8890,	.7750,	1.0390,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,
+gp,	.6390,	.8890,	.7750,	1.0390,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,
FBAR 5-10,	.5082,	.5259,	.5520,	.8089,	.7281,	.5875,	.6741,	.5941,	.5614,	.6204,

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.1659,	.1339,	.1458,	.0488,	.0312,	.0240,	.0645,	.0205,	.0205,	.0438,
4,	.3119,	.5668,	.2237,	.2085,	.1293,	.0982,	.2010,	.1958,	.1225,	.1481,
5,	.4775,	.7532,	.6694,	.3480,	.3551,	.2293,	.2968,	.3084,	.2926,	.3631,
6,	.5724,	.6793,	.8467,	.5466,	.6240,	.5139,	.5493,	.4846,	.5740,	.5906,
7,	.6962,	.6783,	.8410,	.6595,	.6738,	.8520,	.7925,	.7751,	1.0751,	.9894,
8,	.8867,	.9088,	.9357,	.7452,	.7021,	1.0682,	.9976,	1.0070,	1.1983,	1.1095,
9,	.7769,	1.2138,	1.2914,	1.0535,	.8492,	1.2278,	1.1250,	1.0044,	1.2000,	1.0371,
10,	.4635,	.7737,	.9910,	.9532,	1.0905,	.9409,	.6800,	.8504,	1.0063,	.6953,
11,	.3136,	.6313,	1.8478,	1.2622,	1.3288,	1.0964,	.5062,	.4877,	.8220,	.6072,
12,	1.0522,	.2469,	1.4937,	1.3545,	.8580,	.7978,	1.2584,	.2494,	.7154,	.5407,
13,	.5124,	.9914,	2.4481,	.8296,	1.6835,	1.4692,	.4642,	1.1634,	.3032,	.5561,
14,	.6260,	.7740,	1.6430,	1.1030,	1.1770,	1.1240,	.8160,	.7590,	.8190,	.4260,
+gp,	.6260,	.7740,	1.6430,	1.1030,	1.1770,	1.1240,	.8160,	.7590,	.8190,	.4260,
FBAR 5-10,	.6455,	.8345,	.9292,	.7177,	.7158,	.8053,	.7402,	.7383,	.8910,	.7975,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
3,	.0196,	.0235,	.0216,	.0267,	.0080,	.0122,	.0298,	.0095,	.0077,	.0060,	.0077,
4,	.1722,	.1647,	.1209,	.1424,	.0451,	.0552,	.1224,	.0780,	.0757,	.0681,	.0739,
5,	.4814,	.5070,	.3755,	.2327,	.1055,	.1854,	.2357,	.3112,	.2624,	.2020,	.2585,
6,	.7807,	.9653,	.6750,	.3906,	.1937,	.2777,	.4144,	.5271,	.5209,	.3944,	.4808,
7,	1.0226,	1.1022,	1.1283,	.6278,	.2453,	.4331,	.4737,	.5581,	.9449,	.6044,	.7025,
8,	1.1858,	1.0290,	1.0516,	.9027,	.3623,	.3540,	.5398,	.4764,	.8277,	.9446,	.7496,
9,	.9523,	.9680,	1.1023,	.9461,	.3615,	.4083,	.4309,	.5467,	.6647,	.8621,	.6911,
10,	1.0578,	1.4925,	.9804,	1.0712,	.4231,	.3052,	.4082,	.6118,	.8255,	.4545,	.6306,
11,	.7448,	.8602,	1.0584,	.3501,	.3607,	.1357,	.2194,	.7304,	.9687,	.7856,	.8282,
12,	1.4519,	1.1623,	1.2364,	.3253,	.1700,	.1097,	.5149,	.9944,	1.0632,	.8935,	.9837,
13,	.5628,	.8058,	.8915,	.0520,	.7438,	.0163,	.0546,	1.0753,	.7773,	.9163,	.9230,
14,	.8380,	1.0870,	.9710,	.3750,	.3920,	.1640,	.1750,	.7340,	.9190,	1.0354,	.8961,
+gp,	.8380,	1.0870,	.9710,	.3750,	.3920,	.1640,	.1750,	.7340,	.9190,	1.0354,	
FBAR 5-10,	.9134,	1.0107,	.8855,	.6952,	.2819,	.3273,	.4171,	.5052,	.6743,	.5770,	

Table 3.17

Run title : Arctic Cod (run: SVPBB03/V03)

At 28-Aug-96 20:15:33

Traditional vpa using screen input for terminal F

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	1582377,	1292664,	169748,	111970,	197051,	404981,	1015587,	1818303,	525330,	622068,
4,	622846,	1245045,	1027225,	135629,	89590,	154865,	324568,	799413,	1223750,	347422,
5,	199849,	459765,	875147,	683854,	88953,	63625,	114403,	224809,	536116,	610055,
6,	147618,	132409,	314070,	476086,	346146,	49659,	41445,	69546,	129276,	256488,
7,	109007,	82674,	88545,	161181,	227518,	160064,	32085,	23081,	38479,	63735,
8,	46716,	55931,	44102,	48535,	61173,	100065,	77949,	19154,	12396,	20179,
9,	11030,	21692,	23334,	21422,	15724,	21644,	35588,	32653,	8238,	6233,
10,	3157,	4496,	7671,	8762,	5600,	4930,	6962,	9348,	9735,	4481,
11,	1105,	1250,	1606,	3017,	2648,	1697,	1865,	1652,	3638,	2986,
12,	950,	564,	412,	727,	774,	1068,	709,	451,	747,	1089,
13,	174,	417,	181,	228,	227,	401,	500,	266,	195,	323,
14,	21,	74,	141,	39,	79,	91,	194,	130,	145,	27,
+gp,	162,	26,	93,	77,	71,	54,	64,	121,	108,	66,
TOTAL,	2725013,	3297008,	2552278,	1651526,	1035554,	963142,	1651920,	2998927,	2488152,	1935152,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	614203,	347736,	639616,	198956,	140412,	158188,	157838,	168719,	382151,	495947,
4,	468458,	425991,	249016,	452643,	155129,	111428,	126437,	121152,	135329,	306317,
5,	230616,	280787,	197882,	163018,	300842,	111608,	82693,	84672,	81549,	98028,
6,	296492,	117121,	108248,	82949,	94240,	172683,	72656,	50314,	50924,	49831,
7,	104119,	136946,	48614,	38004,	39317,	41339,	84565,	34346,	25372,	23484,
8,	25821,	42494,	56898,	17165,	16090,	16410,	14437,	31344,	12954,	7089,
9,	8170,	8710,	14021,	18275,	6670,	6528,	4617,	4359,	9375,	3200,
10,	2763,	3076,	2119,	3156,	5218,	2336,	1566,	1227,	1307,	2312,
11,	2275,	1423,	1162,	644,	996,	1436,	747,	649,	429,	391,
12,	737,	1361,	620,	150,	149,	216,	393,	368,	326,	154,
13,	379,	211,	871,	114,	32,	52,	80,	91,	235,	131,
14,	61,	186,	64,	62,	41,	5,	10,	41,	23,	142,
+gp,	124,	109,	68,	73,	13,	2,	10,	10,	23,	120,
TOTAL,	1754218,	1366151,	1319196,	975207,	759147,	622230,	546046,	497293,	699998,	987146,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
3,	1015537,	272170,	207019,	162145,	214433,	450182,	869910,	1283494,	924437,	717711,	0,	4838
4,	388483,	727456,	205252,	164456,	129255,	174171,	362374,	687466,	985995,	618318,	326970,	3729
5,	216259,	267748,	505152,	148903,	116772,	101158,	134938,	262503,	519269,	698907,	427051,	2572
6,	55821,	109410,	132037,	284118,	96603,	86033,	68804,	87280,	157066,	320357,	465270,	1498
7,	22601,	20935,	34116,	55041,	157404,	65165,	53358,	37219,	42183,	76380,	176803,	760
8,	7149,	6655,	5693,	9038,	24053,	100837,	34600,	27203,	17439,	13425,	34169,	354
9,	1914,	1788,	1947,	1629,	3000,	13709,	57949,	16511,	13831,	6240,	4274,	157
10,	929,	605,	556,	529,	518,	1711,	7462,	30836,	7825,	5826,	2157,	63
11,	944,	264,	111,	171,	149,	278,	1033,	4062,	13692,	2806,	3028,	24
12,	175,	367,	91,	32,	99,	85,	198,	679,	1602,	4255,	1047,	9
13,	74,	33,	94,	22,	19,	68,	62,	97,	206,	453,	1426,	3
14,	61,	34,	12,	32,	17,	7,	55,	48,	27,	77,	148,	1
+gp,	2,	13,	26,	25,	7,	36,	27,	4,	7,	2,	23,	
TOTAL,	1709948,	1407479,	1092108,	826141,	742328,	993439,	1590770,	2437401,	2683582,	2464759,	1442366,	

Table 3.18

Run title : Arctic Cod (run: SVPB803/V03)

At 28-Aug-96 20:15:33

Traditional vpa using screen input for terminal F

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

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
AGE										
3	968383	738326	105490	63635	124673	294343	712129	1350918	350705	364191
4	586415	1094041	982109	118587	87205	173164	350134	913735	1256865	312921
5	291647	626205	1296900	926783	134206	110271	191292	398285	853466	851683
6	326611	273421	705648	978220	791785	130487	105066	186806	312021	542891
7	354078	250631	292065	486201	764038	617475	119411	91018	136347	198051
8	206720	230991	198178	199451	279857	525879	395218	102896	59835	85424
9	64072	117605	137648	115564	94433	149321	236875	230278	52204	34637
10	22886	30424	56473	58988	41973	42443	57829	82270	76990	31078
11	9627	10162	14203	24397	23841	17554	18610	17463	34567	24878
12	9704	5382	4275	6898	8173	12956	8296	5591	8321	10640
13	2051	4585	2164	2491	2764	5598	6745	3794	2501	3642
14	272	902	1879	469	1067	1420	2916	2069	2066	336
+gp	2286	341	1333	1013	1033	912	1040	2081	1665	895
TOTALBIO	2844753	3383015	3798363	2982694	2355048	2081823	2205562	3387202	3147551	2461266

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

YEAR	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
AGE										
3	408642	224409	417306	138547	88817	113616	110464	59746	193192	226671
4	479500	422940	249947	484937	150963	123126	136135	120364	154900	276958
5	365881	432101	307864	270705	453783	191151	138006	135759	147791	166552
6	713180	273263	255336	208836	215517	448403	183838	125215	141349	145562
7	367679	469078	168345	140468	132001	157592	314126	116556	96078	97297
8	124220	198292	268419	86431	73591	85222	73058	144909	58074	35500
9	51596	53356	86831	120802	40051	44504	30671	26455	55172	19616
10	21774	23514	16374	26031	39097	19877	12980	9295	9600	17686
11	21541	13067	10786	6381	8965	14673	7435	5909	3787	3596
12	8181	14664	6748	1742	1575	2589	4587	3932	3379	1665
13	4852	2613	10925	1525	385	715	1071	1123	2803	1623
14	868	2567	893	918	550	74	146	560	310	1963
+gp	1910	1626	1023	1173	183	27	158	151	334	1789
TOTALBIO	2569824	2131493	1800797	1488496	1205480	1201568	1012676	749974	866769	996480

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

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
3	305148	55271	37714	50318	84134	207205	391756	449810	218268	145119
4	339250	351736	70848	86759	92395	192229	337262	812271	746743	306985
5	318814	323651	339045	132464	140247	169674	236320	481008	732507	797531
6	132089	224302	200028	432029	163956	204828	191763	248200	384989	673407
7	81281	70047	88321	149172	389723	201682	207452	153915	160793	263004
8	35577	33595	23472	43943	82536	428949	175414	149541	97876	68936
9	11088	10669	11519	10394	14330	90740	391681	112088	92713	45099
10	6715	4502	4106	4217	4089	16970	69639	261518	58402	51373
11	8202	2362	987	1634	1371	2990	12102	43434	110136	26629
12	1778	3852	951	355	1067	891	2155	7375	13782	46214
13	864	404	1127	281	233	824	778	1215	2572	5667
14	801	462	163	454	235	98	763	671	377	1077
+gp	27	190	377	381	101	529	411	63	109	25
TOTALBIO	1241634	1081042	778658	912401	974418	1517608	2017495	2721110	2619265	2431066

Table 3.19

Run title : Arctic Cod (run: SVPBB03/V03)

At 28-Aug-96 20:15:33

Traditional vpa using screen input for terminal F

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
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,	206720,	230991,	198178,	199451,	279857,	525879,	395218,	102896,	59835,	85424,
9,	64072,	117605,	137648,	115564,	94433,	149321,	236875,	230278,	52204,	34637,
10,	22886,	30424,	56473,	58988,	41973,	42443,	57829,	82270,	76990,	31078,
11,	9627,	10162,	14203,	24397,	23841,	17554,	18610,	17463,	34567,	24878,
12,	9704,	5382,	4275,	6898,	8173,	12956,	8296,	5591,	8321,	10640,
13,	2051,	4585,	2164,	2491,	2764,	5598,	6745,	3794,	2501,	3642,
14,	272,	902,	1879,	469,	1067,	1420,	2916,	2069,	2066,	336,
+gp,	2286,	341,	1333,	1013,	1033,	912,	1040,	2081,	1665,	895,
TOTSPBIO,	317618,	400391,	416152,	409271,	453141,	756083,	727531,	446441,	238149,	191530,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	597,	0,	0,
4,	0,	0,	0,	0,	0,	0,	6807,	9629,	7745,	2770,
5,	0,	0,	0,	0,	0,	0,	13801,	13576,	26602,	16655,
6,	0,	0,	0,	0,	0,	0,	62505,	37564,	43818,	48036,
7,	0,	0,	0,	0,	0,	0,	204182,	85086,	53804,	57405,
8,	124220,	198292,	268419,	86431,	73591,	85222,	59908,	127520,	52267,	30175,
9,	51596,	53356,	86831,	120802,	40051,	44504,	28217,	25661,	54621,	18047,
10,	21774,	23514,	16374,	26031,	39097,	19877,	12980,	9295,	9600,	17686,
11,	21541,	13067,	10786,	6381,	8965,	14673,	7435,	5909,	3787,	3596,
12,	8181,	14664,	6748,	1742,	1575,	2589,	4587,	3932,	3379,	1665,
13,	4852,	2613,	10925,	1525,	385,	715,	1071,	1123,	2803,	1623,
14,	868,	2567,	893,	918,	550,	74,	146,	560,	310,	1963,
+gp,	1910,	1626,	1023,	1173,	183,	27,	158,	151,	334,	1789,
TOTSPBIO,	234942,	309701,	401998,	245004,	164398,	167680,	401796,	320604,	259070,	201410,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	6785,	3517,	708,	0,	1848,	5767,	3373,	24368,	7467,	0,
5,	28693,	29129,	10171,	2649,	8415,	1697,	18906,	33671,	58601,	31901,
6,	25097,	51589,	50007,	64804,	32791,	47110,	59447,	52122,	115497,	154884,
7,	45517,	18913,	46810,	58177,	183170,	133110,	151440,	86192,	88436,	160433,
8,	27038,	20493,	18543,	25926,	51172,	351738,	161381,	133091,	82216,	51702,
9,	9868,	8642,	11519,	8627,	11608,	87110,	372097,	106484,	88077,	42393,
10,	6715,	3601,	4106,	4217,	3884,	16970,	69639,	258903,	57234,	49832,
11,	8202,	2362,	987,	1634,	1371,	2990,	12102,	43434,	110136,	26097,
12,	1778,	3852,	951,	355,	1067,	891,	2155,	7375,	13782,	46214,
13,	864,	404,	1127,	281,	233,	824,	778,	1215,	2572,	5667,
14,	801,	462,	163,	454,	235,	98,	763,	671,	377,	1077,
+gp,	27,	190,	377,	381,	101,	529,	411,	63,	109,	25,
TOTSPBIO,	161386,	143153,	145470,	167506,	295896,	648834,	852491,	747589,	624502,	570223,

Table 3.20

Run title : Arctic Cod (run: SVPB803/V03)

At 28-Aug-96 20:15:33

Table 17 Summary (with SOP correction)

Traditional vpa using screen input for terminal F

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 5-10,
1946,	729759,	4231927,	2585409,	706000,	.2731,	.6735,	.1928,
1947,	419945,	3410905,	1805121,	882017,	.4886,	.5708,	.3130,
1948,	440690,	3129347,	1355197,	774295,	.5714,	.6152,	.3521,
1949,	466659,	3007242,	1153489,	800122,	.6937,	.6799,	.3705,
1950,	705512,	3106404,	1197239,	731982,	.6114,	.7781,	.3652,
1951,	1085887,	3613344,	1271431,	827180,	.6506,	.8813,	.3983,
1952,	1190838,	3245128,	876072,	876795,	1.0008,	.7499,	.5386,
1953,	1592006,	3918483,	760081,	695546,	.9151,	.8396,	.3605,
1954,	644331,	3858692,	643244,	826021,	1.2841,	.7790,	.4006,
1955,	272941,	3874768,	708237,	1147841,	1.6207,	.8170,	.5498,
1956,	440230,	3463563,	835948,	1343068,	1.6066,	.8448,	.6431,
1957,	805056,	2752695,	771019,	792557,	1.0279,	.8346,	.5059,
1958,	497100,	2629141,	894000,	769313,	.8605,	.8831,	.5123,
1959,	684731,	2418065,	731957,	744607,	1.0173,	.8562,	.5602,
1960,	790432,	2410924,	527354,	622042,	1.1796,	.8819,	.4727,
1961,	918947,	2667130,	462188,	783221,	1.6946,	.9069,	.6226,
1962,	729959,	2651070,	430028,	909266,	2.1144,	.9175,	.7515,
1963,	473302,	1960799,	291642,	776337,	2.6620,	.7829,	.9697,
1964,	338955,	1605043,	196777,	437695,	2.2243,	.8184,	.6693,
1965,	778090,	1959472,	190406,	444930,	2.3367,	.8965,	.5392,
1966,	1582377,	2844752,	317618,	483711,	1.5229,	.9415,	.5082,
1967,	1292665,	3383014,	400391,	572605,	1.4301,	.8787,	.5259,
1968,	169748,	3798364,	416152,	1074084,	2.5810,	.9561,	.5520,
1969,	111970,	2982696,	409271,	1197226,	2.9253,	.8743,	.8089,
1970,	197051,	2355048,	453141,	933246,	2.0595,	.9734,	.7281,
1971,	404980,	2081824,	756084,	689048,	.9113,	1.1182,	.5875,
1972,	1015587,	2205563,	727531,	565254,	.7769,	1.0788,	.6741,
1973,	1818303,	3387203,	446441,	792685,	1.7756,	1.1430,	.5941,
1974,	525330,	3147552,	238149,	1102433,	4.6292,	1.0271,	.5614,
1975,	622068,	2461267,	191530,	829377,	4.3303,	.9007,	.6204,
1976,	614203,	2569825,	234942,	867463,	3.6922,	1.0236,	.6455,
1977,	347736,	2131492,	309700,	905301,	2.9232,	.9928,	.8345,
1978,	639616,	1800797,	401998,	698715,	1.7381,	1.0037,	.9292,
1979,	198956,	1488497,	245003,	440538,	1.7981,	1.0713,	.7177,
1980,	140412,	1205479,	164398,	380434,	2.3141,	.9731,	.7158,
1981,	158188,	1201568,	167680,	399038,	2.3798,	1.1050,	.8053,
1982,	157837,	1012676,	401797,	363730,	.9053,	1.0767,	.7402,
1983,	168719,	749974,	320604,	289992,	.9045,	.9837,	.7383,
1984,	382151,	866770,	259070,	277651,	1.0717,	.9538,	.8910,
1985,	495947,	996480,	201410,	307920,	1.5288,	.9936,	.7975,
1986,	1015537,	1241634,	161386,	430113,	2.6651,	.9390,	.9134,
1987,	272170,	1081042,	143153,	523071,	3.6539,	.9670,	1.0107,
1988,	207019,	778658,	145470,	434939,	2.9899,	.9588,	.8855,
1989,	162145,	912402,	167506,	332481,	1.9849,	1.0344,	.6952,
1990,	214433,	974418,	295896,	212000,	.7165,	.9984,	.2819,
1991,	450182,	1517609,	648835,	319158,	.4919,	.9690,	.3273,
1992,	869911,	2017496,	852491,	513494,	.6023,	1.0008,	.4171,
1993,	1283494,	2721110,	747589,	581611,	.7780,	1.0013,	.5052,
1994,	924438,	2619266,	624502,	771086,	1.2347,	1.0005,	.6743,
1995,	717711,	2431066,	570223,	739958,	1.2977,	1.0010,	.5770,
Arith. Mean ,	623325,	2377593,	582136,	678384,	1.6689		.6070,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 3.21

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

Single option prediction: Input data

Year: 1996								
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	453090.00	0.4763	0.0000	0.0000	0.0000	0.193	0.0076	0.480
4	326970.00	0.2577	0.0000	0.0000	0.0000	0.487	0.0728	0.770
5	427051.00	0.2093	0.0100	0.0000	0.0000	0.970	0.2547	1.350
6	465270.00	0.2000	0.2200	0.0000	0.0000	2.050	0.4738	2.410
7	176803.00	0.2000	0.5600	0.0000	0.0000	3.490	0.6922	3.760
8	34169.000	0.2000	0.8200	0.0000	0.0000	5.570	0.7387	5.760
9	4274.000	0.2000	0.9500	0.0000	0.0000	7.710	0.6810	7.550
10	2157.000	0.2000	0.9800	0.0000	0.0000	9.690	0.6214	9.140
11	3028.000	0.2000	1.0000	0.0000	0.0000	10.660	0.8161	9.250
12	1047.000	0.2000	1.0000	0.0000	0.0000	10.850	0.9693	10.850
13	1426.000	0.2000	1.0000	0.0000	0.0000	12.500	0.9095	12.500
14	148.000	0.2000	1.0000	0.0000	0.0000	13.900	0.8830	13.900
15+	23.000	0.2000	1.0000	0.0000	0.0000	15.000	0.8830	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
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	951000.00	0.4763	0.0000	0.0000	0.0000	0.210	0.0076	0.550
4	.	0.2577	0.0000	0.0000	0.0000	0.580	0.0728	0.970
5	.	0.2093	0.0400	0.0000	0.0000	1.170	0.2547	1.720
6	.	0.2000	0.2500	0.0000	0.0000	2.200	0.4738	2.700
7	.	0.2000	0.5700	0.0000	0.0000	3.580	0.6922	3.910
8	.	0.2000	0.8000	0.0000	0.0000	5.440	0.7387	5.630
9	.	0.2000	0.9500	0.0000	0.0000	7.210	0.6810	7.090
10	.	0.2000	0.9800	0.0000	0.0000	8.650	0.6214	8.360
11	.	0.2000	1.0000	0.0000	0.0000	9.250	0.8161	9.250
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.9693	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.9095	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	0.8830	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	0.8830	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	1410000.0	0.4763	0.0000	0.0000	0.0000	0.210	0.0076	0.550
4	.	0.2577	0.0000	0.0000	0.0000	0.580	0.0728	0.970
5	.	0.2093	0.0400	0.0000	0.0000	1.170	0.2547	1.720
6	.	0.2000	0.2500	0.0000	0.0000	2.200	0.4738	2.700
7	.	0.2000	0.5700	0.0000	0.0000	3.580	0.6922	3.910
8	.	0.2000	0.8000	0.0000	0.0000	5.440	0.7387	5.630
9	.	0.2000	0.9500	0.0000	0.0000	7.210	0.6810	7.090
10	.	0.2000	0.9800	0.0000	0.0000	8.650	0.6214	8.360
11	.	0.2000	1.0000	0.0000	0.0000	9.250	0.8161	9.250
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.9693	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.9095	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	0.8830	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	0.8830	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

(cont.)

Table 3.21 (Cont'd)

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

Single option prediction: Input data

(cont.)

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	870000.00	0.4763	0.0000	0.0000	0.0000	0.210	0.0076	0.550
4	.	0.2577	0.0000	0.0000	0.0000	0.580	0.0728	0.970
5	.	0.2093	0.0400	0.0000	0.0000	1.170	0.2547	1.720
6	.	0.2000	0.2500	0.0000	0.0000	2.200	0.4738	2.700
7	.	0.2000	0.5700	0.0000	0.0000	3.580	0.6922	3.910
8	.	0.2000	0.8000	0.0000	0.0000	5.440	0.7387	5.630
9	.	0.2000	0.9500	0.0000	0.0000	7.210	0.6810	7.090
10	.	0.2000	0.9800	0.0000	0.0000	8.650	0.6214	8.360
11	.	0.2000	1.0000	0.0000	0.0000	9.250	0.8161	9.250
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.9693	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.9095	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	0.8830	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	0.8830	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	870000.00	0.4763	0.0000	0.0000	0.0000	0.210	0.0076	0.550
4	.	0.2577	0.0000	0.0000	0.0000	0.580	0.0728	0.970
5	.	0.2093	0.0400	0.0000	0.0000	1.170	0.2547	1.720
6	.	0.2000	0.2500	0.0000	0.0000	2.200	0.4738	2.700
7	.	0.2000	0.5700	0.0000	0.0000	3.580	0.6922	3.910
8	.	0.2000	0.8000	0.0000	0.0000	5.440	0.7387	5.630
9	.	0.2000	0.9500	0.0000	0.0000	7.210	0.6810	7.090
10	.	0.2000	0.9800	0.0000	0.0000	8.650	0.6214	8.360
11	.	0.2000	1.0000	0.0000	0.0000	9.250	0.8161	9.250
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.9693	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.9095	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	0.8830	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	0.8830	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	870000.00	0.4763	0.0000	0.0000	0.0000	0.210	0.0076	0.550
4	.	0.2577	0.0000	0.0000	0.0000	0.580	0.0728	0.970
5	.	0.2093	0.0400	0.0000	0.0000	1.170	0.2547	1.720
6	.	0.2000	0.2500	0.0000	0.0000	2.200	0.4738	2.700
7	.	0.2000	0.5700	0.0000	0.0000	3.580	0.6922	3.910
8	.	0.2000	0.8000	0.0000	0.0000	5.440	0.7387	5.630
9	.	0.2000	0.9500	0.0000	0.0000	7.210	0.6810	7.090
10	.	0.2000	0.9800	0.0000	0.0000	8.650	0.6214	8.360
11	.	0.2000	1.0000	0.0000	0.0000	9.250	0.8161	9.250
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.9693	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.9095	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	0.8830	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	0.8830	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SPRBB01
Date and time: 28AUG96:21:32

Table 3.22

The SAS System 09:36 Wednesday, August 28, 1996 5

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

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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
0.7186	0.4146	2539807	831658	750000	0.0000	0.0000	2903836	1277197	0	4062051	2226176
.	.	.	.	.	0.0500	0.0288	.	1277197	76909	3969842	2156786
.	.	.	.	.	0.1000	0.0577	.	1277197	151540	3880468	2089660
.	.	.	.	.	0.1500	0.0865	.	1277197	223963	3793835	2024722
.	.	.	.	.	0.2000	0.1154	.	1277197	294251	3709855	1961899
.	.	.	.	.	0.2500	0.1442	.	1277197	362471	3628443	1901120
.	.	.	.	.	0.3000	0.1731	.	1277197	428689	3549514	1842316
.	.	.	.	.	0.3500	0.2019	.	1277197	492968	3472988	1785422
.	.	.	.	.	0.4000	0.2308	.	1277197	555371	3398789	1730373
.	.	.	.	.	0.4500	0.2596	.	1277197	615956	3326839	1677108
.	.	.	.	.	0.5000	0.2885	.	1277197	674782	3257068	1625567
.	.	.	.	.	0.5500	0.3173	.	1277197	731903	3189405	1575694
.	.	.	.	.	0.6000	0.3462	.	1277197	787375	3123782	1527431
.	.	.	.	.	0.6500	0.3750	.	1277197	841248	3060133	1480727
.	.	.	.	.	0.7000	0.4039	.	1277197	893574	2998396	1435528
.	.	.	.	.	0.7500	0.4327	.	1277197	944400	2938508	1391784
.	.	.	.	.	0.8000	0.4616	.	1277197	993775	2880410	1349448
.	.	.	.	.	0.8500	0.4904	.	1277197	1041742	2824046	1308473
.	.	.	.	.	0.9000	0.5193	.	1277197	1088348	2769359	1268813
.	.	.	.	.	0.9500	0.5481	.	1277197	1133633	2716297	1230425
.	.	.	.	.	1.0000	0.5770	.	1277197	1177640	2664808	1193266
.	.	.	.	.	1.0500	0.6058	.	1277197	1220408	2614840	1157296
.	.	.	.	.	1.1000	0.6347	.	1277197	1261976	2566347	1122476
.	.	.	.	.	1.1500	0.6635	.	1277197	1302381	2519281	1088767
.	.	.	.	.	1.2000	0.6924	.	1277197	1341659	2473596	1056134
.	.	.	.	.	1.2500	0.7212	.	1277197	1379845	2429250	1024539
.	.	.	.	.	1.3000	0.7501	.	1277197	1416973	2386200	993950
.	.	.	.	.	1.3500	0.7789	.	1277197	1453075	2344404	964333
.	.	.	.	.	1.4000	0.8078	.	1277197	1488184	2303824	935655
.	.	.	.	.	1.4500	0.8366	.	1277197	1522329	2264420	907887
.	.	.	.	.	1.5000	0.8655	.	1277197	1555540	2226157	880997
.	.	.	.	.	1.5500	0.8943	.	1277197	1587846	2188997	854958
.	.	.	.	.	1.6000	0.9231	.	1277197	1619275	2152907	829742
.	.	.	.	.	1.6500	0.9520	.	1277197	1649853	2117852	805320
.	.	.	.	.	1.7000	0.9808	.	1277197	1679606	2083801	781668
.	.	.	.	.	1.7500	1.0097	.	1277197	1708560	2050722	758760
.	.	.	.	.	1.8000	1.0385	.	1277197	1736739	2018585	736572
.	.	.	.	.	1.8500	1.0674	.	1277197	1764166	1987360	715080
.	.	.	.	.	1.9000	1.0962	.	1277197	1790864	1957020	694262
.	.	.	.	.	1.9500	1.1251	.	1277197	1816855	1927535	674095
.	.	.	.	.	2.0000	1.1539	.	1277197	1842161	1898881	654559
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANBB02
Date and time : 28AUG96:20:39
Computation of ref. F: Simple mean, age 5 - 10
Basis for 1996 : TAC constraints

Table 3.23

The SAS System 09:36 Wednesday, August 28, 1996

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

Single option prediction: Summary table

Year	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
1996	0.7186	0.4146	284519	750036	1895456	2539807	245504	831240	245504	831240
1997	0.4000	0.2308	160845	555360	2140396	2903791	327953	1277168	327953	1277168
1998	0.4000	0.2308	161136	621592	2815566	3398747	362719	1730340	362719	1730340
1999	0.4000	0.2308	172698	652086	2723740	3744437	359690	1947054	359690	1947054
2000	0.4000	0.2308	199819	724401	2730139	4089913	384859	2045823	384859	2045823
2001	0.4000	0.2308	223711	844866	2724524	4435361	457119	2261590	457119	2261590
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBB01
Date and time : 28AUG96:21:32
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

Table 3.23 (Cont'd)

The SAS System 09:36 Wednesday, August 28, 1996 15

Cod in the North-East Arctic (Fishing 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
1996	0.7186	0.4146	284519	750036	1895456	2539807	245504	831240	245504	831240
1997	0.6000	0.3462	229598	787360	2140396	2903791	327953	1277168	327953	1277168
1998	0.6000	0.3462	212252	790694	2754324	3123746	324171	1527403	324171	1527403
1999	0.6000	0.3462	220627	769010	2628407	3242520	293195	1532837	293195	1532837
2000	0.6000	0.3462	253715	827881	2609796	3430184	303017	1488836	303017	1488836
2001	0.6000	0.3462	277723	941345	2578284	3640344	359823	1603170	359823	1603170
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBB01
Date and time : 28AUG96:21:32
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

The SAS System 09:36 Wednesday, August 28, 1996 16

Cod in the North-East Arctic (Fishing 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
1996	0.7186	0.4146	284519	750036	1895456	2539807	245504	831240	245504	831240
1997	0.8000	0.4616	291734	993756	2140396	2903791	327953	1277168	327953	1277168
1998	0.8000	0.4616	250081	898206	2699223	2880378	290092	1349423	290092	1349423
1999	0.8000	0.4616	254806	818506	2550138	2847155	240840	1212307	240840	1212307
2000	0.8000	0.4616	293183	867752	2515832	2955226	243961	1101766	243961	1101766
2001	0.8000	0.4616	314983	972820	2466667	3096702	292142	1177156	292142	1177156
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBB01
Date and time : 28AUG96:21:32
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

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Cod in the North-East Arctic (Fishing 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
1996	0.7186	0.4146	284519	750036	1895456	2539807	245504	831240	245504	831240
1997	1.0000	0.5770	347994	1177618	2140396	2903791	327953	1277168	327953	1277168
1998	1.0000	0.5770	277967	961129	2649559	2664780	259938	1193244	259938	1193244
1999	1.0000	0.5770	280263	829861	2485293	2534171	199455	963657	199455	963657
2000	1.0000	0.5770	323909	878538	2440698	2607810	200753	830567	200753	830567
2001	1.0000	0.5770	342141	977312	2378340	2711942	243539	894836	243539	894836
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBB01
Date and time : 28AUG96:21:32
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

Table 3.23 (Cont'd)

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

Single option prediction: Summary table

Year	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
1996	0.7186	0.4146	284519	750036	1895456	2539807	245504	831240	245504	831240
1997	1.2000	0.6924	399033	1341634	2140396	2903791	327953	1277168	327953	1277168
1998	1.2000	0.6924	298444	992137	2604717	2473572	233235	1056114	233235	1056114
1999	1.2000	0.6924	300210	821017	2431054	2285033	166597	770245	166597	770245
2000	1.2000	0.6924	349076	877477	2379179	2349064	168647	638742	168647	638742
2001	1.2000	0.6924	362734	970907	2306158	2429642	207492	702614	207492	702614
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBB01
Date and time : 28AUG96:21:32
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

Table 3.24

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

Single option prediction: Detailed tables

Year: 1996	F-factor: 0.7186	Reference F: 0.4146				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	0.0055	1964	943	453090	87446	0	0	0	0
4	0.0523	14708	11325	326970	159234	0	0	0	0
5	0.1830	64652	87281	427051	414239	4271	4142	4271	4142
6	0.3405	122377	294928	465270	953804	102359	209837	102359	209837
7	0.4974	63319	238079	176803	617042	99010	345544	99010	345544
8	0.5308	12868	74120	34169	190321	28019	156063	28019	156063
9	0.4894	1511	11410	4274	32953	4060	31305	4060	31305
10	0.4465	709	6483	2157	20901	2114	20483	2114	20483
11	0.5864	1230	11373	3028	32278	3028	32278	3028	32278
12	0.6965	482	5225	1047	11360	1047	11360	1047	11360
13	0.6536	627	7836	1426	17825	1426	17825	1426	17825
14	0.6345	64	885	148	2057	148	2057	148	2057
15+	0.6345	10	148	23	345	23	345	23	345
Total		284519	750036	1895456	2539807	245504	831240	245504	831240
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1997	F-factor: 0.8000	Reference F: 0.4616				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	0.0061	4587	2523	951000	199710	0	0	0	0
4	0.0582	13976	13557	279871	162325	0	0	0	0
5	0.2038	40029	68850	239812	280580	9592	11223	9592	11223
6	0.3790	83003	224107	288466	634624	72116	158656	72116	158656
7	0.5538	105404	412131	271007	970206	154474	553017	154474	553017
8	0.5910	35948	202386	88025	478856	70420	383085	70420	383085
9	0.5448	6320	44811	16453	118624	15630	112693	15630	112693
10	0.4971	768	6419	2145	18555	2102	18184	2102	18184
11	0.6529	496	4591	1130	10452	1130	10452	1130	10452
12	0.7754	683	7411	1379	14964	1379	14964	1379	14964
13	0.7276	203	2532	427	5339	427	5339	427	5339
14	0.7064	282	3921	607	8442	607	8442	607	8442
15+	0.7064	34	517	74	1113	74	1113	74	1113
Total		291734	993756	2140396	2903791	327953	1277168	327953	1277168
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1998	F-factor: 0.8000	Reference F: 0.4616				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	0.0061	6801	3741	1410000	296100	0	0	0	0
4	0.0582	29316	28437	587064	340497	0	0	0	0
5	0.2038	34061	58585	204055	238744	8162	9550	8162	9550
6	0.3790	45654	123266	158665	349063	39666	87266	39666	87266
7	0.5538	62878	245852	161667	578766	92150	329897	92150	329897
8	0.5910	52083	293225	127534	693786	102027	555029	102027	555029
9	0.5448	15332	108703	39911	287761	37916	273373	37916	273373
10	0.4971	2797	23379	7812	67576	7656	66224	7656	66224
11	0.6529	469	4341	1068	9882	1068	9882	1068	9882
12	0.7754	238	2588	482	5225	482	5225	482	5225
13	0.7276	247	3082	520	6500	520	6500	520	6500
14	0.7064	78	1091	169	2348	169	2348	169	2348
15+	0.7064	128	1918	275	4130	275	4130	275	4130
Total		250081	898206	2699223	2880378	290092	1349423	290092	1349423
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 3.24 (Cont'd)

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

Single option prediction: Detailed tables

(cont.)

Year: 1999	F-factor: 0.8000		Reference F: 0.4616			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	0.0061	4196	2308	870000	182700	0	0	0	0
4	0.0582	43466	42162	870411	504838	0	0	0	0
5	0.2038	71447	122888	428030	500795	17121	20032	17121	20032
6	0.3790	38847	104887	135007	297016	33752	74254	33752	74254
7	0.5538	34585	135226	88922	318339	50685	181453	50685	181453
8	0.5910	31069	174920	76079	413871	60863	331097	60863	331097
9	0.5448	22213	157493	57825	416920	54934	396074	54934	396074
10	0.4971	6784	56713	18951	163927	18572	160648	18572	160648
11	0.6529	1709	15808	3891	35988	3891	35988	3891	35988
12	0.7754	225	2446	455	4940	455	4940	455	4940
13	0.7276	86	1076	182	2270	182	2270	182	2270
14	0.7064	96	1328	206	2859	206	2859	206	2859
15+	0.7064	83	1251	179	2692	179	2692	179	2692
Total		254806	818506	2550138	2847155	240840	1212307	240840	1212307
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000	F-factor: 0.8000		Reference F: 0.4616			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	0.0061	4196	2308	870000	182700	0	0	0	0
4	0.0582	26819	26015	537062	311496	0	0	0	0
5	0.2038	105930	182200	634619	742504	25385	29700	25385	29700
6	0.3790	81486	220012	283195	623028	70799	155757	70799	155757
7	0.5538	29428	115064	75663	270874	43128	154398	43128	154398
8	0.5910	17089	96212	41846	227642	33477	182113	33477	182113
9	0.5448	13251	93951	34495	248709	32770	236274	32770	236274
10	0.4971	9829	82168	27457	237504	26908	232754	26908	232754
11	0.6529	4146	38348	9438	87301	9438	87301	9438	87301
12	0.7754	821	8910	1658	17991	1658	17991	1658	17991
13	0.7276	81	1017	172	2146	172	2146	172	2146
14	0.7064	33	464	72	998	72	998	72	998
15+	0.7064	72	1084	156	2334	156	2334	156	2334
Total		293183	867752	2515832	2955226	243961	1101766	243961	1101766
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001	F-factor: 0.8000		Reference F: 0.4616			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	0.0061	4196	2308	870000	182700	0	0	0	0
4	0.0582	26819	26015	537062	311496	0	0	0	0
5	0.2038	65361	112421	391573	458141	15663	18326	15663	18326
6	0.3790	120815	326201	419878	923732	104970	230933	104970	230933
7	0.5538	61729	241360	158712	568191	90466	323869	90466	323869
8	0.5910	14541	81866	35607	193700	28485	154960	28485	154960
9	0.5448	7289	51676	18973	136798	18025	129958	18025	129958
10	0.4971	5863	49017	16379	141681	16052	138847	16052	138847
11	0.6529	6006	55559	13674	126486	13674	126486	13674	126486
12	0.7754	1992	21613	4022	43642	4022	43642	4022	43642
13	0.7276	296	3705	625	7814	625	7814	625	7814
14	0.7064	32	438	68	944	68	944	68	944
15+	0.7064	43	640	92	1378	92	1378	92	1378
Total		314983	972820	2466667	3096702	292142	1177156	292142	1177156
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

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	125,657	27,925	1,854	155,434
1961	165,165	25,642	2,427	193,234
1962	160,972	25,189	1,727	187,888
1963	124,774	21,031	939	146,744
1964	79,056	18,735	1,109	98,900
1965	98,505	18,640	939	118,079
1966	124,115	34,892	1,614	160,621
1967	108,066	27,980	440	136,486
1968	140,970	40,031	725	181,726
1969	88,960	40,208	1,341	130,509
1970	59,493	26,611	497	86,601
1971	56,300	21,567	435	78,302
1972	221,183	41,979	2,155	265,317
1973	283,728	23,348	2,989	320,065
1974	159,037	47,033	5,068	221,138
1975	121,686	44,330	9,726	175,742
1976	94,065	37,566	5,649	137,279
1977	72,159	28,452	9,547	110,158
1978	63,965	30,478	979	95,422
1979	63,841	39,167	615	103,623
1980	54,205	33,616	68	87,889
1981	36,834	39,864	455	77,153
1982	17,948	29,005	2	46,955
1983	7,550	13,872	185	21,607
1984	4,000	13,247	71	17,318
1985	30,385	10,774	111	41,270
1986	69,865	26,006	714	96,585
1987	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 [1]	70,251	53,999	14,073	138,323

[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 [1]	62.0	8.3	38.7	15.3	14.1

[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	853	20,903	-	55,122
1990	875	-	5	128	17,634	-	569	6,605	-	25,816
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	1,794	34,700	654	77,619
1994	2,761	678	770	2,412	64,688	22	4,339	44,484	1,211	121,365
1995 [1]	2,833	598	1,097	2,663	72,773	14	2,560	54,536	1,269	138,323

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

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

	Sub-area I			Division IIa		Division IIb	
Year	Norway[2]	USSR[4]	UK[3]	Norway[2]	UK[3]	Norway[2]	UK[3]
1960	-	-	33	-	2.80	-	34
1961	-	-	29	-	3.30	-	36
1962	-	-	23	-	2.50	-	42
1963	-	-	13	-	0.90	-	33
1964	-	-	18	-	1.60	-	18
1965	-	-	18	-	2.00	-	18
1966	-	-	17	-	2.80	-	34
1967	-	-	18	-	2.40	-	25
1968	-	-	19	-	1.00	-	50
1969	-	-	13	-	2.00	-	42
1970	-	-	7	-	1.00	-	31
1971	-	-	8	-	3.00	-	25
1972	0.06	-	14	0.02	23.00	0.09	18
1973	0.35	-	22	0.18	20.00	0.39	20
1974	0.27	-	20	0.09	15.00	0.51	74
1975	0.26	-	15	0.06	4.00	0.44	60
1976	0.27	-	10	+	3.00	0.24	38
1977	0.11	-	4	+	0.20	0.14	16
1978	0.13	-	5	+	4.00	0.14	15
1979	0.36	-	-	-0.07	-	0.18	-
1980	0.45	-	-	+	-	0.22	-
1981	0.64	-	-	-	-	0.37	-
1982	0.51	-	-	-	-	0.38	-
1983	0.27	-	-	0.04	-	0.17	-
1984	0.13	-	-	0.01	-	0.12	-
1985	0.27	1.00	-	0.01	-	0.11	-
1986	0.56	1.05	-	0.02	-	0.20	-
1987	0.63	0.90	-	0.01	-	0.28	-
1988	0.38	0.70	-	0.02	-	0.40	-
1989	0.22	-	-	0.01	-	0.15	-
1990	0.19	-	-	0.01	-	0.05	-
1991	0.22	-	-	0.01	-	0.07	-
1992	0.46	-	-	0.06	-	0.20	-
1993	0.43	-	-	0.08	-	0.20	-
1994	0.80	-	-	0.25	-	0.26	-
1995 [1]	1.02	-	-	0.31	-	0.42	-

[1] Preliminary figures.
[2] Norwegian data - t per 1,000 t/hrs fishing.
[3] United Kingdom data - t per 100 t/hrs fishing.
[4] USSR data - t per hour fishing.

Table 4.5 North-East Arctic HADDOCK.
Weight at age (kg) in landings of different countries.

Norway

Year	2	3	4	5	6	7	8	9	10	11	12	13	14+
							Age						
1984	1.17	1.58	1.99	2.42	2.64	2.89	3.16	3.41	3.51	4.04	4.04	3.84	4.36
1985	0.81	1.32	1.91	2.35	2.66	2.85	3.14	3.38	3.72	3.81	3.22	3.72	4.19
1986	0.62	1.17	1.51	2.24	2.54	2.62	3.04	3.17	3.51	3.72	3.98	4.06	4.14
1987	0.43	1.02	1.32	1.72	2.60	2.99	3.24	3.14	3.51	3.93	4.00	3.48	5.28
1988	0.61	0.77	0.87	1.10	1.48	2.05	2.52	2.83	3.14	3.32	3.71	3.66	4.78
1989	0.77	1.01	1.15	1.38	1.44	1.71	1.66	1.99	3.21	3.23	5.03	4.73	5.61
1990	0.79	0.95	1.24	1.39	1.58	1.72	2.10	2.24	2.44	2.95	3.19	3.59	4.59
1991	0.57	0.97	1.29	1.46	1.73	1.78	1.93	2.29	2.34	-	4.41	-	3.33
1992	0.36	0.93	1.37	1.62	1.84	1.98	2.09	2.20	2.72	3.14	2.92	2.28	3.29
1993	0.39	0.79	1.18	1.57	1.74	1.96	1.99	2.31	2.39	2.48	3.29	2.86	4.31
1994	0.45	0.73	0.99	1.38	1.73	2.04	2.16	2.38	2.49	2.65	2.68	3.24	-
1995	0.40	0.73	0.92	1.17	1.68	2.07	2.17	2.39	2.85	2.90	2.97	2.66	-

Russia

Year	2	3	4	5	6	7	8	9	10	11	12	13	14+
							Age						
1984	0.66	1.35	1.90	2.48	3.13	3.12	3.57	3.86	3.98	4.77	-	-	5.37
1985	0.25	0.81	1.46	2.51	2.84	3.23	3.29	3.90	4.03	6.75	(5.20)	4.78	-
1986	0.27	0.54	0.98	1.50	2.25	2.63	3.03	3.65	3.80	-	-	-	6.45
1987	-	0.47	0.69	1.09	1.93	2.75	2.72	3.34	2.83	2.40	-	-	4.52
1988	0.18	0.44	0.74	0.98	1.35	1.52	-	4.04	-	3.80	3.70	-	-
1989	0.42	0.41	0.64	0.98	1.28	1.72	2.48	-	-	-	-	-	-
1990	0.45	0.68	1.19	1.41	1.64	1.99	2.59	-	-	-	-	-	4.85
1991	0.25	0.64	1.32	1.70	1.95	2.33	2.61	3.43	-	-	-	-	-
1992	0.24	0.77	1.33	1.91	2.17	2.56	2.78	3.13	3.77	-	-	-	-
1993	0.16	0.45	0.98	1.44	1.93	2.41	2.62	2.88	3.27	3.73	4.14	-	-
1994	0.11	0.29	0.76	1.25	1.75	2.11	2.30	2.71	2.78	3.13	3.17	-	-
1995	0.16	0.24	0.47	0.97	1.65	2.33	2.68	3.19	3.26	3.56	3.94	4.70	5.02
1996 [1]	0.12	0.24	0.50	0.82	1.19	1.90	2.90	2.88	-	-	4.65	3.77	-

Fed. Rep. Germany

Year	2	3	4	5	6	7	8	9	10	11	12	13	14+
							Age						
1994	-	0.41	0.88	1.38	1.74	1.97	2.55	2.54	2.68	2.77	-	-	-
1995	-	0.23	0.42	0.86	1.19	1.72	2.11	2.88	2.93	3.10	3.22	3.33	3.30

UK (England & Wales)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14+
							Age						
1995	-	-	1.16	1.39	1.80	2.10	2.51	2.28	2.72	2.95	2.98	3.03	-

[1] Data from January-June

Table 4.6 HAD-ARCT: Haddock in the North-East Arctic (Fishing Areas I and II)

WEST: Mean Weight in Stock (Kilograms)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1950	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1951	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1952	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1953	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1954	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1955	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1956	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1957	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1958	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1959	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1960	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1961	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1962	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1963	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1964	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1965	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1966	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1967	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1968	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1969	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1970	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1971	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1972	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1973	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1974	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1975	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1976	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1977	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1978	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1979	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1980	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1981	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1982	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1983	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1984	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1985	.	.	0.440	0.820	1.780	2.400	2.690	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1986	.	.	0.280	0.820	1.530	2.260	2.260	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1987	.	.	0.240	0.480	0.930	2.220	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1988	0.025	0.108	0.273	0.390	0.614	1.098	1.560	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1989	0.038	0.103	0.284	0.444	0.704	1.019	1.436	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1990	0.047	0.127	0.276	0.717	0.946	1.267	1.506	2.004	3.700	4.410	5.400	6.700	7.400	8.000
1991	0.051	0.014	0.389	0.754	1.484	1.622	1.689	2.047	2.606	4.410	5.400	6.700	7.400	8.000
1992	0.044	0.142	0.371	0.815	1.540	2.072	2.358	2.245	2.774	4.198	5.400	6.700	7.400	8.000
1993	0.034	0.103	0.304	0.819	1.437	2.115	2.344	3.045	3.391	3.400	4.200	6.700	7.400	8.000
1994	0.028	0.094	0.234	0.545	1.052	1.536	1.954	2.509	2.374	2.621	3.160	6.700	7.400	8.000
1995	0.029	0.089	0.206	0.356	0.796	1.440	1.953	2.913	2.934	3.033	3.623	6.700	7.400	8.000
1996	0.029	0.094	0.210	0.451	0.692	1.126	1.846	2.430	2.815	3.323	3.479	6.700	7.400	8.000
1997	.	.	0.330	0.790	1.330	2.030	2.320	3.330	3.700	4.410	5.400	6.700	7.400	8.000

Table 4.7

HAD-ARCT: Haddock in the North-East Arctic (Fishing Areas I and II)

WECA: Mean Weight in Catch (Kilograms)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1950	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1951	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1952	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1953	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1954	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1955	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1956	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1957	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1958	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1959	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1960	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1961	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1962	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1963	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1964	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1965	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1966	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1967	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1968	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1969	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1970	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1971	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1972	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1973	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1974	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1975	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1976	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1977	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1978	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1979	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1980	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1981	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1982	.	.	0.660	1.030	1.790	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1983	.	.	1.520	1.860	2.100	2.380	2.860	3.330	3.700	4.410	5.400	6.700	7.400	8.000
1984	.	.	1.570	1.990	2.420	2.680	2.930	3.370	3.700	4.410	5.400	6.700	7.400	8.000
1985	.	.	0.920	1.660	2.390	2.710	2.890	3.220	3.700	4.410	5.400	6.700	7.400	8.000
1986	.	.	0.860	1.250	1.880	2.410	2.660	3.040	3.700	4.410	5.400	6.700	7.400	8.000
1987	.	.	0.640	0.860	1.330	2.450	2.980	2.980	3.700	4.410	5.400	6.700	7.400	8.000
1988	.	.	0.580	0.840	1.050	1.430	1.970	2.520	3.700	4.410	5.400	6.700	7.400	8.000
1989	.	.	0.800	0.890	1.170	1.370	1.710	2.010	3.700	4.410	5.400	6.700	7.400	8.000
1990	0.250	0.640	0.890	1.220	1.400	1.600	1.770	2.160	3.700	4.410	5.400	6.700	7.400	8.000
1991	.	.	0.770	1.310	1.610	1.860	2.110	2.340	2.930	2.340	5.400	6.700	7.400	8.000
1992	0.040	0.280	0.840	1.360	1.700	1.960	2.290	2.390	2.320	2.880	3.140	2.920	2.280	3.290
1993	0.090	0.300	0.590	1.060	1.520	1.840	2.180	2.300	2.520	2.640	3.110	3.800	2.860	4.310
1994	0.250	0.440	0.540	0.880	1.330	1.740	2.060	2.200	2.500	2.580	2.890	2.820	3.240	.
1995	0.200	0.310	0.630	0.660	1.060	1.680	2.110	2.340	2.670	2.910	3.020	3.080	2.740	.

Table 4.8 North-East Arctic HADDOCK. Maturity at age in percent from Russian data.

Year	Maturity at age in percent									
	Age									
	3	4	5	6	7	8	9	10	11	12
1981	1	12	64	73	96	100	100	-	-	-
1982	9	55	73	93	96	100	93	-	-	-
1983	17	70	100	99	99	100	-	-	-	-
1984	7	14	35	47	74	82	89	-	-	-
1985	2	8	80	93	96	91	96	-	-	-
1986	+	22	53	86	86	100	83	100	-	-
1987	-	1	21	53	100	100	-	100	-	-
1988	-	3	33	51	-	-	-	-	-	-
1989	-	4	30	63	82	100	-	-	-	-
1990	-	2	30	54	77	87	80	100	-	-
1991	-	7	30	50	80	92	100	100	-	-
1992	2	13	50	62	77	80	94	100	-	-
1993	2	24	50	79	80	89	87	87	-	-
1994	-	2	13	41	90	88	100	100	-	-
1995	-	1.4	14	46.5	78	83	100	87	100	95
1996	-	-	10.6	39.6	77.4	85.5	90	91.7	90	100

Table 4.9

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HAD-ARCT: Haddock in the North-East Arctic (Fishing 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

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HAD-ARCT: Haddock in the North-East Arctic (Fishing 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

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HAD-ARCT: Haddock in the North-East Arctic (Fishing 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	0.40	166	365	26	7	3	1
1986	0.65	57	142	236	27	23	2
1987	1.06	28	41	41	69	43	1
1988	0.78	16	1	8	79	54	8
1989	0.63	127	1	9	3	8	1
1990	0.55	149	3	0	0	1	1
1991	0.55	703	58	7	0	1	1
1992	0.33	394	599	96	2	2	0
1993	0.41	200	279	282	36	9	1
1994	0.72	209	214	497	224	64	16
1995	1.05	55	71	121	80	200	0

Table 4.9 (Cont'd)

HAD-ARCT: Haddock in the North-East Arctic (Fishing 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

HAD-ARCT: Haddock in the North-East Arctic (Fishing 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

Table 4.10

HADNEW.RCT

```
NORTHEAST ARCTIC HADDOCK : recruits as 1 year-olds (inc. data f
or ages 0 & 1),,,
4,39,2  (No. of surveys, No. of years, VPA Column No.),
1957,370,38,-11,-11,-11
1958,170,2,-11,-11,-11
1959,373,7,-11,-11,-11
1960,420,30,-11,-11,-11
1961,485,32,-11,-11,-11
1962,152,5,-11,-11,-11
1963,366,16,-11,-11,-11
1964,441,11,-11,-11,-11
1965,30,0.3,-11,-11,-11
1966,26,0.3,1,-11,-11
1967,249,3,8,-11,-11
1968,144,0.3,0.3,-11,-11
1969,1539,31,29,-11,-11
1970,419,10,64,-11,-11
1971,89,3,26,-11,-11
1972,78,2,16,-11,-11
1973,91,13,26,-11,-11
1974,184,15,51,-11,-11
1975,285,163,60,-11,-11
1976,205,6,38,-11,-11
1977,29,1,33,-11,-11
1978,9,0.3,12,-11,-11
1979,12,0.3,20,-11,-11
1980,7,0.3,15,3.1,7
1981,14,0.3,3,3.9,9
1982,415,23,38,2776.8,0.3
1983,1918,40,62,5382,1685
1984,1779,9.7,78,1421.2,1809
1985,681,3.9,27,649,680
1986,864,0.2,39,134.3,111
1987,52,0.4,10,44.6,20
1988,443,1.9,13,80.8,58
1989,582,3.3,14,555.4,493
1990,2141,72,61,1526,1938
1991,3266,16,117,1282.2,859
1992,2291,20,87,717.5,1424
1993,2695,5.5,64,587.5,848
1994,5477,14,64,1271.8,1380
1995,-11,9.9,25,312.7,249
R-T-1    Russian Bottom Trawl Survey, age 0+
INTOGP   International 0 Group Survey, (scaled x 100)
N-BST1   Norwegian Barents Sea Bottom Trawl Survey, age 1
N-BSA1   Norwegian Barents Sea Acoustic Survey, age 1
```

Table 4.11

```
Analysis by RCT3 ver3.1 of data from file :

g:\acfm\afwg\had_arct\hadnew.rct

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

Data for    4 surveys over   39 years :  1957 - 1995

Regression type = C
Tapered time weighting applied
power =     0 over  20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as    .00
Minimum of   3 points used for regression

Forecast/Hindcast variance correction used.

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-T-1	.25	.91	9.70	.049	38	9.90	3.42	10.490	.013
INTOGP	.09	1.72	1.94	.566	29	25.00	4.07	2.111	.330
N-BST1	.00	2.62	4.58	.167	15	312.70	3.69	5.131	.056
N-BSA1	.00	3.51	2.01	.508	15	249.00	4.45	2.271	.285
					VPA Mean =		5.74	2.152	.317

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	107	4.68	1.21	.38	.10		

Table 4.12

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Arctic Haddock (run: XSALOR12/X12)

CPUE data from file /users/fish/ifad/ifapwork/afwg/had_arct/FLEET.X12

Catch data for 46 years. 1950 to 1995. Ages 1 to 14.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT23: Russian botto,	1984,	1995,	1,	7,	.900,	1.000
FLT24: Russian acous,	1985,	1995,	1,	7,	.900,	1.000
FLT29: Norwegian tra,	1985,	1995,	8,	13,	.000,	1.000
FLT30: Norway bottom,	1984,	1995,	1,	7,	.990,	1.000
FLT31: Norway acoust,	1984,	1995,	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 < 4

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

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 had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00335

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9,	10
Iteration 29,	2.5800,	1.2803,	.3607,	.2764,	.2580,	.3264,	.7713,	.9061,	.5587,	.7644
Iteration 30,	2.5799,	1.2802,	.3607,	.2763,	.2580,	.3263,	.7711,	.9058,	.5583,	.7638

Age ,	11,	12,	13
Iteration 29,	.3801,	.2506,	.9475
Iteration 30,	.3795,	.2503,	.9468

Table 4.12 (Cont'd)

Log catchability residuals.

Fleet : FLT23: Russian botto

Age	1984	1985
1	1.02	.29
2	.70	.70
3	.75	.92
4	-.26	-.47
5	-.68	-.24
6	99.99	-.19
7	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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.07	.40	-.29	-.48	.56	.16	.33	-.31	-.74	-.44
2	.16	-.39	-.18	.50	.38	-.30	.05	-.06	-.40	-.64
3	-.24	-.04	-.48	-.94	1.30	-.25	.04	.24	.01	-.83
4	.20	.21	-.44	-.52	1.23	-.45	-.09	.63	.32	-.57
5	-1.25	.34	.02	.26	1.60	-.82	-.63	.78	.16	-.10
6	99.99	99.99	-.75	.47	.92	-.75	.14	.56	.22	-.71
7	99.99	99.99	99.99	.09	.42	-.18	.02	.16	-.38	-.10
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	4	5	6	7
Mean Log q	-6.6349	-6.7795	-6.4485	-6.2628
S.E(Log q)	.5736	.7786	.6304	.2560

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	.86	1.065	9.15	.87	12	.52	-8.34
2	.83	1.528	7.98	.90	12	.46	-7.07
3	.85	.935	7.37	.81	12	.72	-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
4	.95	.461	6.86	.90	12	.57	-6.63
5	.86	1.115	7.28	.88	12	.66	-6.78
6	1.08	-.356	6.19	.76	9	.72	-6.45
7	.87	1.347	6.63	.95	7	.21	-6.26

Table 4.12 (Cont'd)

Fleet : FLT24: Russian acous

Age	1984	1985
1	99.99	.95
2	99.99	1.09
3	99.99	.64
4	99.99	-.80
5	99.99	-.25
6	99.99	-1.85
7	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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.78	.74	-.77	.06	.66	-.13	-.02	-.89	-.80	-.01
2	.93	-.10	-1.30	1.61	.10	-.43	-.14	-.43	-.78	-.01
3	.47	-.02	-.05	-.88	.83	.06	-.21	-.31	-.35	.11
4	1.87	.04	.25	-.56	.28	-.29	-.49	.14	-.26	.02
5	-.57	.39	1.38	.09	.43	-.54	-.93	.33	-.27	-.03
6	-1.55	-2.80	1.64	.92	1.01	.05	.37	.73	.35	-.04
7	-1.11	99.99	99.99	.52	.80	.61	.40	.10	-2.04	.54
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	4	5	6	7
Mean Log q	-4.2922	-4.4614	-4.7860	-4.5973
S.E(Log q)	.6581	.6344	1.3128	1.0151

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	.75	1.379	7.94	.79	11	.70	-5.94
2	.95	.244	5.21	.72	11	.89	-4.81
3	.74	2.002	6.42	.88	11	.51	-4.54

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
4	.88	.917	5.12	.88	11	.58	-4.29
5	.85	1.521	5.39	.92	11	.50	-4.46
6	.60	2.741	6.61	.86	11	.60	-4.79
7	.60	2.659	6.28	.89	8	.44	-4.60

Table 4.12 (Cont'd)

Fleet : FLT29: Norwegian tra

Age	1984	1985
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	.85
9	99.99	1.84
10	99.99	-.37
11	99.99	.51
12	99.99	1.31
13	99.99	1.66

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	.74	-.07	-.36	.34	-.82	-.55	-.05	-.02	.50	-.18
9	1.50	1.22	-1.78	-1.92	-1.99	-.80	.89	.54	.82	.40
10	1.10	-.32	-.03	.67	99.99	-1.19	-.19	-.28	.64	.09
11	.28	.48	1.79	.24	99.99	99.99	-1.40	-.77	-.14	-.45
12	2.33	1.08	1.61	.76	-.21	.15	.30	.33	-.30	.02
13	.94	-.10	.60	-.99	-.55	.16	99.99	-.16	1.19	99.99

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	-1.9290	-2.5178	-1.7819	-2.0433	-2.0433	-2.0433
S.E(Log q)	.5100	1.4051	.6554	.9260	1.0205	.8873

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	1.13	-1.025	1.18	.88	11	.58	-1.93
9	.70	1.539	3.89	.77	11	.91	-2.52
10	.99	.090	1.85	.85	10	.69	-1.78
11	1.23	-.768	1.11	.65	9	1.17	-2.04
12	1.12	-.641	1.05	.77	11	.94	-1.45
13	1.27	-.574	1.40	.43	9	1.13	-1.79

Table 4.12 (Cont'd)

Fleet : FLT30: Norway bottom

Age	1984	1985
1	.54	.10
2	.52	-.25
3	.34	-.04
4	-.80	.71
5	-.65	.71
6	.44	-.53
7	-.83	-.47
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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.86	.24	-.76	.02	.69	-.02	-.16	-.07	-.51	-.47
2	.70	.61	-.79	-.12	.44	.30	-.67	-.06	-.22	-.13
3	.36	.39	-.09	-.82	.25	.32	-.30	-.18	-.18	.18
4	.10	.58	.22	-.45	-.32	-.17	-.61	-.26	.29	.69
5	-1.91	.72	.65	.43	-.18	-.38	-1.07	-.27	.49	1.17
6	2.76	-.79	.22	.53	-.34	-.32	-.39	-1.16	.17	.01
7	99.99	99.99	99.99	-.18	-.31	.15	.20	.46	.56	-.10
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	4	5	6	7
Mean Log q	-5.3790	-6.0931	-6.0751	-5.5274
S.E(Log q)	.4955	.8741	.9485	.4224

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	.61	2.976	8.56	.87	12	.51	-5.06
2	.68	2.581	7.51	.88	12	.51	-5.21
3	.97	.396	5.22	.94	12	.39	-4.99

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
4	.88	1.523	6.08	.95	12	.41	-5.38
5	.74	2.708	7.19	.93	12	.50	-6.09
6	1.12	-.479	5.70	.66	12	1.11	-6.08
7	1.02	-.106	5.47	.86	9	.46	-5.53

Table 4.12 (Cont'd)

Fleet : FLT31: Norway acoust

Age	1984	1985
1	.47	.17
2	.52	.28
3	.80	.45
4	-.63	-1.54
5	-.07	.37
6	.73	.86
7	.60	.85
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	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	.02	-.59	.02	-.25	.40	-.23	.22	.23	-.03	-.28
2	.31	-.42	.52	-.37	.26	-.21	-.22	.05	-.27	-.09
3	.23	-.37	-.06	-.38	.17	-.37	-.06	.11	-.19	.10
4	.48	-.03	.22	-.25	-.30	-.43	-.18	.62	.88	.48
5	-.64	-.08	.45	.31	-.19	-1.31	-1.41	.81	.91	.81
6	1.16	-.10	.14	.72	-.46	-1.50	-.61	-.46	.46	-.07
7	1.19	1.29	-.26	-.49	-.42	-1.25	-.36	-.61	.27	.13
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	4	5	6	7
Mean Log q	-5.8376	-6.2631	-6.3656	-5.7545
S.E(Log q)	.6285	.8256	.7604	.7722

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	.75	3.080	7.38	.95	12	.32	-5.15
2	.79	2.495	6.83	.94	12	.35	-5.35
3	.89	1.382	6.05	.95	12	.34	-5.37

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
4	.75	5.175	7.15	.98	12	.24	-5.84
5	.78	2.181	7.18	.92	12	.54	-6.26
6	1.14	-.697	5.96	.75	12	.89	-6.37
7	1.97	-4.100	3.28	.68	12	.93	-5.75

Table 4.12 (Cont'd)

Terminal year survivor and F summaries :

Age 1 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,	219082.,	.565,	.000,	.00,	1,	.091,	2.992
FLT24: Russian acous,	337680.,	.776,	.000,	.00,	1,	.048,	2.586
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	211604.,	.552,	.000,	.00,	1,	.095,	3.025
FLT31: Norway acoust,	257095.,	.348,	.000,	.00,	1,	.239,	2.840
P shrinkage mean ,	146847.,	1.63,,,,				.144,	3.375
F shrinkage mean ,	693695.,	1.00,,,,				.383,	1.942

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
339838.,	.46,	.30,	6,	.651,	2.580

Age 2 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,	45873.,	.430,	.033,	.08,	2,	.200,	1.793
FLT24: Russian acous,	73108.,	.749,	.329,	.44,	2,	.060,	1.421
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	73444.,	.464,	.134,	.29,	2,	.167,	1.417
FLT31: Norway acoust,	81338.,	.310,	.023,	.07,	2,	.368,	1.341
P shrinkage mean ,	81007.,	1.61,,,,				.057,	1.344
F shrinkage mean ,	364882.,	1.00,,,,				.148,	.488

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
88406.,	.24,	.23,	10,	.943,	1.280

Age 3 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,	33990.,	.405,	.152,	.37,	3,	.138,	.568
FLT24: Russian acous,	56907.,	.466,	.248,	.53,	3,	.134,	.376
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	64716.,	.323,	.121,	.37,	3,	.267,	.338
FLT31: Norway acoust,	58803.,	.255,	.129,	.51,	3,	.399,	.366
P shrinkage mean ,	52028.,	1.68,,,,				.016,	.405
F shrinkage mean ,	298299.,	1.00,,,,				.046,	.084

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
59869.,	.17,	.13,	14,	.774,	.361

Table 4.12 (Cont'd)

Age 4 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
FLT23: Russian botto,	129723.,	.331,	.167,	.51,	4,	.178,	.334
FLT24: Russian acous,	129527.,	.379,	.108,	.29,	4,	.149,	.334
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	183054.,	.271,	.227,	.84,	4,	.284,	.247
FLT31: Norway acoust,	165659.,	.231,	.137,	.59,	4,	.356,	.270
F shrinkage mean ,	376432.,	1.00,,,,				.032,	.128

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
161528.,	.14,	.09,	17,	.628,	.276

Age 5 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,	403504.,	.288,	.071,	.25,	5,	.190,	.228
FLT24: Russian acous,	290650.,	.319,	.058,	.18,	5,	.164,	.304
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	347616.,	.248,	.242,	.98,	5,	.260,	.260
FLT31: Norway acoust,	375544.,	.203,	.200,	.99,	5,	.362,	.243
F shrinkage mean ,	177581.,	1.00,,,,				.025,	.459

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
351167.,	.13,	.09,	21,	.683,	.258

Age 6 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,	48410.,	.265,	.224,	.85,	6,	.217,	.335
FLT24: Russian acous,	46231.,	.307,	.135,	.44,	6,	.152,	.348
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	51093.,	.238,	.164,	.69,	6,	.244,	.320
FLT31: Norway acoust,	56227.,	.194,	.154,	.79,	6,	.355,	.294
F shrinkage mean ,	19029.,	1.00,,,,				.031,	.699

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
49878.,	.12,	.09,	25,	.717,	.326

Age 7 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,	2652.,	.244,	.078,	.32,	7,	.422,	.792
FLT24: Russian acous,	3355.,	.388,	.136,	.35,	7,	.090,	.670
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	2638.,	.288,	.106,	.37,	7,	.248,	.795
FLT31: Norway acoust,	2933.,	.267,	.140,	.52,	7,	.176,	.738
F shrinkage mean ,	2671.,	1.00,,,,				.064,	.788

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2755.,	.15,	.05,	29,	.324,	.771

Table 4.12 (Cont'd)

Age 8 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,	190.,	.230,	.169,	.73,	7,	.278,	1.042
FLT24: Russian acous,	159.,	.347,	.473,	1.36,	7,	.071,	1.160
FLT29: Norwegian tra,	197.,	.535,	.000,	.00,	1,	.199,	1.019
FLT30: Norway bottom,	277.,	.264,	.223,	.84,	7,	.173,	.815
FLT31: Norway acoust,	202.,	.240,	.181,	.76,	7,	.138,	1.004
F shrinkage mean ,	560.,	1.00,,,,				.141,	.485

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
237.,	.20,	.12,	30,	.583,	.906

Age 9 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,	426.,	.227,	.172,	.76,	7,	.315,	.505
FLT24: Russian acous,	279.,	.359,	.219,	.61,	7,	.087,	.694
FLT29: Norwegian tra,	607.,	.516,	.038,	.07,	2,	.125,	.379
FLT30: Norway bottom,	343.,	.260,	.221,	.85,	7,	.205,	.596
FLT31: Norway acoust,	284.,	.246,	.215,	.87,	7,	.177,	.686
F shrinkage mean ,	342.,	1.00,,,,				.090,	.598

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
374.,	.15,	.09,	31,	.598,	.558

Age 10 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,	351.,	.224,	.199,	.89,	7,	.249,	.795
FLT24: Russian acous,	396.,	.343,	.155,	.45,	7,	.077,	.731
FLT29: Norwegian tra,	411.,	.466,	.136,	.29,	3,	.222,	.711
FLT30: Norway bottom,	383.,	.248,	.130,	.52,	7,	.171,	.748
FLT31: Norway acoust,	252.,	.242,	.176,	.73,	7,	.143,	.991
F shrinkage mean ,	491.,	1.00,,,,				.138,	.625

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
372.,	.19,	.07,	32,	.376,	.764

Age 11 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
FLT23: Russian botto,	654.,	.234,	.150,	.64,	7,	.232,	.391
FLT24: Russian acous,	901.,	.356,	.136,	.38,	7,	.071,	.298
FLT29: Norwegian tra,	712.,	.460,	.270,	.59,	4,	.272,	.364
FLT30: Norway bottom,	837.,	.262,	.084,	.32,	7,	.157,	.318
FLT31: Norway acoust,	485.,	.267,	.212,	.79,	7,	.122,	.498
F shrinkage mean ,	610.,	1.00,,,,				.146,	.414

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
679.,	.21,	.07,	33,	.348,	.380

Table 4.12 (Cont'd)

Age 12 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,	1716.,	.256,	.053,	.21,	7,	.241,	.174
FLT24: Russian acous,	2627.,	.461,	.195,	.42,	6,	.046,	.117
FLT29: Norwegian tra,	953.,	.421,	.152,	.36,	5,	.350,	.294
FLT30: Norway bottom,	1082.,	.323,	.158,	.49,	7,	.131,	.263
FLT31: Norway acoust,	1309.,	.332,	.175,	.53,	7,	.084,	.222
F shrinkage mean ,	695.,	1.00,,,,				.147,	.384

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1147.,	.22,	.08,	33,	.361,	.250

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 11

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	238.,	.280,	.105,	.37,	6,	.236,	.913
FLT24: Russian acous,	482.,	.613,	.254,	.41,	5,	.032,	.551
FLT29: Norwegian tra,	131.,	.369,	.143,	.39,	5,	.330,	1.310
FLT30: Norway bottom,	204.,	.376,	.090,	.24,	6,	.118,	1.009
FLT31: Norway acoust,	211.,	.436,	.191,	.44,	6,	.061,	.987
F shrinkage mean ,	455.,	1.00,,,,				.223,	.576

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
225.,	.27,	.11,	29,	.406,	.947

Table 4.12 (Cont'd)

Run title : Arctic Haddock (run: XSALOR12/X12)

At 28-Aug-96 20:20:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
AGE										
1	.0000	.0000	.0000	.0000	.0003	.0000	.0017	.0000	.0034	.0080
2	.0079	.0024	.0017	.0058	.0026	.0031	.0307	.0941	.0662	.0673
3	.1270	.0619	.0369	.1015	.1663	.0229	.2844	.3355	.2199	.2561
4	.3866	.3032	.4022	.1474	.2316	.2666	.3824	.6007	.3414	.5745
5	.5757	.4253	.5649	.5077	.2044	.1819	1.0680	.9526	.4193	.5171
6	.7177	.4945	.4643	.5551	.5093	.1462	.9650	.4685	.6384	.4446
7	.8034	.5020	.6415	.4101	.4781	.4188	.4099	.3005	.5790	.5105
8	.4908	.5559	.6437	.4259	.4132	.3395	.6184	.1775	.4963	.3370
9	.4133	.3452	.4586	.4135	.3017	.3032	.5533	.3021	.4258	.2096
10	.3489	.2915	.5453	.4182	.3280	.2573	.6334	.1986	.7421	.1481
11	.7987	.5454	.2708	.2348	.4068	.2757	.4147	.1935	.6501	.3989
12	.2750	.9422	1.0710	.1764	.2175	.6542	.8331	.2434	.6791	.1934
13	.4688	.5404	.6031	.3358	.3355	.3683	.6159	.2241	.6039	.2587
+gp	.4688	.5404	.6031	.3358	.3355	.3683	.6159	.2241	.6039	.2587
FBAR 4- 7	.6208	.4312	.5182	.4051	.3558	.2534	.7063	.5806	.4945	.5117

Table 8 Fishing mortality (F) at age

YEAR	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
AGE										
1	.0136	.0010	.0018	.0000	.0000	.0002	.0002	.0000	.8740	1.3616
2	.0571	.0927	.0135	.0023	.0000	.0076	.0055	.0157	.0530	.0126
3	.3189	.7673	.3627	.1546	.0371	.0990	.1296	.1773	.0669	.1321
4	.6497	1.2838	.6420	.5080	.3097	.2088	.2684	.4609	.3327	.1976
5	.6127	.9473	.8905	.9735	.6917	.5600	.4674	.4610	.3707	.3755
6	.7085	.4980	.4518	.9547	.8245	.9091	.7047	.3518	.2856	.6325
7	.8004	.6373	.6845	.5239	.4177	.7862	.5883	.4097	.3378	.5371
8	.6448	.5329	.4513	.5159	.7382	.5283	.6648	.4119	.5516	.5223
9	.7642	.3227	.6613	.4999	.4268	.5599	.5002	.1915	.4199	.7427
10	.9097	.5159	.2775	.5542	.6068	.2276	.6028	.4961	.4263	.7579
11	.5366	2.3157	.7949	.5736	.7106	.5101	.5017	.4561	.7551	.6231
12	1.5172	.3769	.4286	.6933	.8680	.7963	1.5516	.2029	2.0889	.3223
13	.8838	.8212	.5269	.5722	.6763	.5287	.7718	.3539	.8573	.2745
+gp	.8838	.8212	.5269	.5722	.6763	.5287	.7718	.3539	.8573	.2745
FBAR 4- 7	.6928	.8416	.6672	.7400	.5609	.6160	.5072	.4208	.3317	.4357

Table 8 Fishing mortality (F) at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	FBAR 93-95
AGE											
1	2.3690	3.5294	.4030	.9001	.3330	.2777	1.4483	2.0937	1.7369	2.5799	2.1369
2	1.2677	.0033	.0297	.0069	.3803	.0511	.1235	.3786	.5902	1.2802	.7497
3	.5083	.0518	.2994	.0730	.2432	.0547	.0570	.0631	.1036	.3607	.1758
4	.4444	.4684	.1616	.1852	.1092	.1560	.2469	.1695	.0856	.2763	.1771
5	.2672	.8794	.5486	.3452	.1252	.2566	.2913	.5897	.3208	.2580	.3895
6	.4833	.2439	1.0131	.5148	.1856	.2881	.3999	.6479	.7363	.3263	.5702
7	.7371	.5411	.2484	.4729	.2760	.3111	.3475	.4093	1.1505	.7711	.7770
8	.5039	.6410	.3220	.2519	.2028	.2932	.3048	.3828	.5797	.9058	.6228
9	.4940	.5296	.3743	.0818	.8009	.1375	.2979	.4373	.7486	.5583	.5814
10	.6858	.3779	.7075	.8447	.6408	.0844	.1154	.3731	.8660	.7638	.6676
11	.4666	.5712	1.1068	.4197	.1451	.0222	.0634	.2165	.6061	.3795	.4007
12	1.3446	.8304	1.2943	.4831	.1734	.5891	.1161	.4567	.3069	.2503	.3380
13	.3267	.5041	.5103	.5232	.3715	.1675	.1508	.4128	.8949	.9468	.7515
+gp	.3267	.5041	.5103	.5232	.3715	.1675	.1508	.4128	.8949	.9468	
FBAR 4- 7	.4830	.5332	.4929	.3795	.1740	.2529	.3214	.4541	.5733	.4079	

Table 4.12 (Cont'd)

Run title : Arctic Haddock (run: XSALOR12/X12)

At 28-Aug-96 20:20:02

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	29990,	26006,	248989,	144609,	1538796,	418733,	89020,	78246,	90647,	183812,
2,	361053,	24553,	21291,	203854,	118395,	1259425,	342816,	72763,	64061,	73961,
3,	242406,	293289,	20054,	17402,	165944,	96684,	1027931,	272196,	54222,	49089,
4,	77452,	174798,	225722,	15825,	12872,	115049,	77367,	633279,	159332,	35630,
5,	158375,	43081,	105676,	123609,	11180,	8360,	72153,	43214,	284338,	92718,
6,	62239,	72911,	23052,	49181,	60914,	7461,	5706,	20303,	13648,	153070,
7,	11430,	24861,	36408,	11863,	23114,	29970,	5278,	1780,	10404,	5902,
8,	1647,	4191,	12322,	15694,	6445,	11732,	16142,	2868,	1079,	4774,
9,	1420,	825,	1968,	5300,	8393,	3491,	6840,	7121,	1966,	538,
10,	705,	769,	479,	1019,	2870,	5081,	2111,	3221,	4310,	1052,
11,	374,	407,	470,	227,	549,	1692,	3217,	917,	2162,	1680,
12,	115,	138,	193,	294,	147,	299,	1052,	1740,	619,	924,
13,	24,	71,	44,	54,	202,	97,	127,	374,	1117,	257,
+gp,	20,	18,	46,	8,	73,	14,	100,	71,	345,	443,
TOTAL,	947250,	665920,	696715,	588937,	1949893,	1958088,	1649860,	1138094,	688250,	603850,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	285184,	204841,	28519,	8500,	12073,	7185,	14063,	415150,	1918222,	1779166,
2,	149297,	230344,	167543,	23308,	6959,	9884,	5881,	11512,	339896,	655322,
3,	56614,	115451,	171890,	135333,	19040,	5698,	8031,	4789,	9278,	263914,
4,	31109,	33694,	43883,	97923,	94931,	15021,	4225,	5776,	3284,	7105,
5,	16423,	13301,	7641,	18906,	48241,	57022,	9981,	2645,	2983,	1928,
6,	45263,	7286,	4223,	2568,	5847,	19776,	26667,	5120,	1366,	1686,
7,	80342,	18248,	3626,	2201,	809,	2099,	6523,	10791,	2949,	840,
8,	2900,	29545,	7899,	1497,	1067,	436,	783,	2966,	5865,	1722,
9,	2790,	1246,	14197,	4119,	732,	418,	211,	330,	1608,	2766,
10,	357,	1064,	739,	6000,	2045,	391,	195,	105,	223,	865,
11,	743,	118,	520,	458,	2822,	913,	255,	88,	52,	119,
12,	923,	356,	10,	192,	211,	1135,	449,	126,	45,	20,
13,	623,	166,	200,	5,	79,	73,	419,	78,	84,	5,
+gp,	85,	190,	174,	133,	33,	112,	69,	335,	350,	261,
TOTAL,	672653,	655849,	451063,	301144,	194890,	120162,	77752,	459810,	2286207,	2715720,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
1,	680814,	863959,	52703,	442478,	582357,	2140793,	3266023,	2291026,	2694558,	5477138,	0,	2113
2,	373284,	52160,	20741,	28838,	147277,	341741,	1327764,	628310,	231140,	388413,	339838,	1300
3,	529808,	86022,	42566,	16484,	23448,	82436,	265861,	960793,	352296,	104877,	88406,	957
4,	189339,	260919,	66874,	25833,	12546,	15053,	63902,	205604,	738560,	260047,	59869,	641
5,	4774,	99397,	133728,	46580,	17575,	9209,	10545,	40871,	142091,	555070,	161528,	359
6,	1084,	2992,	33775,	63258,	27003,	12697,	5834,	6452,	18554,	84407,	351167,	172
7,	733,	547,	1919,	10040,	30951,	18364,	7793,	3202,	2763,	7274,	49878,	82
8,	402,	287,	261,	1226,	5123,	19229,	11016,	4507,	1741,	716,	2755,	39
9,	836,	199,	124,	155,	780,	3424,	11742,	6649,	2517,	798,	237,	18
10,	1078,	418,	96,	70,	117,	287,	2443,	7137,	3516,	975,	374,	8
11,	332,	444,	234,	39,	25,	50,	216,	1782,	4024,	1211,	372,	4
12,	52,	170,	206,	63,	21,	17,	40,	166,	1175,	1797,	679,	1
13,	12,	11,	61,	46,	32,	14,	8,	29,	86,	708,	1147,	
+gp,	28,	53,	30,	40,	53,	50,	8,	19,	4,	4,	226,	
TOTAL,	1782576,	1367578,	353318,	635150,	847307,	2643365,	4973194,	4156547,	4193024,	6883432,	1056476,	

Table 4.13

Run title : Arctic Haddock (run: XSALOR12/X12)

At 29-Aug-96 17:15:39

Table 4 Natural Mortality (M) at age

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
1,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
1,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
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 4.13 (Cont'd)

Run title : Arctic Haddock (run: XSALOR14/X14)

At 29-Aug-96 17:15:39

Table 4 Natural Mortality (M) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
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,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	1.0740,	1.5616,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2522,	.2087,
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2107,	.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,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
1,	2.5686,	3.7294,	.6030,	1.1001,	.5330,	.4777,	1.6475,	2.2936,	1.9369,	2.7799,
2,	1.4641,	.2000,	.2273,	.2000,	.5776,	.2500,	.3211,	.5776,	.7878,	1.4793,
3,	.6402,	.2000,	.4755,	.2000,	.4157,	.2000,	.2042,	.2472,	.2930,	.5441,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2229,	.2139,	.4108,
5,	.2000,	.2000,	.2024,	.2000,	.2000,	.2000,	.2000,	.3189,	.2094,	.2897,
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 4.13 (Cont'd)

Run title : Arctic Haddock (run: XSALOR14/X14)

At 29-Aug-96 17:15:39

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
1,	1,	4069,	1,	392,	1726,	1,
2,	4446,	222,	13673,	8031,	493,	989,
3,	3190,	65644,	6012,	64527,	6563,	1154,
4,	37949,	9178,	151996,	13014,	154695,	10689,
5,	35344,	18014,	13634,	70780,	5884,	176678,
6,	18849,	13551,	9851,	5431,	27590,	4994,
7,	27869,	6808,	4693,	2866,	3233,	28278,
8,	9199,	6849,	3237,	1079,	1302,	1445,
9,	1980,	3321,	2434,	424,	711,	272,
10,	1093,	1182,	606,	315,	319,	100,
11,	853,	734,	534,	393,	126,	50,
12,	868,	177,	185,	202,	69,	30,
13,	712,	81,	138,	121,	51,	15,
+gp,	258,	82,	1,	176,	34,	5,
TOTALNUM,	142611,	129912,	206995,	167751,	202796,	224700,
TONSLAND,	131733,	120057,	127660,	123447,	156448,	202745,
SOPCOF %,	45,	65,	51,	57,	60,	47,

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

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
1,	97,	828,	153,	169,	2319,	362,	1,	3,	149,	1,
2,	3012,	243,	2312,	2425,	3632,	5531,	4536,	2151,	831,	3483,
3,	16436,	2074,	1727,	20317,	40117,	15430,	39604,	28567,	22305,	5911,
4,	5922,	24704,	5913,	7826,	71280,	56859,	30947,	72995,	49162,	46161,
5,	14714,	7942,	31437,	7244,	13717,	63354,	49028,	19035,	30592,	40032,
6,	127879,	12535,	5821,	14039,	7138,	8706,	33922,	13627,	5800,	12578,
7,	3182,	46619,	12748,	3153,	6267,	3578,	3209,	9290,	3519,	1672,
8,	8003,	1087,	17565,	2237,	1587,	4407,	1344,	1243,	2709,	970,
9,	450,	1970,	822,	5918,	2352,	787,	1778,	561,	832,	893,
10,	200,	356,	1072,	285,	2015,	527,	243,	409,	104,	122,
11,	80,	17,	226,	316,	497,	1287,	247,	79,	206,	204,
12,	60,	1,	79,	70,	70,	67,	482,	84,	234,	123,
13,	30,	33,	89,	4,	30,	60,	20,	169,	121,	14,
+gp,	15,	36,	18,	23,	12,	20,	8,	41,	67,	205,
TOTALNUM,	180080,	98445,	79982,	64026,	151033,	160975,	165369,	148254,	116631,	112369,
TONSLAND,	213279,	122705,	112672,	88179,	155454,	193234,	187888,	146744,	98900,	118079,
SOPCOF %,	55,	56,	62,	80,	84,	80,	74,	74,	62,	70,

Table 4.13 (Cont'd)

Run title : Arctic Haddock (run:

At 29-Aug-96 17:15:39

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	1,	1,	1,	1,	480,	15,	133,	1,	281,	1321,
2,	2559,	53,	33,	1058,	276,	3535,	9369,	5915,	3713,	4355,
3,	26157,	15918,	657,	1520,	23004,	1979,	230229,	70204,	9684,	10037,
4,	22469,	41373,	67632,	1963,	2408,	24359,	22246,	258773,	41701,	14089,
5,	62724,	13505,	41267,	44526,	1870,	1258,	42849,	24018,	88111,	33871,
6,	28840,	25736,	7748,	18956,	21995,	918,	3196,	6872,	5827,	49712,
7,	5711,	8878,	15599,	3611,	7948,	9279,	1606,	418,	4138,	2135,
8,	578,	1617,	5292,	4925,	1974,	3056,	6736,	422,	382,	1236,
9,	435,	218,	655,	1624,	1978,	826,	2630,	1680,	617,	92,
10,	188,	176,	182,	315,	726,	1043,	896,	525,	2043,	131,
11,	186,	155,	101,	43,	166,	369,	988,	146,	935,	500,
12,	25,	76,	115,	43,	26,	130,	538,	340,	276,	147,
13,	8,	27,	18,	14,	52,	27,	53,	68,	458,	53,
+gp,	7,	7,	19,	2,	19,	4,	42,	13,	143,	92,
TOTALNUM,	149888,	107740,	139319,	78601,	62922,	46798,	321511,	369395,	158309,	117771,
TONSLAND,	160621,	136486,	181726,	130509,	86601,	78302,	265317,	320065,	221138,	175742,
SOPCOF %,	66,	79,	79,	80,	75,	100,	86,	83,	86,	81,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	3475,	184,	46,	0,	0,	1,	2,	0,	0,	1,
2,	7496,	18456,	2033,	48,	0,	68,	29,	162,	252,	2288,
3,	13989,	55967,	47311,	17540,	627,	486,	883,	704,	456,	29548,
4,	13449,	22043,	18812,	35290,	22878,	2561,	900,	1930,	841,	1153,
5,	6808,	7368,	4076,	10645,	21794,	22124,	3372,	884,	836,	546,
6,	20789,	2586,	1389,	1429,	2971,	10685,	12203,	1374,	307,	715,
7,	40044,	7781,	1626,	812,	250,	1034,	2625,	3282,	765,	316,
8,	1247,	11043,	2596,	546,	504,	162,	344,	906,	2250,	634,
9,	1349,	311,	6215,	1466,	230,	162,	75,	52,	499,	1312,
10,	193,	388,	162,	2310,	842,	72,	80,	37,	70,	416,
11,	279,	96,	258,	181,	1299,	330,	91,	29,	25,	50,
12,	652,	101,	3,	87,	111,	564,	320,	21,	36,	5,
13,	331,	84,	74,	2,	35,	27,	204,	21,	44,	1,
+gp,	46,	98,	65,	53,	15,	42,	34,	91,	185,	57,
TOTALNUM,	110147,	126506,	84666,	70409,	51556,	38318,	21162,	9493,	6566,	37042,
TONSLAND,	137279,	110158,	95422,	103623,	87889,	77153,	46955,	21607,	17661,	41270,
SOPCOF %,	63,	77,	95,	112,	103,	98,	93,	91,	91,	97,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
1,	96,	8,	0,	0,	6,	21,	1258,	117,	11,	29,
2,	690,	154,	46,	180,	294,	329,	2668,	455,	388,	187,
3,	25596,	3928,	794,	1050,	518,	3968,	12342,	13398,	3201,	1326,
4,	61470,	88297,	9031,	3951,	1174,	1967,	12652,	25092,	45937,	13474,
5,	1013,	52611,	50868,	12305,	1871,	1886,	2411,	13154,	34253,	74497,
6,	376,	586,	19465,	23032,	4138,	2876,	1740,	2784,	8749,	21264,
7,	346,	207,	382,	3423,	6754,	4442,	2070,	973,	1709,	3538,
8,	144,	123,	65,	247,	851,	4422,	2619,	1297,	693,	386,
9,	295,	74,	35,	11,	389,	398,	2737,	2131,	1200,	309,
10,	484,	119,	44,	36,	50,	21,	241,	2011,	1843,	471,
11,	112,	175,	142,	12,	3,	1,	12,	314,	1655,	346,
12,	35,	87,	135,	22,	3,	7,	4,	55,	281,	360,
13,	3,	4,	22,	17,	9,	2,	1,	9,	46,	392,
+gp,	7,	19,	11,	15,	15,	7,	1,	6,	2,	2,
TOTALNUM,	90667,	146392,	81040,	44301,	16075,	20347,	40756,	61796,	99968,	116581,
TONSLAND,	96585,	150659,	91744,	55122,	25816,	33605,	53886,	77355,	121365,	138323,
SOPCOF %,	90,	98,	99,	96,	96,	96,	100,	101,	100,	100,

Table 4.14

Run title : Arctic Haddock (run: XSALOR12/X12)

At 28-Aug-96 20:20:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
1,	.0000,	.0029,	.0000,	.0054,	.0074,	.0000,
2,	.0072,	.0032,	.0118,	.0571,	.0084,	.0052,
3,	.0540,	.1391,	.1117,	.0710,	.0604,	.0245,
4,	.5944,	.2170,	.5481,	.3746,	.2425,	.1322,
5,	.8100,	.6363,	.5794,	.5365,	.2889,	.4826,
6,	.7984,	.8779,	.9018,	.4812,	.4126,	.4266,
7,	1.1370,	.7746,	.9030,	.7344,	.5966,	1.0197,
8,	.9332,	1.0095,	1.1372,	.5310,	.9203,	.5896,
9,	.5318,	1.1402,	1.4150,	.4138,	.8298,	.4866,
10,	.5263,	.7172,	.6427,	.6785,	.6367,	.2511,
11,	.9286,	.8395,	.8644,	1.2524,	.6430,	.1868,
12,	1.7946,	.4910,	.5190,	1.0068,	.7675,	.3043,
13,	.9534,	.8483,	.9257,	.7843,	.7670,	.3661,
+gp,	.9534,	.8483,	.9257,	.7843,	.7670,	.3661,
FBAR 4- 7,	.8350,	.6265,	.7331,	.5317,	.3851,	.5153,

Table 8 Fishing mortality (F) at age

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
1,	.0010,	.0019,	.0005,	.0011,	.0069,	.0010,	.0000,	.0000,	.0004,	.0000,
2,	.0494,	.0031,	.0063,	.0089,	.0293,	.0203,	.0147,	.0060,	.0074,	.0129,
3,	.1125,	.0436,	.0278,	.0708,	.1990,	.1677,	.1981,	.1209,	.0793,	.0668,
4,	.1687,	.2466,	.1685,	.1694,	.3774,	.4801,	.5926,	.6799,	.3147,	.2341,
5,	.2714,	.3580,	.5704,	.3210,	.5029,	.6885,	1.0468,	.9354,	.6899,	.4587,
6,	.7947,	.3922,	.4867,	.5437,	.6081,	.7064,	1.0438,	.9877,	.8586,	.6910,
7,	.5346,	.7776,	.9076,	.5358,	.5007,	.7183,	.6202,	.9557,	.7582,	.6516,
8,	.9485,	.3494,	.7793,	.3810,	.5723,	.8167,	.6581,	.5218,	.8442,	.4812,
9,	.3646,	.6455,	.4881,	.6647,	.9053,	.6307,	.9740,	.6438,	.8212,	.7633,
10,	.8277,	.5535,	.9233,	.3099,	.4984,	.5159,	.4026,	.6221,	.2289,	.2588,
11,	.3271,	.1436,	.8517,	.7904,	1.4864,	.7014,	.4885,	.2192,	.7566,	.9579,
12,	.3583,	.0059,	2.0894,	.7099,	.3943,	.8285,	.6254,	.3033,	2.1785,	1.7424,
13,	.5700,	.3417,	1.0382,	.5760,	.7791,	.7053,	.6354,	.4655,	.9767,	.8495,
+gp,	.5700,	.3417,	1.0382,	.5760,	.7791,	.7053,	.6354,	.4655,	.9767,	.8495,
FBAR 4- 7,	.4423,	.4436,	.5333,	.3925,	.4972,	.6483,	.8259,	.8897,	.6554,	.5088,

Table 4.14 (Cont'd)

Run title : Arctic Haddock (run: XSALOR12/X12)

At 28-Aug-96 20:20:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0003,	.0000,	.0017,	.0000,	.0034,	.0080,
2,	.0079,	.0024,	.0017,	.0058,	.0026,	.0031,	.0307,	.0941,	.0662,	.0673,
3,	.1270,	.0619,	.0369,	.1015,	.1663,	.0229,	.2844,	.3355,	.2199,	.2561,
4,	.3866,	.3032,	.4022,	.1474,	.2316,	.2666,	.3824,	.6007,	.3414,	.5745,
5,	.5757,	.4253,	.5649,	.5077,	.2044,	.1819,	1.0680,	.9526,	.4193,	.5171,
6,	.7177,	.4945,	.4643,	.5551,	.5093,	.1462,	.9650,	.4685,	.6384,	.4446,
7,	.8034,	.5020,	.6415,	.4101,	.4781,	.4188,	.4099,	.3005,	.5790,	.5105,
8,	.4908,	.5559,	.6437,	.4259,	.4132,	.3395,	.6184,	.1775,	.4963,	.3370,
9,	.4133,	.3452,	.4586,	.4135,	.3017,	.3032,	.5533,	.3021,	.4258,	.2096,
10,	.3489,	.2915,	.5453,	.4182,	.3280,	.2573,	.6334,	.1986,	.7421,	.1481,
11,	.7987,	.5454,	.2708,	.2348,	.4068,	.2757,	.4147,	.1935,	.6501,	.3989,
12,	.2750,	.9422,	1.0710,	.1764,	.2175,	.6542,	.8331,	.2434,	.6791,	.1934,
13,	.4688,	.5404,	.6031,	.3358,	.3355,	.3683,	.6159,	.2241,	.6039,	.2587,
+gp,	.4688,	.5404,	.6031,	.3358,	.3355,	.3683,	.6159,	.2241,	.6039,	.2587,
FBAR 4- 7,	.6208,	.4312,	.5182,	.4051,	.3558,	.2534,	.7063,	.5806,	.4945,	.5117,

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	.0136,	.0010,	.0018,	.0000,	.0000,	.0002,	.0002,	.0000,	.8740,	1.3616,
2,	.0571,	.0927,	.0135,	.0023,	.0000,	.0076,	.0055,	.0157,	.0530,	.0126,
3,	.3189,	.7673,	.3627,	.1546,	.0371,	.0990,	.1296,	.1773,	.0669,	.1321,
4,	.6497,	1.2838,	.6420,	.5080,	.3097,	.2088,	.2684,	.4609,	.3327,	.1976,
5,	.6127,	.9473,	.8905,	.9735,	.6917,	.5600,	.4674,	.4610,	.3707,	.3755,
6,	.7085,	.4980,	.4518,	.9547,	.8245,	.9091,	.7047,	.3518,	.2856,	.6325,
7,	.8004,	.6373,	.6845,	.5239,	.4177,	.7862,	.5883,	.4097,	.3378,	.5371,
8,	.6448,	.5329,	.4513,	.5159,	.7382,	.5283,	.6648,	.4119,	.5516,	.5223,
9,	.7642,	.3227,	.6613,	.4999,	.4268,	.5599,	.5002,	.1915,	.4199,	.7427,
10,	.9097,	.5159,	.2775,	.5542,	.6068,	.2276,	.6028,	.4961,	.4263,	.7579,
11,	.5366,	2.3157,	.7949,	.5736,	.7106,	.5101,	.5017,	.4561,	.7551,	.6231,
12,	1.5172,	.3769,	.4286,	.6933,	.8680,	.7963,	1.5516,	.2029,	2.0889,	.3223,
13,	.8838,	.8212,	.5269,	.5722,	.6763,	.5287,	.7718,	.3539,	.8573,	.2745,
+gp,	.8838,	.8212,	.5269,	.5722,	.6763,	.5287,	.7718,	.3539,	.8573,	.2745,
FBAR 4- 7,	.6928,	.8416,	.6672,	.7400,	.5609,	.6160,	.5072,	.4208,	.3317,	.4357,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
1,	2.3690,	3.5294,	.4030,	.9001,	.3330,	.2777,	1.4483,	2.0937,	1.7369,	2.5799,	2.1369,
2,	1.2677,	.0033,	.0297,	.0069,	.3803,	.0511,	.1235,	.3786,	.5902,	1.2802,	.7497,
3,	.5083,	.0518,	.2994,	.0730,	.2432,	.0547,	.0570,	.0631,	.1036,	.3607,	.1758,
4,	.4444,	.4684,	.1616,	.1852,	.1092,	.1560,	.2469,	.1695,	.0856,	.2763,	.1771,
5,	.2672,	.8794,	.5486,	.3452,	.1252,	.2566,	.2913,	.5897,	.3208,	.2580,	.3895,
6,	.4833,	.2439,	1.0131,	.5148,	.1856,	.2881,	.3999,	.6479,	.7363,	.3263,	.5702,
7,	.7371,	.5411,	.2484,	.4729,	.2760,	.3111,	.3475,	.4093,	1.1505,	.7711,	.7770,
8,	.5039,	.6410,	.3220,	.2519,	.2028,	.2932,	.3048,	.3828,	.5797,	.9058,	.6228,
9,	.4940,	.5296,	.3743,	.0818,	.8009,	.1375,	.2979,	.4373,	.7486,	.5583,	.5814,
10,	.6858,	.3779,	.7075,	.8447,	.6408,	.0844,	.1154,	.3731,	.8660,	.7638,	.6676,
11,	.4666,	.5712,	1.1068,	.4197,	.1451,	.0222,	.0634,	.2165,	.6061,	.3795,	.4007,
12,	1.3446,	.8304,	1.2943,	.4831,	.1734,	.5891,	.1161,	.4567,	.3069,	.2503,	.3380,
13,	.3267,	.5041,	.5103,	.5232,	.3715,	.1675,	.1508,	.4128,	.8949,	.9468,	.7515,
+gp,	.3267,	.5041,	.5103,	.5232,	.3715,	.1675,	.1508,	.4128,	.8949,	.9468,	
FBAR 4- 7,	.4830,	.5332,	.4929,	.3795,	.1740,	.2529,	.3214,	.4541,	.5733,	.4079,	

Table 4.15

Run title : Arctic Haddock (run: XSALOR12/X12)

At 28-Aug-96 20:20:02

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
1,	94092,	1576082,	195454,	79840,	257970,	84276,
2,	687398,	77035,	1286705,	160024,	65012,	209646,
3,	67027,	558771,	62870,	1041093,	123750,	52782,
4,	93593,	51991,	398086,	46034,	793989,	95379,
5,	70365,	42289,	34262,	188393,	25914,	510089,
6,	37878,	25629,	18324,	15715,	90199,	15892,
7,	45346,	13957,	8722,	6089,	7952,	48884,
8,	16757,	11909,	5267,	2895,	2392,	3585,
9,	5305,	5396,	3553,	1383,	1394,	780,
10,	2952,	2552,	1413,	707,	749,	498,
11,	1558,	1428,	1020,	608,	294,	324,
12,	1150,	504,	505,	352,	142,	126,
13,	1280,	157,	253,	246,	105,	54,
+gp,	456,	156,	2,	353,	69,	18,
TOTAL,	1125158,	2367855,	2016434,	1543730,	1369930,	1022334,

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

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
1,	104412,	494191,	369905,	169905,	373300,	420268,	485106,	151997,	366494,	440992,
2,	68999,	85397,	403860,	302714,	138954,	303533,	343759,	397170,	124442,	299925,
3,	170749,	53766,	69697,	328561,	245647,	110479,	243507,	277341,	323229,	101132,
4,	42170,	124925,	42143,	55501,	250619,	164820,	76491,	163532,	201219,	244455,
5,	68418,	29167,	79927,	29154,	38359,	140693,	83495,	34624,	67840,	120261,
6,	257761,	42702,	16694,	36993,	17314,	18994,	57864,	23997,	11124,	27862,
7,	8493,	95327,	23619,	8401,	17585,	7717,	7673,	16682,	7317,	3859,
8,	14436,	4074,	35864,	7803,	4025,	8726,	3081,	3379,	5252,	2807,
9,	1628,	4578,	2352,	13470,	4364,	1859,	3157,	1306,	1642,	1849,
10,	393,	926,	1965,	1182,	5673,	1445,	810,	976,	562,	591,
11,	317,	140,	436,	639,	710,	2822,	706,	444,	429,	366,
12,	220,	187,	100,	152,	237,	131,	1146,	355,	292,	165,
13,	76,	126,	152,	10,	61,	131,	47,	502,	214,	27,
+gp,	38,	136,	30,	57,	24,	43,	19,	121,	117,	390,
TOTAL,	738107,	935643,	1046746,	954543,	1096872,	1181662,	1306861,	1072424,	1110172,	1244681,

Table 4.15 (Cont'd)

Run title : Arctic Haddock (run: XSALOR12/X12)

At 28-Aug-96 20:20:02

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
1,	29990,	26006,	248989,	144609,	1538796,	418733,	89020,	78246,	90647,	183812,
2,	361053,	24553,	21291,	203854,	118395,	1259425,	342816,	72763,	64061,	73961,
3,	242406,	293289,	20054,	17402,	165944,	96684,	1027931,	272196,	54222,	49089,
4,	77452,	174798,	225722,	15825,	12872,	115049,	77367,	633279,	159332,	35630,
5,	158375,	43081,	105676,	123609,	11180,	8360,	72153,	43214,	284338,	92718,
6,	62239,	72911,	23052,	49181,	60914,	7461,	5706,	20303,	13648,	153070,
7,	11430,	24861,	36408,	11863,	23114,	29970,	5278,	1780,	10404,	5902,
8,	1647,	4191,	12322,	15694,	6445,	11732,	16142,	2868,	1079,	4774,
9,	1420,	825,	1968,	5300,	8393,	3491,	6840,	7121,	1966,	538,
10,	705,	769,	479,	1019,	2870,	5081,	2111,	3221,	4310,	1052,
11,	374,	407,	470,	227,	549,	1692,	3217,	917,	2162,	1680,
12,	115,	138,	193,	294,	147,	299,	1052,	1740,	619,	924,
13,	24,	71,	44,	54,	202,	97,	127,	374,	1117,	257,
+gp,	20,	18,	46,	8,	73,	14,	100,	71,	345,	443,
TOTAL,	947250,	665920,	696715,	588937,	1949893,	1958088,	1649860,	1138094,	688250,	603850,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
1,	285184,	204841,	28519,	8500,	12073,	7185,	14063,	415150,	1918222,	1779166,
2,	149297,	230344,	167543,	23308,	6959,	9884,	5881,	11512,	339896,	655322,
3,	56614,	115451,	171890,	135333,	19040,	5698,	8031,	4789,	9278,	263914,
4,	31109,	33694,	43883,	97923,	94931,	15021,	4225,	5776,	3284,	7105,
5,	16423,	13301,	7641,	18906,	48241,	57022,	9981,	2645,	2983,	1928,
6,	45263,	7286,	4223,	2568,	5847,	19776,	26667,	5120,	1366,	1686,
7,	80342,	18248,	3626,	2201,	809,	2099,	6523,	10791,	2949,	840,
8,	2900,	29545,	7899,	1497,	1067,	436,	783,	2966,	5865,	1722,
9,	2790,	1246,	14197,	4119,	732,	418,	211,	330,	1608,	2766,
10,	357,	1064,	739,	6000,	2045,	391,	195,	105,	223,	865,
11,	743,	118,	520,	458,	2822,	913,	255,	88,	52,	119,
12,	923,	356,	10,	192,	211,	1135,	449,	126,	45,	20,
13,	623,	166,	200,	5,	79,	73,	419,	78,	84,	5,
+gp,	85,	190,	174,	133,	33,	112,	69,	335,	350,	261,
TOTAL,	672653,	655849,	451063,	301144,	194890,	120162,	77752,	459810,	2286207,	2715720,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
1,	680814,	863959,	52703,	442478,	582357,	2140793,	3266023,	2291026,	2694558,	5477138,	0,	2113
2,	373284,	52160,	20741,	28838,	147277,	341741,	1327764,	628310,	231140,	388413,	339838,	1300
3,	529808,	86022,	42566,	16484,	23448,	82436,	265861,	960793,	352296,	104877,	88406,	957
4,	189339,	260919,	66874,	25833,	12546,	15053,	63902,	205604,	738560,	260047,	59869,	641
5,	4774,	99397,	133728,	46580,	17575,	9209,	10545,	40871,	142091,	555070,	161528,	359
6,	1084,	2992,	33775,	63258,	27003,	12697,	5834,	6452,	18554,	84407,	351167,	172
7,	733,	547,	1919,	10040,	30951,	18364,	7793,	3202,	2763,	7274,	49878,	82
8,	402,	287,	261,	1226,	5123,	19229,	11016,	4507,	1741,	716,	2755,	39
9,	836,	199,	124,	155,	780,	3424,	11742,	6649,	2517,	798,	237,	18
10,	1078,	418,	96,	70,	117,	287,	2443,	7137,	3516,	975,	374,	8
11,	332,	444,	234,	39,	25,	50,	216,	1782,	4024,	1211,	372,	4
12,	52,	170,	206,	63,	21,	17,	40,	166,	1175,	1797,	679,	1
13,	12,	11,	61,	46,	32,	14,	8,	29,	86,	708,	1147,	
+gp,	28,	53,	30,	40,	53,	50,	8,	19,	4,	4,	226,	
TOTAL,	1782576,	1367578,	353318,	635150,	847307,	2643365,	4973194,	4156547,	4193024,	6883432,	1056476,	

Table 4.16

Run title : Arctic Haddock (run: XSALOR12/X12)

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Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 7,
1950,	94092,	604125,	312274,	131733,	.4219,	.8350,
1951,	1576082,	683321,	171120,	120057,	.7016,	.6265,
1952,	195454,	629095,	127009,	127660,	1.0051,	.7331,
1953,	79840,	1154731,	143042,	123447,	.8630,	.5317,
1954,	257970,	1203578,	205484,	156448,	.7614,	.3851,
1955,	84276,	1243929,	377916,	202745,	.5365,	.5153,
1956,	104411,	976237,	435772,	213279,	.4894,	.4423,
1957,	494191,	629257,	350576,	122705,	.3500,	.4436,
1958,	369905,	480948,	254378,	112672,	.4429,	.5333,
1959,	169905,	524311,	168188,	88179,	.5243,	.3925,
1960,	373299,	641069,	155170,	155454,	1.0018,	.4972,
1961,	420268,	621541,	168956,	193234,	1.1437,	.6483,
1962,	485106,	586119,	167911,	187888,	1.1190,	.8259,
1963,	151997,	548121,	124544,	146744,	1.1782,	.8897,
1964,	366494,	622253,	103221,	98900,	.9581,	.6554,
1965,	440992,	636342,	131962,	118079,	.8948,	.5088,
1966,	29990,	721050,	193334,	160621,	.8308,	.6208,
1967,	26006,	719560,	205200,	136486,	.6651,	.4312,
1968,	248989,	648831,	229971,	181726,	.7902,	.5182,
1969,	144609,	480041,	222571,	130509,	.5864,	.4051,
1970,	1538795,	425070,	211041,	86601,	.4104,	.3558,
1971,	418733,	387116,	179794,	78302,	.4355,	.2534,
1972,	89020,	1030478,	167622,	265317,	1.5828,	.7063,
1973,	78246,	1032739,	150351,	320065,	2.1288,	.5806,
1974,	90647,	827816,	225311,	221138,	.9815,	.4945,
1975,	183812,	659484,	290860,	175742,	.6042,	.5117,
1976,	285184,	473354,	304515,	137279,	.4508,	.6928,
1977,	204841,	317695,	173815,	110158,	.6338,	.8416,
1978,	28519,	280574,	107162,	95422,	.8904,	.6672,
1979,	8500,	287976,	73053,	103623,	1.4185,	.7400,
1980,	12073,	245713,	66877,	87889,	1.3142,	.5609,
1981,	7185,	193062,	126031,	77153,	.6122,	.6160,
1982,	14063,	121926,	105131,	46955,	.4466,	.5072,
1983,	415150,	73026,	68617,	21607,	.3149,	.4208,
1984,	1918222,	57003,	41013,	17661,	.4306,	.3317,
1985,	1779165,	154371,	34151,	41270,	1.2085,	.4357,
1986,	680814,	326654,	53198,	96585,	1.8156,	.4830,
1987,	863958,	254113,	33331,	150659,	4.5201,	.5332,
1988,	52703,	168531,	54870,	91744,	1.6720,	.4929,
1989,	442477,	153866,	68989,	55122,	.7990,	.3795,
1990,	582357,	173594,	72223,	25816,	.3574,	.1740,
1991,	2140794,	273104,	87300,	33605,	.3849,	.2529,
1992,	3266021,	598782,	100723,	53886,	.5350,	.3214,
1993,	2291027,	752472,	149741,	77355,	.5166,	.4541,
1994,	2694558,	806317,	83933,	121365,	1.4460,	.5733,
1995,	5477136,	914253,	158727,	138323,	.8715,	.4079,
Arith. Mean,	688650,	550947,	161673,	122591,	.9140,	.5267,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 4.17

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
3,	.0544,	.1401,	.1123,	.0715,	.0608,	.0246,
4,	.5956,	.2181,	.5490,	.3752,	.2440,	.1331,
5,	.8103,	.6381,	.5792,	.5381,	.2900,	.4843,
6,	.7987,	.8772,	.9010,	.4819,	.4156,	.4277,
7,	1.1364,	.7757,	.9008,	.7359,	.5966,	1.0182,
8,	.9343,	1.0114,	1.1298,	.5326,	.9201,	.5896,
9,	.5336,	1.1372,	1.4057,	.4141,	.8286,	.4908,
10,	.5279,	.7186,	.6458,	.6776,	.6343,	.2532,
11,	.9269,	.8381,	.8649,	1.2449,	.6419,	.1873,
12,	1.7829,	.4937,	.5208,	1.0044,	.7641,	.3055,
13,	.9534,	.8483,	.9257,	.7843,	.7670,	.3661,
+gp,	.9534,	.8483,	.9257,	.7843,	.7670,	.3661,
FBAR 4- 7,	.8353,	.6273,	.7325,	.5328,	.3865,	.5158,

Table 8 Fishing mortality (F) at age

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
3,	.1132,	.0439,	.0280,	.0715,	.2008,	.1691,	.1996,	.1216,	.0798,	.0672,
4,	.1696,	.2479,	.1695,	.1705,	.3797,	.4831,	.5945,	.6799,	.3158,	.2351,
5,	.2729,	.3592,	.5709,	.3225,	.5040,	.6908,	1.0447,	.9334,	.6898,	.4597,
6,	.7943,	.3943,	.4879,	.5449,	.6087,	.7058,	1.0422,	.9837,	.8556,	.6908,
7,	.5355,	.7769,	.9052,	.5374,	.5030,	.7178,	.6205,	.9540,	.7551,	.6499,
8,	.9465,	.3516,	.7779,	.3831,	.5747,	.8178,	.6580,	.5234,	.8427,	.4803,
9,	.3663,	.6469,	.4915,	.6640,	.9025,	.6348,	.9730,	.6438,	.8199,	.7619,
10,	.8344,	.5553,	.9212,	.3141,	.4992,	.5169,	.4089,	.6255,	.2307,	.2609,
11,	.3302,	.1472,	.8507,	.7888,	1.4776,	.7000,	.4904,	.2246,	.7626,	.9531,
12,	.3582,	.0060,	2.0698,	.7105,	.3960,	.8268,	.6242,	.3062,	2.1614,	1.7264,
13,	.5700,	.3417,	1.0382,	.5760,	.7791,	.7053,	.6354,	.4655,	.9767,	.8495,
+gp,	.5700,	.3417,	1.0382,	.5760,	.7791,	.7053,	.6354,	.4655,	.9767,	.8495,
FBAR 4- 7,	.4431,	.4446,	.5334,	.3938,	.4988,	.6494,	.8255,	.8877,	.6541,	.5089,

Table 4.17 (Cont'd)

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	.1277,	.0623,	.0370,	.1024,	.1677,	.0231,	.2856,	.3364,	.2210,	.2579,
4,	.3868,	.3043,	.4029,	.1479,	.2334,	.2689,	.3846,	.6004,	.3427,	.5745,
5,	.5752,	.4254,	.5646,	.5080,	.2049,	.1838,	1.0626,	.9490,	.4204,	.5180,
6,	.7160,	.4946,	.4642,	.5547,	.5098,	.1467,	.9627,	.4693,	.6377,	.4462,
7,	.8008,	.5022,	.6397,	.4103,	.4783,	.4202,	.4098,	.3029,	.5792,	.5109,
8,	.4902,	.5554,	.6421,	.4258,	.4135,	.3407,	.6192,	.1782,	.5003,	.3388,
9,	.4126,	.3455,	.4589,	.4137,	.3023,	.3041,	.5537,	.3046,	.4260,	.2131,
10,	.3506,	.2916,	.5437,	.4190,	.3287,	.2581,	.6317,	.2001,	.7445,	.1489,
11,	.7988,	.5472,	.2710,	.2351,	.4080,	.2768,	.4153,	.1943,	.6509,	.4038,
12,	.2760,	.9389,	1.0633,	.1769,	.2179,	.6538,	.8276,	.2446,	.6756,	.1954,
13,	.4688,	.5404,	.6031,	.3358,	.3355,	.3683,	.6159,	.2241,	.6039,	.2587,
+gp,	.4688,	.5404,	.6031,	.3358,	.3355,	.3683,	.6159,	.2241,	.6039,	.2587,
FBAR 4- 7,	.6197,	.4316,	.5179,	.4052,	.3566,	.2549,	.7049,	.5804,	.4950,	.5124,

Table 8 Fishing mortality (F) at age

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	.3226,	.7674,	.3641,	.1555,	.0373,	.0995,	.1303,	.1779,	.0564,	.1333,
4,	.6509,	1.2789,	.6440,	.5094,	.3110,	.2096,	.2691,	.4615,	.3332,	.1983,
5,	.6123,	.9438,	.8894,	.9716,	.6923,	.5606,	.4674,	.4610,	.3721,	.3760,
6,	.7077,	.4986,	.4530,	.9502,	.8236,	.9058,	.7037,	.3526,	.2865,	.6327,
7,	.7987,	.6370,	.6831,	.5255,	.4183,	.7850,	.5879,	.4111,	.3390,	.5369,
8,	.6436,	.5337,	.4526,	.5159,	.7386,	.5282,	.6645,	.4129,	.5529,	.5230,
9,	.7633,	.3238,	.6613,	.5018,	.4275,	.5628,	.5004,	.1930,	.4214,	.7429,
10,	.9200,	.5174,	.2790,	.5555,	.6094,	.2290,	.6076,	.4964,	.4288,	.7566,
11,	.5362,	2.2922,	.7939,	.5746,	.7112,	.5149,	.5032,	.4637,	.7514,	.6267,
12,	1.5089,	.3776,	.4294,	.6931,	.8649,	.7961,	1.5369,	.2049,	2.0649,	.3223,
13,	.8838,	.8212,	.5269,	.5722,	.6763,	.5287,	.7718,	.3539,	.8573,	.2745,
+gp,	.8838,	.8212,	.5269,	.5722,	.6763,	.5287,	.7718,	.3539,	.8573,	.2745,
FBAR 4- 7,	.6924,	.8396,	.6674,	.7392,	.5613,	.6152,	.5070,	.4215,	.3327,	.4360,

Table 8 Fishing mortality (F) at age

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	FBAR 93-95
AGE											
3,	.0681,	.0520,	.0239,	.0734,	.0277,	.0551,	.0530,	.0160,	.0106,	.0166,	.0144,
4,	.4468,	.4684,	.1622,	.1859,	.1097,	.1573,	.2485,	.1470,	.0719,	.0655,	.0948,
5,	.2680,	.8788,	.5452,	.3455,	.1259,	.2574,	.2936,	.4718,	.3114,	.1683,	.3172,
6,	.4833,	.2450,	1.0077,	.5136,	.1863,	.2892,	.4006,	.6511,	.7366,	.3263,	.5713,
7,	.7358,	.5403,	.2497,	.4729,	.2763,	.3119,	.3489,	.4101,	1.1479,	.7711,	.7764,
8,	.5038,	.6402,	.3227,	.2536,	.2039,	.2936,	.3060,	.3847,	.5796,	.9058,	.6234,
9,	.4953,	.5293,	.3755,	.0823,	.7995,	.1385,	.2983,	.4385,	.7488,	.5583,	.5819,
10,	.6871,	.3804,	.7038,	.8398,	.6388,	.0852,	.1164,	.3733,	.8614,	.7638,	.6662,
11,	.4679,	.5747,	1.0994,	.4183,	.1456,	.0223,	.0641,	.2183,	.6036,	.3795,	.4005,
12,	1.3349,	.8274,	1.2856,	.4824,	.1734,	.5859,	.1166,	.4593,	.3096,	.2503,	.3397,
13,	.3267,	.5041,	.5103,	.5232,	.3715,	.1675,	.1508,	.4128,	.8949,	.9468,	.7515,
+gp,	.3267,	.5041,	.5103,	.5232,	.3715,	.1675,	.1508,	.4128,	.8949,	.9468,	
FBAR 4- 7,	.4835,	.5331,	.4912,	.3795,	.1745,	.2540,	.3229,	.4200,	.5670,	.3328,	

Table 4.18

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
3,	66395,	552715,	62335,	1030207,	122543,	52293,
4,	92388,	51480,	393364,	45615,	785242,	94407,
5,	69301,	41696,	33888,	185997,	25663,	503726,
6,	37312,	25233,	18035,	15546,	88910,	15722,
7,	44456,	13744,	8593,	5997,	7861,	48041,
8,	16464,	11682,	5180,	2858,	2353,	3544,
9,	5237,	5296,	3479,	1370,	1374,	768,
10,	2915,	2514,	1391,	698,	742,	491,
11,	1534,	1408,	1003,	597,	290,	322,
12,	1119,	497,	499,	346,	141,	125,
13,	1258,	154,	248,	242,	104,	54,
+gp,	456,	156,	2,	353,	69,	18,
TOTAL,	338835,	706575,	528017,	1289827,	1035291,	719510,

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

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
3,	169092,	53252,	68981,	324524,	242528,	109128,	240727,	274817,	320328,	100300,
4,	41772,	123622,	41727,	54918,	247367,	162447,	75447,	161433,	199248,	242140,
5,	67660,	28865,	78989,	28837,	37913,	138542,	82047,	34089,	66966,	118953,
6,	254092,	42163,	16501,	36539,	17101,	18753,	56846,	23632,	10975,	27505,
7,	8393,	94012,	23271,	8294,	17348,	7618,	7580,	16414,	7235,	3819,
8,	14209,	4022,	35392,	7706,	3968,	8589,	3043,	3337,	5177,	2784,
9,	1609,	4515,	2317,	13311,	4301,	1828,	3104,	1290,	1619,	1825,
10,	385,	913,	1936,	1160,	5611,	1428,	793,	960,	555,	584,
11,	312,	137,	429,	631,	694,	2788,	697,	432,	421,	361,
12,	219,	184,	97,	150,	235,	130,	1134,	350,	282,	161,
13,	75,	125,	149,	10,	60,	129,	46,	497,	211,	27,
+gp,	38,	136,	30,	57,	24,	43,	19,	121,	117,	390,
TOTAL,	557854,	351948,	269820,	476139,	577150,	451423,	471483,	517372,	613132,	498847,

Table 4.18 (Cont'd)

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	240258,	290548,	19921,	17204,	163910,	95483,	1017754,	269624,	53678,	48507,
4,	76785,	173128,	223516,	15717,	12714,	113476,	76388,	626278,	157685,	35232,
5,	156712,	42699,	104560,	122312,	11099,	8243,	71000,	42573,	281300,	91645,
6,	61502,	72180,	22845,	48675,	60256,	7404,	5616,	20087,	13494,	151268,
7,	11285,	24607,	36037,	11759,	22884,	29631,	5234,	1756,	10286,	5839,
8,	1633,	4148,	12193,	15562,	6387,	11613,	15936,	2845,	1062,	4719,
9,	1410,	819,	1949,	5253,	8323,	3458,	6763,	7024,	1949,	527,
10,	697,	764,	474,	1008,	2844,	5037,	2089,	3183,	4241,	1042,
11,	368,	402,	467,	226,	543,	1676,	3185,	909,	2133,	1649,
12,	114,	136,	190,	292,	146,	296,	1040,	1722,	613,	911,
13,	23,	71,	43,	54,	200,	96,	126,	372,	1104,	255,
+gp,	20,	18,	46,	8,	73,	14,	100,	71,	345,	443,
TOTAL,	550808,	609520,	422243,	238068,	289380,	276427,	1205232,	976444,	527889,	342039,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	55675,	113807,	170035,	134052,	18881,	5652,	7955,	4751,	9207,	260742,
4,	30686,	33014,	43254,	96733,	93949,	14893,	4189,	5717,	3256,	7048,
5,	16239,	13105,	7524,	18599,	47587,	56359,	9888,	2621,	2950,	1910,
6,	44697,	7207,	4175,	2531,	5763,	19497,	26342,	5073,	1353,	1665,
7,	79272,	18033,	3584,	2173,	801,	2071,	6453,	10670,	2919,	832,
8,	2868,	29200,	7809,	1482,	1052,	432,	773,	2935,	5791,	1703,
9,	2753,	1234,	14019,	4066,	724,	411,	208,	326,	1590,	2728,
10,	349,	1051,	731,	5925,	2015,	387,	192,	103,	220,	854,
11,	735,	114,	513,	453,	2783,	897,	252,	86,	52,	117,
12,	902,	352,	9,	190,	209,	1119,	439,	125,	44,	20,
13,	613,	163,	198,	5,	78,	72,	413,	77,	83,	5,
+gp,	85,	190,	174,	133,	33,	112,	69,	335,	350,	261,
TOTAL,	234875,	217471,	252025,	266341,	173876,	101901,	57173,	32818,	27815,	277884,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	GMST
AGE												
3,	524834,	85395,	42215,	16355,	23169,	81535,	264145,	955295,	350296,	104356,	0,	947
4,	186845,	258480,	66370,	25620,	12443,	14871,	63174,	204243,	734265,	258574,	59567,	634
5,	4733,	97857,	132480,	46203,	17418,	9129,	10403,	40341,	141096,	551720,	160594,	355
6,	1074,	2964,	33272,	62728,	26776,	12574,	5778,	6350,	18296,	83813,	348989,	170
7,	724,	542,	1899,	9944,	30728,	18196,	7709,	3169,	2711,	7171,	49516,	81
8,	398,	284,	259,	1211,	5074,	19085,	10906,	4453,	1722,	704,	2715,	38
9,	826,	197,	123,	153,	770,	3388,	11650,	6575,	2481,	790,	233,	18
10,	1062,	412,	95,	69,	116,	283,	2415,	7078,	3472,	961,	370,	8
11,	328,	438,	231,	38,	24,	50,	213,	1760,	3990,	1201,	366,	4
12,	51,	168,	202,	63,	21,	17,	40,	164,	1158,	1786,	673,	1
13,	12,	11,	60,	46,	32,	14,	8,	29,	85,	696,	1139,	
+gp,	28,	53,	30,	40,	53,	50,	8,	19,	4,	4,	222,	
TOTAL,	720914,	446801,	277236,	162473,	116623,	159193,	376450,	1229476,	1259575,	1011775,	624385,	

Table 4.19

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

Table 12 Stock biomass at age (start of year) Tonnes

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
3,	43821,	364792,	41141,	679936,	80878,	34513,
4,	95160,	53025,	405165,	46984,	808799,	97239,
5,	124049,	74635,	60659,	332934,	45938,	901670,
6,	88803,	60055,	42924,	37000,	211604,	37418,
7,	127143,	39307,	24576,	17153,	22483,	137397,
8,	54824,	38901,	17251,	9517,	7834,	11803,
9,	19375,	19594,	12871,	5070,	5083,	2840,
10,	12854,	11089,	6132,	3080,	3270,	2166,
11,	8284,	7601,	5419,	3223,	1568,	1739,
12,	7501,	3331,	3340,	2318,	943,	838,
13,	9313,	1141,	1838,	1794,	768,	397,
+gp,	3648,	1248,	14,	2821,	553,	143,
TOTALBIO,	594776,	674718,	621330,	1141830,	1189721,	1228163,

Table 12 Stock biomass at age (start of year) Tonnes

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
3,	111601,	35147,	45528,	214186,	160069,	72025,	158880,	181379,	211416,	66198,
4,	43025,	127331,	42979,	56565,	254788,	167320,	77711,	166276,	205225,	249405,
5,	121111,	51669,	141390,	51618,	67865,	247990,	146864,	61019,	119869,	212926,
6,	604737,	100349,	39273,	86963,	40700,	44632,	135294,	56245,	26120,	65461,
7,	24003,	268875,	66555,	23721,	49614,	21786,	21679,	46945,	20692,	10923,
8,	47315,	13394,	117856,	25662,	13212,	28600,	10132,	11111,	17239,	9270,
9,	5954,	16704,	8572,	49251,	15915,	6765,	11484,	4773,	5989,	6752,
10,	1696,	4028,	8536,	5117,	24743,	6299,	3499,	4236,	2447,	2574,
11,	1686,	738,	2318,	3406,	3747,	15057,	3766,	2331,	2272,	1947,
12,	1465,	1231,	647,	1006,	1572,	869,	7595,	2342,	1891,	1076,
13,	558,	926,	1106,	74,	447,	957,	344,	3679,	1560,	197,
+gp,	302,	1092,	242,	459,	193,	345,	149,	965,	934,	3118,
TOTALBIO,	963452,	621482,	475003,	518030,	632866,	612644,	577395,	541302,	615654,	629847,

Table 4.19 (Cont'd)

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

Table 12 Stock biomass at age (start of year) Tonnes

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	158570,	191762,	13148,	11354,	108181,	63019,	671718,	177952,	35428,	32015,
4,	79088,	178322,	230222,	16188,	13096,	116880,	78680,	645066,	162416,	36289,
5,	280514,	76431,	187162,	218939,	19867,	14755,	127090,	76207,	503527,	164045,
6,	146376,	171788,	54371,	115846,	143408,	17620,	13366,	47806,	32115,	360018,
7,	32276,	70376,	103066,	33630,	65449,	84745,	14970,	5022,	29417,	16700,
8,	5436,	13813,	40603,	51820,	21270,	38671,	53067,	9472,	3536,	15714,
9,	5217,	3029,	7211,	19435,	30795,	12796,	25023,	25990,	7211,	1950,
10,	3075,	3370,	2092,	4447,	12540,	22211,	9213,	14036,	18703,	4596,
11,	1988,	2172,	2524,	1218,	2932,	9050,	17201,	4911,	11519,	8906,
12,	763,	909,	1276,	1955,	978,	1981,	6970,	11535,	4108,	6103,
13,	173,	523,	321,	399,	1481,	711,	932,	2755,	8167,	1890,
+gp,	164,	147,	367,	62,	585,	114,	798,	569,	2757,	3547,
TOTALBIO,	713641,	712641,	642364,	475293,	420583,	382554,	1019027,	1021322,	818904,	651773,

Table 12 Stock biomass at age (start of year) Tonnes

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	36746,	75113,	112223,	88474,	12462,	3730,	5250,	3136,	6076,	114726,
4,	31607,	34004,	44552,	99635,	96767,	15339,	4315,	5888,	3354,	5780,
5,	29068,	23457,	13467,	33293,	85181,	100882,	17699,	4691,	5281,	3400,
6,	106379,	17153,	9937,	6024,	13717,	46403,	62693,	12073,	3220,	3996,
7,	226718,	51575,	10250,	6215,	2292,	5922,	18455,	30517,	8349,	2238,
8,	9551,	97238,	26003,	4935,	3503,	1438,	2575,	9773,	19286,	5671,
9,	10187,	4565,	51872,	15043,	2680,	1522,	771,	1205,	5883,	10092,
10,	1538,	4634,	3222,	26128,	8888,	1705,	846,	456,	970,	3766,
11,	3970,	614,	2769,	2444,	15029,	4844,	1360,	462,	278,	633,
12,	6041,	2359,	63,	1272,	1398,	7497,	2941,	835,	295,	133,
13,	4539,	1208,	1462,	37,	575,	532,	3058,	572,	615,	34,
+gp,	682,	1524,	1389,	1064,	266,	895,	551,	2679,	2797,	2086,
TOTALBIO,	467026,	313444,	277211,	284564,	242757,	190711,	120514,	72288,	56405,	152556,

Table 12 Stock biomass at age (start of year) Tonnes

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	146953,	20495,	11525,	4645,	6395,	31717,	97998,	290410,	81969,	21497,
4,	153213,	124070,	25884,	11375,	8922,	11213,	51487,	167275,	400174,	92052,
5,	7241,	91007,	81343,	32527,	16477,	13548,	16021,	57970,	148433,	439169,
6,	2427,	6579,	36533,	63920,	33925,	20395,	11972,	13431,	28102,	120691,
7,	1636,	1551,	2963,	14280,	46276,	30733,	18178,	7429,	5297,	14005,
8,	1326,	946,	861,	4034,	10168,	39067,	24484,	13558,	4320,	2052,
9,	3058,	729,	454,	567,	2847,	8829,	32318,	22296,	5891,	2317,
10,	4685,	1818,	419,	304,	510,	1249,	10138,	24066,	9101,	2914,
11,	1772,	2363,	1246,	208,	132,	270,	1150,	7392,	12608,	4352,
12,	344,	1127,	1351,	422,	139,	116,	268,	1096,	7761,	11968,
13,	87,	82,	446,	338,	235,	106,	58,	216,	626,	5149,
+gp,	220,	420,	241,	322,	424,	400,	63,	156,	29,	28,
TOTALBIO,	322962,	251187,	163265,	132942,	126451,	157641,	264135,	605293,	704310,	716196,

Table 4.20

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,
AGE						
3,	0,	0,	0,	0,	0,	0,
4,	4758,	2651,	20258,	2349,	40440,	4862,
5,	28531,	17166,	13952,	76575,	10566,	207384,
6,	47066,	31829,	22750,	19610,	112150,	19831,
7,	111886,	34590,	21626,	15094,	19785,	120910,
8,	53728,	38123,	16906,	9327,	7677,	11567,
9,	19375,	19594,	12871,	5070,	5083,	2840,
10,	12854,	11089,	6132,	3080,	3270,	2166,
11,	8284,	7601,	5419,	3223,	1568,	1739,
12,	7501,	3331,	3340,	2318,	943,	838,
13,	9313,	1141,	1838,	1794,	768,	397,
+gp,	3648,	1248,	14,	2821,	553,	143,
TOTSPBIO,	306945,	168363,	125106,	141262,	202803,	372676,

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

YEAR,	1956,	1957,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	2151,	6367,	2149,	2828,	12739,	8366,	3886,	8314,	10261,	12470,
5,	27855,	11884,	32520,	11872,	15609,	57038,	33779,	14034,	27570,	48973,
6,	320511,	53185,	20815,	46090,	21571,	23655,	71706,	29810,	13844,	34694,
7,	21122,	236610,	58569,	20875,	43660,	19172,	19077,	41312,	18209,	9612,
8,	46368,	13126,	115499,	25149,	12948,	28028,	9929,	10889,	16894,	9085,
9,	5954,	16704,	8572,	49251,	15915,	6765,	11484,	4773,	5989,	6752,
10,	1696,	4028,	8536,	5117,	24743,	6299,	3499,	4236,	2447,	2574,
11,	1686,	738,	2318,	3406,	3747,	15057,	3766,	2331,	2272,	1947,
12,	1465,	1231,	647,	1006,	1572,	869,	7595,	2342,	1891,	1076,
13,	558,	926,	1106,	74,	447,	957,	344,	3679,	1560,	197,
+gp,	302,	1092,	242,	459,	193,	345,	149,	965,	934,	3118,
TOTSPBIO,	429669,	345890,	250973,	166128,	153145,	166549,	165213,	122684,	101869,	130499,

Table 4.20 (Cont'd)

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:34

Traditional vpa using file input for terminal F

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

YEAR,	1966,	1967,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	3954,	8916,	11511,	809,	655,	5844,	3934,	32253,	8121,	1814,
5,	64518,	17579,	43047,	50356,	4569,	3394,	29231,	17528,	115811,	37730,
6,	77579,	91048,	28817,	61398,	76006,	9339,	7084,	25337,	17021,	190809,
7,	28403,	61931,	90698,	29594,	57595,	74576,	13174,	4419,	25887,	14696,
8,	5328,	13537,	39791,	50784,	20844,	37898,	52006,	9283,	3465,	15400,
9,	5217,	3029,	7211,	19435,	30795,	12796,	25023,	25990,	7211,	1950,
10,	3075,	3370,	2092,	4447,	12540,	22211,	9213,	14036,	18703,	4596,
11,	1988,	2172,	2524,	1218,	2932,	9050,	17201,	4911,	11519,	8906,
12,	763,	909,	1276,	1955,	978,	1981,	6970,	11535,	4108,	6103,
13,	173,	523,	321,	399,	1481,	711,	932,	2755,	8167,	1890,
+gp,	164,	147,	367,	62,	585,	114,	798,	569,	2757,	3547,
TOTSPBIO,	191163,	203160,	227656,	220457,	208982,	177913,	165565,	148617,	222771,	287442,

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

YEAR,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,
AGE										
3,	0,	0,	0,	0,	0,	37,	473,	533,	425,	2295,
4,	1580,	1700,	2228,	4982,	4838,	1841,	2373,	4122,	470,	462,
5,	6686,	5395,	3098,	7657,	19592,	64565,	12920,	4691,	1848,	2720,
6,	56381,	9091,	5267,	3193,	7270,	33874,	58304,	12073,	1514,	3716,
7,	199511,	45386,	9020,	5469,	2017,	5685,	17717,	30517,	6178,	2148,
8,	9360,	95293,	25483,	4836,	3433,	1438,	2575,	9773,	19286,	5671,
9,	10187,	4565,	51872,	15043,	2680,	1522,	771,	1205,	5883,	10092,
10,	1538,	4634,	3222,	26128,	8888,	1705,	846,	456,	970,	3766,
11,	3970,	614,	2769,	2444,	15029,	4844,	1360,	462,	278,	633,
12,	6041,	2359,	63,	1272,	1398,	7497,	2941,	835,	295,	133,
13,	4539,	1208,	1462,	37,	575,	532,	3058,	572,	615,	34,
+gp,	682,	1524,	1389,	1064,	266,	895,	551,	2679,	2797,	2086,
TOTSPBIO,	300476,	171769,	105873,	72125,	65986,	124436,	103889,	67918,	40559,	33758,

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

YEAR,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,
AGE										
3,	0,	0,	0,	0,	0,	0,	1960,	5808,	0,	0,
4,	33707,	1241,	777,	455,	178,	785,	6693,	36800,	8003,	921,
5,	3838,	19111,	26843,	9758,	4943,	4064,	8011,	28405,	19296,	61484,
6,	2087,	3487,	18632,	40270,	18320,	10198,	7423,	10207,	11522,	56725,
7,	1407,	1551,	2963,	11710,	35633,	24587,	13997,	5869,	4768,	10924,
8,	1326,	946,	861,	4034,	8846,	35941,	19587,	11931,	3801,	1703,
9,	3058,	729,	454,	567,	2278,	8829,	30379,	19398,	5891,	2317,
10,	4685,	1818,	419,	304,	510,	1249,	10138,	20937,	9101,	2535,
11,	1772,	2363,	1246,	208,	132,	270,	1150,	7392,	12229,	4352,
12,	344,	1127,	1351,	422,	139,	116,	268,	1096,	7761,	11370,
13,	87,	82,	446,	338,	235,	106,	58,	216,	626,	5149,
+gp,	220,	420,	241,	322,	424,	400,	63,	156,	29,	28,
TOTSPBIO,	52531,	32875,	54232,	68387,	71638,	86543,	99727,	148215,	83028,	157508,

Table 4.21

Run title : Arctic Haddock (run: SVPLOR07/V07)

At 28-Aug-96 20:58:35

Table 16 Summary (without SOP correction) (with SOP correction)

Traditional vpa using file input for terminal F

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 4- 7,	Spawning Stock Biomass
1950,	66395,	594776,	306944,	131733,	.4292,	.8353,	139.64
1951,	552715,	674718,	168363,	120057,	.7131,	.6273,	110.18
1952,	62335,	621330,	125106,	127660,	1.0204,	.7325,	64.04
1953,	1030207,	1141830,	141262,	123447,	.8739,	.5328,	80.68
1954,	122543,	1189721,	202803,	156448,	.7714,	.3865,	122.37
1955,	52293,	1228163,	372676,	202745,	.5440,	.5158,	176.68
1956,	169092,	963452,	429669,	213279,	.4964,	.4431,	236.73
1957,	53252,	621482,	345890,	122705,	.3548,	.4446,	195.31
1958,	68981,	475003,	250973,	112672,	.4489,	.5334,	154.84
1959,	324525,	518030,	166128,	88179,	.5308,	.3938,	133.34
1960,	242528,	632866,	153145,	155454,	1.0151,	.4988,	128.20
1961,	109128,	612644,	166549,	193234,	1.1602,	.6494,	135.53
1962,	240727,	577395,	165213,	187888,	1.1372,	.8255,	122.89
1963,	274817,	541301,	122684,	146744,	1.1961,	.8877,	91.06
1964,	320328,	615653,	101869,	98900,	.9709,	.6541,	62.71
1965,	100300,	629847,	130499,	118079,	.9048,	.5089,	91.42
1966,	240258,	713641,	191162,	160621,	.8402,	.6197,	126.20
1967,	290548,	712641,	203160,	136486,	.6718,	.4316,	160.74
1968,	19921,	642364,	227656,	181726,	.7982,	.5179,	180.29
1969,	17204,	475292,	220457,	130509,	.5920,	.4052,	176.94
1970,	163910,	420583,	208982,	86601,	.4144,	.3566,	157.66
1971,	95483,	382554,	177913,	78302,	.4401,	.2549,	177.92
1972,	1017754,	1019028,	165565,	265317,	1.6025,	.7049,	141.91
1973,	269624,	1021321,	148617,	320065,	2.1536,	.5804,	122.91
1974,	53678,	818904,	222771,	221138,	.9927,	.4950,	191.86
1975,	48507,	651774,	287443,	175742,	.6114,	.5124,	233.83
1976,	55675,	467026,	300476,	137279,	.4569,	.6924,	189.25
1977,	113807,	313444,	171770,	110158,	.6413,	.8396,	131.88
1978,	170035,	277211,	105873,	95422,	.9013,	.6674,	100.33
1979,	134052,	284564,	72125,	103623,	1.4367,	.7392,	81.12
1980,	18881,	242757,	65986,	87889,	1.3319,	.5613,	68.10
1981,	5652,	190711,	124436,	77153,	.6200,	.6152,	122.30
1982,	7955,	120514,	103889,	46955,	.4520,	.5070,	97.00
1983,	4751,	72288,	67918,	21607,	.3181,	.4215,	61.85
1984,	9207,	56405,	40559,	17661,	.4354,	.3327,	36.93
1985,	260742,	152556,	33758,	41270,	1.2225,	.4360,	32.59
1986,	524834,	322962,	52531,	96585,	1.8386,	.4835,	47.35
1987,	85395,	251187,	32875,	150659,	4.5828,	.5331,	32.29
1988,	42215,	163265,	54232,	91744,	1.6917,	.4912,	53.82
1989,	16355,	132942,	68387,	55122,	.8060,	.3795,	65.77
1990,	23169,	126451,	71638,	25816,	.3604,	.1745,	68.99
1991,	81535,	157641,	86543,	33605,	.3883,	.2540,	82.91
1992,	264145,	264135,	99727,	53886,	.5403,	.3229,	101.05
1993,	955295,	605293,	148215,	77355,	.5219,	.4200,	149.60
1994,	350296,	704311,	83028,	121365,	1.4617,	.5670,	82.97
1995,	104356,	716196,	157508,	138323,	.8782,	.3328,	157.64
Arith. Mean	200770,	524308,	159673,	122591,	.9254,	.5243,	119.12
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			1000 tonnes

Table 4.22

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

Single option prediction: Input data

Year: 1996								
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	88406.000	0.2825	0.0000	0.0000	0.0000	0.210	0.0265	0.511
4	59567.000	0.2727	0.0000	0.0000	0.0000	0.451	0.1211	0.716
5	160594.00	0.2000	0.0160	0.0000	0.0000	0.687	0.2637	0.837
6	348989.00	0.2000	0.3960	0.0000	0.0000	1.126	0.4218	1.190
7	49516.000	0.2000	0.7740	0.0000	0.0000	1.846	0.5246	1.886
8	2715.000	0.2000	0.8550	0.0000	0.0000	1.973	0.4333	1.973
9	233.000	0.2000	0.9000	0.0000	0.0000	2.539	0.3829	2.539
10	370.000	0.2000	0.9170	0.0000	0.0000	3.013	0.3860	3.013
11	366.000	0.2000	0.9000	0.0000	0.0000	2.886	0.2260	2.886
12	673.000	0.2000	1.0000	0.0000	0.0000	3.233	0.3021	3.233
13	1139.000	0.2000	1.0000	0.0000	0.0000	2.947	0.4514	2.947
14+	222.000	0.2000	1.0000	0.0000	0.0000	4.310	0.4514	4.310
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
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	131855.00	0.2825	0.0000	0.0000	0.0000	0.217	0.0265	0.560
4	.	0.2727	0.0000	0.0000	0.0000	0.451	0.1211	0.752
5	.	0.2000	0.0160	0.0000	0.0000	0.845	0.2637	1.076
6	.	0.2000	0.3960	0.0000	0.0000	1.367	0.4218	1.537
7	.	0.2000	0.7740	0.0000	0.0000	1.918	0.5246	2.019
8	.	0.2000	0.8550	0.0000	0.0000	2.171	0.4333	2.171
9	.	0.2000	0.9000	0.0000	0.0000	2.570	0.3829	2.570
10	.	0.2000	0.9170	0.0000	0.0000	2.834	0.3860	2.834
11	.	0.2000	0.9000	0.0000	0.0000	2.932	0.2260	2.932
12	.	0.2000	1.0000	0.0000	0.0000	3.044	0.3021	3.044
13	.	0.2000	1.0000	0.0000	0.0000	2.976	0.4514	2.976
14+	.	0.2000	1.0000	0.0000	0.0000	4.310	0.4514	4.310
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	4006.000	0.2825	0.0000	0.0000	0.0000	0.248	0.0265	0.587
4	.	0.2727	0.0000	0.0000	0.0000	0.573	0.1211	0.867
5	.	0.2000	0.0160	0.0000	0.0000	1.095	0.2637	1.303
6	.	0.2000	0.3960	0.0000	0.0000	1.697	0.4218	1.753
7	.	0.2000	0.7740	0.0000	0.0000	2.084	0.5246	2.117
8	.	0.2000	0.8550	0.0000	0.0000	2.280	0.4333	2.280
9	.	0.2000	0.9000	0.0000	0.0000	2.563	0.3829	2.563
10	.	0.2000	0.9170	0.0000	0.0000	2.710	0.3860	2.710
11	.	0.2000	0.9000	0.0000	0.0000	3.007	0.2260	3.007
12	.	0.2000	1.0000	0.0000	0.0000	3.233	0.3021	3.233
13	.	0.2000	1.0000	0.0000	0.0000	2.947	0.4514	2.947
14+	.	0.2000	1.0000	0.0000	0.0000	4.300	0.4514	4.310
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

(cont.)

Table 4.22 (Cont'd)

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

Single option prediction: Input data

(cont.)

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	94700.000	0.2000	0.0000	0.0000	0.0000	0.248	0.0265	0.587
4	.	0.2000	0.0000	0.0000	0.0000	0.573	0.1211	0.867
5	.	0.2000	0.0160	0.0000	0.0000	1.095	0.2637	1.303
6	.	0.2000	0.3960	0.0000	0.0000	1.697	0.4218	1.753
7	.	0.2000	0.7740	0.0000	0.0000	2.084	0.5246	2.117
8	.	0.2000	0.8550	0.0000	0.0000	2.280	0.4333	2.280
9	.	0.2000	0.9000	0.0000	0.0000	2.563	0.3829	2.563
10	.	0.2000	0.9170	0.0000	0.0000	2.710	0.3860	2.710
11	.	0.2000	0.9000	0.0000	0.0000	3.007	0.2260	3.007
12	.	0.2000	1.0000	0.0000	0.0000	3.233	0.3021	3.233
13	.	0.2000	1.0000	0.0000	0.0000	2.947	0.4514	2.947
14+	.	0.2000	1.0000	0.0000	0.0000	4.300	0.4514	4.310
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2000								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	94700.000	0.2000	0.0000	0.0000	0.0000	0.248	0.0265	0.587
4	.	0.2000	0.0000	0.0000	0.0000	0.573	0.1211	0.867
5	.	0.2000	0.0160	0.0000	0.0000	1.095	0.2637	1.303
6	.	0.2000	0.3960	0.0000	0.0000	1.697	0.4218	1.753
7	.	0.2000	0.7740	0.0000	0.0000	2.084	0.5246	2.117
8	.	0.2000	0.8550	0.0000	0.0000	2.280	0.4333	2.280
9	.	0.2000	0.9000	0.0000	0.0000	2.563	0.3829	2.563
10	.	0.2000	0.9170	0.0000	0.0000	2.710	0.3860	2.710
11	.	0.2000	0.9000	0.0000	0.0000	3.007	0.2260	3.007
12	.	0.2000	1.0000	0.0000	0.0000	3.233	0.3021	3.233
13	.	0.2000	1.0000	0.0000	0.0000	2.947	0.4514	2.947
14+	.	0.2000	1.0000	0.0000	0.0000	4.300	0.4514	4.310
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : SPRHS02
Date and time: 18SEP96:11:49

Table 4.23

Haddock in the North-East Arctic (Fishing 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	4.920	7905.705	2.124	6050.907	2.124	6050.907
0.0500	0.0166	0.056	124.290	4.644	6990.022	1.872	5177.276	1.872	5177.276
0.1000	0.0333	0.102	218.825	4.415	6253.957	1.666	4480.625	1.666	4480.625
0.1500	0.0499	0.141	292.030	4.222	5651.353	1.493	3915.025	1.493	3915.025
0.2000	0.0666	0.175	349.569	4.055	5150.452	1.348	3448.924	1.348	3448.924
0.2500	0.0832	0.204	395.360	3.911	4728.701	1.223	3059.952	1.223	3059.952
0.3000	0.0998	0.230	432.187	3.785	4369.650	1.115	2731.825	1.115	2731.825
0.3500	0.1165	0.253	462.067	3.673	4061.026	1.022	2452.423	1.022	2452.423
0.4000	0.1331	0.273	486.490	3.574	3793.496	0.940	2212.549	0.940	2212.549
0.4500	0.1498	0.291	506.575	3.485	3559.839	0.867	2005.106	0.867	2005.106
0.5000	0.1664	0.308	523.175	3.404	3354.385	0.803	1824.538	0.803	1824.538
0.5500	0.1830	0.323	536.949	3.331	3172.628	0.745	1666.437	0.745	1666.437
0.6000	0.1997	0.336	548.411	3.265	3010.939	0.694	1527.271	0.694	1527.271
0.6500	0.2163	0.349	557.966	3.204	2866.370	0.648	1404.173	0.648	1404.173
0.7000	0.2330	0.361	565.940	3.148	2736.500	0.606	1294.802	0.606	1294.802
0.7500	0.2496	0.371	572.591	3.097	2619.329	0.568	1197.224	0.568	1197.224
0.8000	0.2662	0.381	578.132	3.049	2513.185	0.533	1109.835	0.533	1109.835
0.8500	0.2829	0.390	582.736	3.005	2416.669	0.502	1031.291	0.502	1031.291
0.9000	0.2995	0.399	586.545	2.964	2328.596	0.473	960.460	0.473	960.460
0.9500	0.3162	0.407	589.678	2.925	2247.959	0.447	896.386	0.447	896.386
1.0000	0.3328	0.415	592.232	2.889	2173.899	0.423	838.253	0.423	838.253
1.0500	0.3494	0.422	594.291	2.855	2105.678	0.400	785.363	0.400	785.363
1.1000	0.3661	0.429	595.925	2.824	2042.657	0.379	737.117	0.379	737.117
1.1500	0.3827	0.435	597.193	2.794	1984.286	0.360	692.997	0.360	692.997
1.2000	0.3994	0.441	598.144	2.765	1930.083	0.343	652.554	0.343	652.554
1.2500	0.4160	0.447	598.822	2.739	1879.631	0.326	615.399	0.326	615.399
1.3000	0.4326	0.452	599.264	2.713	1832.561	0.311	581.190	0.311	581.190
1.3500	0.4493	0.457	599.501	2.689	1788.550	0.297	549.630	0.297	549.630
1.4000	0.4659	0.462	599.561	2.666	1747.314	0.283	520.457	0.283	520.457
1.4500	0.4826	0.467	599.468	2.644	1708.599	0.271	493.438	0.271	493.438
1.5000	0.4992	0.472	599.242	2.623	1672.183	0.259	468.371	0.259	468.371
1.5500	0.5158	0.476	598.901	2.603	1637.867	0.248	445.073	0.248	445.073
1.6000	0.5325	0.480	598.461	2.584	1605.472	0.238	423.385	0.238	423.385
1.6500	0.5491	0.484	597.936	2.565	1574.840	0.228	403.164	0.228	403.164
1.7000	0.5658	0.488	597.336	2.547	1545.828	0.219	384.280	0.219	384.280
1.7500	0.5824	0.492	596.674	2.530	1518.310	0.210	366.621	0.210	366.621
1.8000	0.5990	0.496	595.957	2.514	1492.168	0.202	350.083	0.202	350.083
1.8500	0.6157	0.499	595.195	2.498	1467.301	0.194	334.575	0.194	334.575
1.9000	0.6323	0.502	594.394	2.483	1443.613	0.187	320.012	0.187	320.012
1.9500	0.6490	0.506	593.560	2.468	1421.019	0.180	306.322	0.180	306.322
2.0000	0.6656	0.509	592.699	2.454	1399.443	0.173	293.435	0.173	293.435
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDHS02
Date and time : 18SEP96:13:30
Computation of ref. F: Simple mean, age 4 - 7
F-0.1 factor : 0.5145
F-max factor : 1.3935
F-0.1 reference F : 0.1712
F-max reference F : 0.4638
Recruitment : Single recruit

Table 4.24

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

Prediction with management option table

Year: 1996					Year: 1997					Year: 1998	
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
0.8068	0.2685	654735	241701	170000	0.0000	0.0000	696116	419143	0	795314	547396
.	.	.	.	.	0.1000	0.0333	.	419143	29468	763412	521941
.	.	.	.	.	0.2000	0.0666	.	419143	57614	732972	497692
.	.	.	.	.	0.3000	0.0998	.	419143	84499	703925	474592
.	.	.	.	.	0.4000	0.1331	.	419143	110184	676205	452585
.	.	.	.	.	0.5000	0.1664	.	419143	134724	649749	431619
.	.	.	.	.	0.6000	0.1997	.	419143	158174	624497	411644
.	.	.	.	.	0.7000	0.2330	.	419143	180584	600392	392612
.	.	.	.	.	0.8000	0.2662	.	419143	202003	577380	374479
.	.	.	.	.	0.9000	0.2995	.	419143	222478	555410	357201
.	.	.	.	.	1.0000	0.3328	.	419143	242052	534432	340737
.	.	.	.	.	1.1000	0.3661	.	419143	260768	514400	325048
.	.	.	.	.	1.2000	0.3994	.	419143	278665	495269	310097
.	.	.	.	.	1.3000	0.4326	.	419143	295782	476997	295850
.	.	.	.	.	1.4000	0.4659	.	419143	312155	459543	282272
.	.	.	.	.	1.5000	0.4992	.	419143	327818	442869	269331
.	.	.	.	.	1.6000	0.5325	.	419143	342805	426939	256997
.	.	.	.	.	1.7000	0.5658	.	419143	357146	411718	245241
.	.	.	.	.	1.8000	0.5990	.	419143	370872	397172	234036
.	.	.	.	.	1.9000	0.6323	.	419143	384011	383269	223355
.	.	.	.	.	2.0000	0.6656	.	419143	396590	369981	213173
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANHS03
Date and time : 18SEP96:13:03
Computation of ref. F: Simple mean, age 4 - 7
Basis for 1996 : TAC constraints

Table 4.25

Haddock in the North-East Arctic (Fishing 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
1996	0.8068	0.2685	143281	169992	712790	654735	184328	241701	184328	241701
1997	0.2000	0.0666	32313	57614	577753	696127	226004	419151	226004	419151
1998	0.2000	0.0666	26733	53947	435660	732982	223867	497700	223867	497700
1999	0.2000	0.0666	21986	46852	421406	690329	202080	484035	202080	484035
2000	0.2000	0.0666	19599	42617	419883	651303	189600	469334	189600	469334
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRHS02

							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
1996	0.8068	0.2685	143281	169992	712790	654735	184328	241701	184328	241701
1997	0.4000	0.1331	61937	110186	577753	696127	226004	419151	226004	419151
1998	0.4000	0.1331	47541	95073	409091	676214	203753	452592	203753	452592
1999	0.4000	0.1331	36949	77405	381040	596175	169850	405442	169850	405442
2000	0.4000	0.1331	31664	66840	373376	535617	150776	369810	150776	369810
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
1996	0.8068	0.2685	143281	169992	712790	654735	184328	241701	184328	241701
1997	0.6000	0.1997	89116	158176	577753	696127	226004	419151	226004	419151
1998	0.6000	0.1997	63557	125881	384799	624505	185488	411651	185488	411651
1999	0.6000	0.1997	46844	96328	346895	517109	142941	339933	142941	339933
2000	0.6000	0.1997	38822	79296	336556	444917	120457	292458	120457	292458
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
1996	0.8068	0.2685	143281	169992	712790	654735	184328	241701	184328	241701
1997	0.8000	0.2662	114068	202006	577753	696127	226004	419151	226004	419151
1998	0.8000	0.2662	75711	148418	362576	577388	168898	374485	168898	374485
1999	0.8000	0.2662	53114	107053	317948	450616	120458	285301	120458	285301
2000	0.8000	0.2662	42838	84399	307270	373572	96720	232220	96720	232220
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
1996	0.8068	0.2685	143281	169992	712790	654735	184328	241701	184328	241701
1997	1.0000	0.3328	136992	242056	577753	696127	226004	419151	226004	419151
1998	1.0000	0.3328	84764	164355	342234	534439	153828	340742	153828	340742
1999	1.0000	0.3328	56818	112088	293346	394608	101660	239714	101660	239714
2000	1.0000	0.3328	44886	85057	283856	317244	78083	185208	78083	185208
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRHS02
Date and time : 18SEP96:13:04
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

Table 4.25 (Cont'd)

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

Single option prediction: Detailed tables

Year: 1996 F-factor: 0.8068 Reference F: 0.2685						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	0.0214	1630	833	88406	18565	0	0	0	0
4	0.0977	4864	3482	59567	26865	0	0	0	0
5	0.2128	27993	23430	160594	110328	2570	1765	2570	1765
6	0.3403	91755	109188	348989	392962	138200	155613	138200	155613
7	0.4232	15596	29414	49516	91407	38325	70749	38325	70749
8	0.3496	730	1441	2715	5357	2321	4580	2321	4580
9	0.3089	56	143	233	592	210	532	210	532
10	0.3114	90	272	370	1115	339	1022	339	1022
11	0.1823	55	160	366	1056	329	951	329	951
12	0.2437	132	428	673	2176	673	2176	673	2176
13	0.3642	317	934	1139	3357	1139	3357	1139	3357
14+	0.3642	62	266	222	957	222	957	222	957
Total		143281	169992	712790	654735	184328	241701	184328	241701
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1997 F-factor: 0.8000 Reference F: 0.2662						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	0.0212	2411	1350	131855	28613	0	0	0	0
4	0.0969	5284	3974	65239	29423	0	0	0	0
5	0.2110	7115	7655	41128	34753	658	556	658	556
6	0.3374	27745	42644	106285	145292	42089	57536	42089	57536
7	0.4197	63598	128404	203310	389949	157362	301820	157362	301820
8	0.3466	7090	15392	26550	57641	22701	49283	22701	49283
9	0.3063	377	968	1567	4027	1410	3625	1410	3625
10	0.3088	34	96	140	397	128	364	128	364
11	0.1808	33	98	222	651	200	585	200	585
12	0.2417	49	149	250	760	250	760	250	760
13	0.3611	119	355	432	1285	432	1285	432	1285
14+	0.3611	214	922	774	3337	774	3337	774	3337
Total		114068	202006	577753	696127	226004	419151	226004	419151
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1998 F-factor: 0.8000 Reference F: 0.2662						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	0.0212	73	43	4006	993	0	0	0	0
4	0.0969	7882	6831	97320	55797	0	0	0	0
5	0.2110	7799	10164	45082	49365	721	790	721	790
6	0.3374	7118	12481	27269	46275	10798	18325	10798	18325
7	0.4197	19424	41115	62096	129388	48063	100146	48063	100146
8	0.3466	29215	66610	109405	249442	93541	213273	93541	213273
9	0.3063	3694	9470	15370	39393	13833	35454	13833	35454
10	0.3088	229	619	944	2560	866	2347	866	2347
11	0.1808	13	38	84	253	76	228	76	228
12	0.2417	30	96	152	490	152	490	152	490
13	0.3611	44	131	161	473	161	473	161	473
14+	0.3611	190	820	688	2959	688	2959	688	2959
Total		75711	148418	362576	577388	168898	374485	168898	374485
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.25 (Cont'd)

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

Single option prediction: Detailed tables

(cont.)

Year: 1999 F-factor: 0.8000 Reference F: 0.2662

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	0.0212	1801	1057	94700	23486	0	0	0	0
4	0.0969	248	215	2957	1695	0	0	0	0
5	0.2110	11633	15162	67250	73639	1076	1178	1076	1178
6	0.3374	7802	13680	29890	50723	11836	20086	11836	20086
7	0.4197	4984	10549	15931	33196	12331	25694	12331	25694
8	0.3466	8923	20345	33415	76186	28570	65139	28570	65139
9	0.3063	15223	39021	63333	162323	57000	146091	57000	146091
10	0.3088	2242	6076	9264	25104	8495	23021	8495	23021
11	0.1808	85	257	568	1707	511	1537	511	1537
12	0.2417	11	36	58	186	58	186	58	186
13	0.3611	27	79	97	287	97	287	97	287
14+	0.3611	134	577	484	2082	484	2082	484	2082
Total		53114	107053	317948	450616	120458	285301	120458	285301
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000 F-factor: 0.8000 Reference F: 0.2662

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	0.0212	1801	1057	94700	23486	0	0	0	0
4	0.0969	6363	5514	75907	43520	0	0	0	0
5	0.2110	380	495	2197	2406	35	38	35	38
6	0.3374	11639	20407	44588	75666	17657	29964	17657	29964
7	0.4197	5463	11563	17463	36387	13516	28163	13516	28163
8	0.3466	2289	5220	8573	19546	7330	16712	7330	16712
9	0.3063	4649	11918	19344	49578	17409	44620	17409	44620
10	0.3088	9239	25037	38172	103445	35003	94859	35003	94859
11	0.1808	837	2518	5569	16747	5012	15072	5012	15072
12	0.2417	76	245	388	1254	388	1254	388	1254
13	0.3611	10	30	37	109	37	109	37	109
14+	0.3611	92	395	332	1427	332	1427	332	1427
Total		42838	84399	307270	373572	96720	232220	96720	232220
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRHS02
Date and time : 18SEP96:13:04
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors