Advisory Committee on Fishery Management

ICES CM 1999/ACFM:3

REPORT OF THE

ARCTIC FISHERIES WORKING GROUP

ICES Headquarters
19 - 27 August 1998

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1 INTRODUCTION

1.1 Participants

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1.2 Introduction

The terms of reference for the meeting as outlined at the 1997 Annual Meeting of ICES are as follows:

"2:11:2 The Arctic Fisheries Working Group [AFWG] (Chairman: R. Bowering, Canada), will meet at ICES Headquarters from 19–27 August 1998 to:

a) assess the status and provide catch options for 1999 for the stocks of cod, haddock, saithe and Greenland halibut in Sub-areas I and II, taking into account interactions with other species;

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

c) consider the reference points proposed by SGPAFM, adopting those reference points or presenting alternatives with reasons for the alternative selection;

d) consider the harvest control rules proposed by SGPAFM, taking into account uncertainties in the data, in the assessments and in the biological processes, and assuming a stock-recruitment relationship, to estimate the probability of avoiding limit reference points;

e) update information on quantities of discards by gear type for the stocks and fisheries considered by this group using the format proposed by the WGECO with a view to establishing a time series.

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

AFWG will report to ACFM before its October 1998 meeting."

In addition to the above terms of reference, the Working Group has been asked to prepare agreed first drafts of the ACFM extracts for each stock under consideration. Although no major structural changes to the Working Group report were necessary from 1997 to address the Terms of Reference, the organisation of the report has been changed somewhat from previous years. All tables and figures relevant to each stock evaluation have now been appended at the end of each respective section for ease of review rather than at the end of the entire report.

1.3 General Comments

The Working Group reviewed the comments from ACFM as detailed in the technical minutes from both the October 1997 and May 1998 meetings and where practical addressed the suggestions as indicated. Nevertheless, there were some recommendations within the minutes of the meetings, which were in contrast to the subsequent Terms of Reference set up by ACFM that the Working Group was expected to address. In particular were the recommendations in the minutes not to carry out assessments for the redfish and Greenland halibut stocks but yet such assessments were required according to the Terms of Reference. To avoid confusion in future the Working Group requests ACFM to indicate clearly both in the advice to management and the subsequent Terms of Reference if assessments of certain stocks are not deemed necessary in a particular year.

VPA based assessments on redfish stocks were not considered to have any added value to the information base and were not performed this year. The commercial CPUE database was reviewed to evaluate the potential use of stock production models. For *Sebastes marinus*, the time series exhibited little contrast, therefore, were of little value in establishing acceptable parameters in the any of the analyses. The Working Group was informed also that the time series of CPUE data provided for *Sebastes mentella* were not likely to be reflective of the true trends in stock size and any results with respect to stock production analysis would not represent the correct stock situation. Reviews of stock status were therefore based upon updated results of survey data in conjunction with recent observations from the fisheries.

The assessment for saithe was carried out along similar lines as in the past. However, establishing the size of the 1993 year class, which has a significant effect on the short-term projections, was especially problematic. The agreed estimate used in the assessment was calculated as in previous years and the Working Group considered it to be rather conservative. Although recent survey data suggested this year class might be considerably larger than estimated above, the WG was not in position at this time to be able to confirm its overall strength.

Evaluation of the status of the Greenland halibut resource was based largely on trends in abundance indices from surveys. It has been reported in recent assessments that year classes of the early 1990's were very low in abundance compared to previous periods, which resulted in advice for severe reductions in fishing mortality. As some of these year classes approach ages 5 and older, however, they are estimated to be much closer to average in strength. It is hypothesised that these year classes at very young ages may have been distributed much further north than usual, outside the survey area, and therefore were underestimated. If this is confirmed, improvement in the spawning stock biomass of Greenland halibut should be more rapid than previously anticipated provided fishing mortality is kept at a low level.

1.4 Biological reference Points

ACFM is now basing management advice largely on the fishing mortality reference points F_{pa} and F_{lim} for stocks on which these values have been agreed. The Working Group has been instructed by ACFM to evaluate proposed reference points for NE Arctic cod, saithe and haddock as outlined by the SGPAFM. The following are excerpts from the SG Report (ICES CM 1998) which were considered relevant to the discussion of this issue during the meeting:

1. "F_{lim} is a fishing mortality which should be avoided with a high probability because it is associated with unknown population dynamics or stock collapse."

2. "In order to have a high probability that fishing mortality will be below F_{lim}, a precautionary reference point, F_{pa} lower than F_{lim}, is defined."

3. "F_{pa} is the upper bound on fishing mortality rate to be used by ACFM in providing advice. F_{pa}, given uncertainties, must have a large probability of being below F_{lim}, and it must have a large probability of being sustainable based on the history of the fishery."

4. "Fishing mortality rates in excess of F_{pa} will be regarded as "overfishing"."

The Study Group report describes several ways to estimate or calculate F_{pa}. When applied to north-east Arctic stocks the results vary considerably, depending on the approach. Among the suggested reference points, F_{lim} is equal to F_{med} for north-east Arctic cod, haddock and saithe. It implies that fishing in excess of F_{med} represents an unsustainable level that should not be exceeded in any given year. Using the recommended level of uncertainty in the estimation of F_{pa} gives values, which are very low, compared to most historical F values experienced for the above stocks and also low compared to a number of the other stocks evaluated by the Study Group.

The way ACFM intends to use F_{pa} in its advice will keep fishing mortality, on average, at F_{pa} or below if used in management. In managing the north-east Arctic stocks, F_{med} has been considered a level which on average should not be exceeded and the aim has been to keep fishing mortality at or below F_{med} each year. Fishing in excess of F_{med} has been considered by ACFM to be outside safe biological limits and the advice in some cases has been to set the TAC well below F_{med}. However, TAC's corresponding to fishing mortalities below F_{med} have never been labelled "overfishing" as now proposed.

A crucial question addressed during this meeting is whether it is appropriate to set F_{med} equal to F_{lim}. The SG is not clear on this and suggests that both F_{lim} and F_{pa} could be equal to F_{med}, depending on the information available for the stock. However, it is quite clear that F_{med} for the north-east Arctic stocks is neither associated with unknown population dynamics or stock collapse. Therefore, it seems difficult to defend that fishing mortality rates, which on average are below F_{med}, represent overfishing.

The suggested F_{pa} and F_{lim} (F_{med}) correspond poorly with B_{pa} and B_{lim}, especially for cod. With fishing at F_{lim} the SSB will rarely fall below B_{pa} and the probability of nearing B_{lim} is very low. By fishing at F_{pa} the SSB will likely remain far in excess of B_{pa}, with the possible exception of haddock where large stock fluctuations are known to occur.

Calculation of other reference points, e.g., F_{loss} or F_{crash}, will probably support the use of F_{med} as F_{pa} rather than as F_{lim}. This would also be more consistent with that suggested for most of the other stocks by the SGPAFM.

See stock specific assessment reports for complete details on developments of reference points by the WG.

1.5 Information on Discards

The Working Group was informed that no new data are expected to become available on historic discards. However, new regulations are now in effect in both the Norwegian and Russian zones prohibiting discards. This is complemented by a new observer program in the Norwegian zone to collect data. Exclusion devices also are used more frequently and altogether should improve the precision of catch information. Currently, discarding in the Barents Sea is not considered to be major problems.

1.6 Scientific Presentations

Results of several research projects were reviewed by the Working Group and are summarised as follows:

Preliminary results from an analysis of a Russian database describing seasonal and interannual variation in the liver condition index (LCI) of Northeast Arctic cod were presented (Yaragina and Marshall WD1998). Both total stock biomass of capelin and the frequency of occurrence of capelin in cod stomachs were positively related to the cod LCI. A multivariate model having stock biomass of capelin and temperature as independent variables explained between 60 and 76% of the interannual variation in cod LCI. Norwegian spring-spawning herring affect cod LCI indirectly through predation on capelin. The implications of interannual variation in LCI for the reproductive potential of the stock is also being investigated.

An update of progress on the development of a new assessment software package for Northeast Arctic cod by Norway was highlighted. It is anticipated that an early version of the model will be tested and running later in autumn 1998. It will then be evaluated at an international workshop on assessment methods to be held in Bergen, Norway in early December. Following this a more refined package will be developed for further evaluation by the Comprehensive Fisheries Evaluation Working Group in early 1999 and eventual use by the AFWG in August 1999.

1.7 Recommendations

1.7.1 Multispecies effects on cod stock projections

There is growing knowledge about how fluctuations in capelin abundance affect growth rates and cannibalism in Northeast Arctic cod. Prior to next years WG meeting, it is recommended that models be developed which predict age-specific maturity, weight and mortality due to cannibalism using the short term predictions of capelin stock biomass which are now available. These models must be designed to meet the specific operational requirements of the WG for input data to the projections.

1.7.2 Severe reduction in survey coverage

It was pointed out in the 1997 report that the assessments of cod and haddock primarily were confounded by the lack of survey coverage in the Russian zone during the 1997 Barents Sea winter survey by Norway. This was especially problematic in estimating the recruiting age groups that are widely distributed inside the Russian zone. The distribution of young age groups throughout the Barents Sea can vary significantly on an annual basis depending on ocean climate conditions. Therefore, making assumptions about total abundance from survey data covering only a portion of the area potentially can introduce a high degree of error. This problem was exacerbated in the current assessment with the lack of survey coverage again in the 1998 survey. This further compromises the quality of the assessment results. The Working Group reiterates its recommendation that ICES make urgent representation to the appropriate authorities regarding this serious gap in survey coverage in an attempt to resolve the problem prior to the next scheduled survey.

1.7.3 New assessment software

The Working Group expressed some concerns with respect to the complexity and user friendliness of the new assessment software program being developed for NEA cod and anticipated to be in use at the next WG meeting. It is recommended, therefore, that the developer should attend the 1999 meeting and an extra day be added to the schedule to train members in use and understanding of the program.

1.7.4 Redfish surveys

Low confidence in using analytical assessments for estimation of redfish stock status and short term projections make it even more important to monitor stock status through scientific surveys. Except for the Russian survey on the *Sebastes mentella* "spawning grounds", there are no surveys covering the fishable stocks of *S. marinus* and *S. mentella*. The WG therefore recommends that such a survey be designed and conducted.

2 NORWEGIAN COASTAL COD IN SUB-AREAS I AND II

2.1 Status of the fisheries

2.1.1 Historical development of the fisheries (Table 9.1)

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

The Norwegian catch statistics separate the catch of cod into north-east Arctic and Norwegian Coastal cod. This is based on where and when the catches are caught, and not based on biological sampling of the catch. The definition of the catches is given as catches in ICES Division IIa, Norwegian statistical areas 05 and 00 (quarter 3 & 4), 06 and 07 (all year) (ICES 1997/Assess:4). The Norwegian coastal surveys from 1992–1997 have also found Coastal cod further north and east (Norwegian statistical areas 03 and 04). None of the catches in these areas have been allocated to the Norwegian Coastal cod. For the period 1960–70, landings of Norwegian Coastal cod are available (ICES 1971/F:3). Landings for the period 1971–79 were unavailable. The average landings for the 29 years of statistics is 36,000 t. (Table 9.1).

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

2.1.2 Landings prior to 1997 (Table 9.1)

The estimated landings of Norwegian Coastal cod reported to the Working Group in 1996 is 32,036 t and the provisional figure for 1997 is 36,058 t (Table 9.1). The quotas for both these years were 40,000 t (exclusive Norwegian quota).

2.1.3 Expected landings in 1998

No estimate of expected landings for 1998 are available from the catch statistics.

However, in order to give advice for NCC in the future, expected landings in the assessing year must be included in the forecast. Since the catches cannot be split into north-east Arctic cod (NEAC) and CC until the following year, the expected catch of NCC has to be calculated in some way. An attempt has been made to calculate the landings of NCC in 1998 as following:

- The catch of NCC was assumed to be proportional with the catch of NEAC.
- A linear regression equation on the total catch of NCC and NEAC is used for the five last years.
- This gives the following: Catch NCC = 37.253 + 0.03* catch NEAC ($R^2 = 0.42$).
- The expected catch of NEAC in 1998 is 654,000 t.

With these assumptions the expected landings of Norwegian Coastal cod in 1998 will be 56,873 tonnes, which is about 6,500 t lower than in 1997 (Based on the new method of splitting catches of NCC and NEAC, see Section 9.2.4).

2.2 Status of research

2.2.1 Survey results (Tables 9.2–9.8)

A Norwegian standard trawl-acoustic survey was conducted along the coast from Varanger to Stadt in September-October 1997 using RV *Michael Sars*. The survey covered the same areas as the coastal surveys in 1995 and 1996.

The results from the trawl-acoustic coastal survey in 1998 estimated a total survey biomass of NCC of about 135,000 t (131 million fish) for the coastal area from Varanger to Stadt at 62°N (Tables 9.2 and 9.3). The spawning biomass accounted for 74,000 t (26 million fish) of this total (Tables 9.4 and 9.5). Thus, spawners make up about 54% of the total biomass. Eighty-two percent of the total coastal biomass was distributed from the Russian border to 67° N and 18% south of 67° N (areas 06 and 07). The bulk of the biomass was comprised of age classes 3–7 (Table 9.4).

The data indicated a higher proportion of Norwegian Coastal cod in the fjords and to the South compared with the northern and outer areas. In the Norwegian statistical areas 06 and 07 (south of 67° N) nearly all otoliths collected were of the Norwegian Coastal cod type, which is similar to the results of the 1993, 1994, 1995 and 1996 surveys (ICES 1994/Assess:2; 1996/Assess:4; ICES 1997/Assess:4; ICES 1998/Assess:2).

The numbers of Norwegian Coastal cod per age-class from all the coastal surveys is given in Table 9.6. The total numbers increased in 1997 mostly due to increased numbers of cod younger than 4 years.

The Norwegian 1998 coastal survey (September-October) will be conducted in a similar way as the 1995, 1996 and 1997 surveys to build up a time series for Norwegian Coastal cod over its distribution area.

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

A total of 1604 cod otoliths were sampled during the 1997 survey. These were separated into Norwegian Coastal cod type (1501) and North-east Arctic cod type (103). As in previous years, Norwegian Coastal cod were found throughout the survey area. The 1997 survey data shows the same pattern as the 1995 and 1996 surveys. The proportion of the Norwegian Coastal cod increases going from north to south along the Norwegian coast. The Norwegian Coastal cod type otoliths dominate south of 67° N (Norwegian statistical areas 06 and 07). Although the proportion is lower, there is significant biomass of Norwegian Coastal cod north of 67° N. It must be emphasised that the Norwegian Coastal cod surveys are conducted in August-October each year, and therefore there may be north-east Arctic cod in this southern area at other times of the year, especially during the spawning season in the winter time.

2.2.2 Weight at age (Table 9.7)

The weight at age (weighted average) from the trawl-acoustic survey has slightly decreased for most of the age groups compared with the results from the 1996 survey. Weight at age of NCC is well above the present level for NEAC. There is a general tendency for cod to be heavier when caught further south along the coast (Table 9.7). The same tendency was found for the surveys in 1995–1996. (ICES CM 1997/Assess:4; ICES CM 1998/Assess:2).

2.2.3 Maturity at age (Table 9.8)

The maturity at age is estimated from the data collected at the Norwegian coastal survey. This is not an optimal way to do it because the survey is conducted in the early autumn when the stage at the maturity scale is hard to define. Further improvement of maturity ogives is recommended. The age at 50% maturity (M_{50}) for the Norwegian Coastal cod was estimated to be about 5 years old on average for the surveyed area in 1997 (Table 9.8). 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 1997 data show that the average M_{50} is at about the same level to that found in the 1996 survey (5-years)(ICES 1998/Assess:2). The average M_{50} for the north-east Arctic cod in 1997 is close to 7 years old (ICES 1998/Assess:2).

2.2.4 Catch statistics

A detailed breakdown of the catches of Norwegian Coastal cod for the period 1984 to 1997 have been done to form the basis of a VPA. This was carried out by analysing Norwegian landings of cod by vessel size, area caught, landed as given by the Norwegian Directorate for Fisheries, and cod samplings done by the Institute of Marine Research, Bergen to separate Norwegian Coastal cod and north-east Arctic cod by otolith type.

The separation of the Norwegian catches into north-east Arctic and Norwegian Coastal cod is based on:

- No catches outside the 12 n.mile zone have been allocated to the Norwegian Coastal cod catches.
- The catches inside 12 n.mile zone is separated into quarter, fishing gear and Norwegian statistical areas.

- From the otolith structure, catches inside the 12 n.mile zone have been allocated into Norwegian Coastal cod and north-east Arctic cod. The Institute of Marine Research in Bergen has been taking samples of commercial catches along the coast for a long period.

This new method of splitting the catches between NCC and NEAC is described in a working document submitted to AFWG in 1998 (Berg and Eriksen WD 1998)

2.3 Preliminary VPA and tuning (Table 9.9)

The tuning series for Norwegian Coastal cod is not yet long enough to have the minimum recommended number of years for tuning. Next year the survey data from 1998 will be available and will make up the recommended 5 years. Nevertheless, a preliminary VPA using Extended Survivors Analysis (XSA) with four years of tuning was made. The default settings were used with the following exceptions:

- The catchability was set to be independent of age for ages 7 years and older.
- The survivors estimates were shrunk to the mean of the final 2 years or the 4 oldest ages.
- Only four points were used for regression due to lack of more tuning data.

2.4 Results of the assessment (Table 9.9)

The average age 4–7 fishing mortalities in 1997 was estimated to 0.29 (Table 9.9). The highest fishing mortalities for these age groups was estimated from 1984–1988 (0.49–0.62). In 1990 and 1991 the lowest F-values was estimated (0.18 and 0.17). The total biomass of the stock in the period from 1984–1997 has been between 204,000 t and 325,000 t. The spawning stock biomass has been between 118,000 t and 224,000 t (Table 9.9).

2.5 Comments to the assessment

This assessment on Norwegian Coastal cod must be seen as an preliminary assessment, because the tuning data includes only three points. Consequently the assessment is not included in the report from this years AFWG. As more years of survey data become available, prospects for a meaningful analytical assessment will improve. Nevertheless, the assessment seems to reflect the Norwegian Coastal cod stock in a fairly good way compared with the results from the coastal surveys.

There is no explicit management of this stock. In accordance to the precautionary approach, management objectives should be defined. Biological reference points consistent with these objectives need to be identified and implemented as a basis for advice.

Table 9.1 Landings of Norwegian Coastal cod in Division IIa -(areas 00, 05, 06 and 07), (Figure 9.1) (in '000 tonnes)

1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
43	32	30	40	46	24	29	33	47	52
1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
49	*)	*)	*)	*)	*)	*)	*)	*)	*)
1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
40	49	42	38	33	28	26	31	22	17
1990	1991	1992	1993	1994	1995	1996	1997		
24	25	35	44	48	39	32	36**)		

*) No data
**) Provisional data

Table 9.2 Estimated survey number (x1000) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1997.

	Age											
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**Total**
03 East Finnmark	1448	12934	9005	7380	3672	2518	2046	737	243	-	45	**40028**
04 West Finnmark/Troms	3926	7928	5192	8091	5813	4582	4127	1489	529	19	201	**41897**
05 Lofoten/Vesterålen	104	3376	1471	5298	3083	2143	2098	950	390	-	292	**19205**
00 Vestfjord	152	6056	1106	2993	1025	664	726	204	197	-	94	**13217**
06 Nordland	-	252	1492	4069	2568	1724	997	303	90	-	24	**11519**
07 Møre	2	148	561	1082	1173	748	618	245	66	7	7	**4657**
Total	**5632**	**30694**	**18827**	**28913**	**17334**	**12379**	**10612**	**3928**	**1515**	**26**	**663**	**130523**

Table 9.3 Estimated survey biomass (tonnes) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1997.

	Age											
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**Total**
03 East Finnmark	12	556	2161	5041	5009	4767	5762	2826	1421	-	587	**28142**
04 West Finnmark/Troms	31	341	1246	5526	7929	8674	11622	5709	3094	182	2620	**46974**
05 Lofoten/Vesterålen	1	145	353	3619	4205	4057	5908	3642	2281	-	3807	**28018**
00 Vestfjord	1	260	265	2044	1398	1257	2044	782	1152	-	1225	**10428**
06 Nordland	-	11	358	2779	3503	3264	2808	1162	526	-	313	**14724**
07 Møre	-	6	135	739	1600	1416	1740	939	386	67	91	**7119**
Total	**45**	**1319**	**4518**	**19748**	**23644**	**23435**	**29884**	**15060**	**8860**	**249**	**8643**	**135405**

Table 9.4 Estimated survey spawning stock number (x1000) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1997.

	Age											
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**Total**
03 East Finnmark	0	0	0	443	1065	1133	1555	715	243	0	45	5199
04 West Finnmark/Troms	0	0	0	485	1686	2062	3137	1444	529	19	201	9563
05 Lofoten/Vesterålen	0	0	0	318	894	964	1594	922	390	0	292	5374
00 Vestfjord	0	0	0	180	297	299	552	198	197	0	94	1817
06 Nordland	0	0	0	244	745	776	758	294	90	0	24	2931
07 Møre	0	0	0	65	340	337	470	238	66	7	7	1530
Total	0	0	0	1735	5027	5571	8065	3810	1515	26	663	26414

Table 9.5 Estimated survey spawning stock biomass (tonnes) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1997.

	Age											
Area	0	1	2	3	4	5	6	7	8	9	10+	Total
03 East Finnmark	0	0	0	302	1453	2145	4379	2741	1421	0	587	13028
04 West Finnmark/Troms	0	0	0	332	2299	3903	8833	5538	3094	182	2620	26801
05 Lofoten/Vesterålen	0	0	0	217	1219	1826	4490	3533	2281	0	3807	17373
00 Vestfjord	0	0	0	123	405	566	1553	759	1152	0	1225	5783
06 Nordland	0	0	0	167	1016	1469	2134	1127	526	0	313	6752
07 Møre	0	0	0	44	464	637	1322	911	386	67	91	3922
Total	0	0	0	1185	6857	10546	22712	14608	8860	249	8643	73659

Table 9.6 Estimated survey numbers at age (x1000) of Norwegian Coastal cod from the coastal surveys from 1995–1997.

	Age											
YEAR	0	1	2	3	4	5	6	7	8	9	10+	TOTAL
1995	2157	28707	20191	13633	15636	16219	9550	3174	1158	781	579	111785
1996	-	1756	17378	22815	12382	12514	6817	3180	754	242	5	77843
1997	5632	30694	18827	28913	17334	12379	10612	3928	1515	26	663	130523

Table 9.7 Weight (gram) at age (year) for Norwegian Coastal cod from the Norwegian coastal survey during the autumn 1997.

	Age										
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**
03 East Finnmark	8	34	160	590	1176	1759	2641	3155			
04 West Finnmark/Troms		49	243	605	1467	1777	2664	3319	4735	9600	12055
05 Lofoten/Vesterålen	8	52	334	579	1270	1869	3055	5088	9275	9600	13528
00 Vestfjord			282	851	1555	2205	3474	5465	5595	9600	15000
06–07 Nordland/Møre		74	383	801	1315	2025	2712	3548	5334		
Weigthed average	**8**	**43**	**240**	**683**	**1364**	**1893**	**2816**	**3834**	**5849**	**9600**	**13037**

Table 9.8 Percent mature at age for Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 1997.

	Age										
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**
03 East Finnmark	0	0	1	3	32	43	47	97	100		
04 West Finnmark/Troms		0	0	6	29	45	73	100	100	100	100
05 Lofoten/Vesterålen	0	0	0	8	4	26	86	100	100	100	100
00 Vestfjord			0	0	3	33	86	100	100	100	100
06–07 Nordland/Møre		0	0	13	53	60	80	86	100	100	
Weighted average	**0**	**0**	**0**	**6**	**29**	**45**	**76**	**97**	**100**	**100**	**100**

Table 9.9 Summary table from the preliminary VPA for Norwegian Coastal cod.

Run title: Coastal cod (run: XSANCC10/X10)
At 26-Aug-98 10:46:40

Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

```
RECRUITS, TOTALBIO, TOTSPBIO,LANDINGS,YIELD/SSB, SOPCOFAC, FBAR 4- 7,
Age 0
1984, 55083, 318254, 186721, 74824,.4007, 1.0001,.6219,
1985, 54152, 298443, 164085, 75451,.4598, 1.0000,.5272,
1986, 61075, 295776, 170966, 68905,.4030, 1.0001,.5798,
1987, 64145, 260962, 160284, 60972,.3804, 1.0000,.4900,
1988, 66042, 237837, 158132, 59294,.3750, 1.0001,.6138,
1989, 93841, 203988, 118322, 40285,.3405, 1.0000,.3687,
1990, 74997, 220615, 137231, 28127,.2050, 1.0002,.1784,
1991, 62083, 256966, 160241, 24822,.1549, 1.0002,.1651,
1992, 57675, 299884, 188293, 41690,.2214, 1.0001,.2329,
1993, 76697, 319426, 198195, 52557,.2652, 1.0000,.2283,
1994, 95422, 322945, 223999, 54562,.2436, 1.0000,.2350,
1995, 78949, 325725, 177530, 57207,.3222,  .9999,.2776,
1996, 96461, 300889, 189659, 61776,.3257, 1.0000,.3055,
1997, 68473, 287516, 179243, 63319,.3533, 1.0000,.2905,

Arith.
Mean, 71792, 282088, 172350, 54557,.3179.3653,
Units,thousands), (Tonnes), (Tonnes),(Tonnes),
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3 NORTH-EAST ARCTIC COD (SUB-AREAS I AND II)

3.1 Status of the fisheries

3.1.1 Historical development of the fisheries (Table 3.1)

From a level of about 900,000 t in the mid-1970s, landings declined steadily to around 300,000 t in 1983–1985 (Table 3.1). Landings increased to above 500,000 t in 1987 before dropping to 212,000 t in 1990, the lowest level recorded in the post-war period. The catches increased rapidly from 1991 onwards, and have been stable around 750,000 t since 1994. This level is the highest since 1977, and is also above the long-term mean for the period 1946–1997.

The fishery is conducted both with an international trawler fleet and with coastal vessels using traditional fishing gears. Quotas were introduced in 1978 for the trawler fleets and in 1989 for the coastal fleets. In addition to quotas, the fishery is regulated by a minimum catch size, a minimum mesh size in trawls and Danish seines, a maximum by-catch of undersized fish, closure of areas having high densities of juveniles and by seasonal and area restrictions.

3.1.2 Landings prior to 1998 (Tables 3.1–3.3, Figure 3.1A)

Final reported landings for 1996 amount to 726,879 t (Table 3.1), excluding 32,036 t of Norwegian coastal cod. The provisional figures for 1997 are 754,832 t excluding 36,058 t of Norwegian coastal cod. This is about 85,000 t lower than the estimate of 840,000 t used by the Working Group last year. The catch of North-east Arctic cod and Norwegian coastal cod combined is about 100,000 t lower than the agreed TAC of 890,000 t, which includes 40,000 t of coastal cod. The catch by area, split into trawl and other gears, is given in Table 3.2 and the nominal catch by country is given in Table 3.3. From 1996 to 1997, catches decreased slightly in ICES Sub-area I but increased in the other areas (Table 3.1). For some ICES countries (Faroe Islands, France, Ireland) that had not reported their landings to ICES, catches were assumed to be the same in 1997 as in 1996. The catches by other non-quota countries than Iceland were estimated to be 1,575 tonnes in 1997 assuming the same ratio between catches of Iceland and other non-quota countries as in 1995.

3.1.3 Expected landings in 1998

The mixed Norwegian-Russian Fisheries Commission agreed on a TAC for North-east Arctic cod and Norwegian coastal cod combined for 1998 of 694,000 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 1998, 80,000 t was allocated to third countries and 6,000 t transferred from Russia to Norway, giving a Norwegian TAC of 313,000 t (coastal cod included) and a Russian TAC of 301,000 t. Of the Norwegian TAC, 209,710 t (67%) was allocated to the fishery with conventional gears and 103,290 t (33%) to the trawl fishery.

The Working Group has no information on the size of expected unreported landings in 1998 but believes this problem may continue.

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 (equal to the TAC) for the current year (1998). The Working Group bases this on information from the Norwegian and Russian authorities. There is a comprehensive monitoring program by the Norwegian coast guard that includes counting vessels at sea and checkpoints for catch control and reporting.

3.2 Status of research

3.2.1 Fishing effort and CPUE (Table A1)

CPUE series of the Norwegian, Russian and Spanish trawl fisheries are given in Table A1. The data reflect the total trawl effort, both for Norway and Russia. The Norwegian series has been revised and is given as a total for all areas in the tuning data series (Table 3.12), but the indices by area in Table A1 have not been updated.

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

Mehl (1998) describes the results from the Norwegian survey on demersal fish in the Barents Sea in winter 1998. Tables A2 and A3 show the time series of abundance estimates (acoustic and bottom trawl, respectively) from this survey. A substantial part of the stock distribution area (i.e., the Russian EEZ) was not surveyed in both the 1997 and 1998 surveys. Indices for the total area in 1997 and 1998, therefore, were estimated by dividing the indices for the Norwegian zone in 1997 (1998) by the index for the Norwegian zone in 1996 and multiplying by the total for 1996 (i.e., the most recent survey in which area coverage was complete). The part of Svalbard Area covered during the winter survey varies from year to year due to the extent of ice coverage and the indices for this area are not included in the adjustment procedure but added to the total afterwards for both the 1997 and 1998 data. This was not done in the previous adjustment of the 1997 data used in last year's assessment. The 1996 indices were used for adjustment because in comparison to recent years with complete coverage (1993–1996), 1996 was the year having oceanographic conditions most similar to 1997 and 1998. The text table below shows the proportions found in the Norwegian zone in 1993–1996.

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

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

The estimated abundance indices from the Norwegian acoustic survey off Lofoten and Vesterålen (the main spawning area for this stock) in March/April are given in Table A4. A description of the survey, sampling effort and details of the estimation procedure can be found in Korsbrekke (1997).

A further adjustment (not described in Korsbrekke 1997) has been made to the Lofoten time series. Due to the intense fishing activity (gillnets, longlines) there are few or no trawl samples from the highest densities of spawning cod. Most trawl samples are from medium or low densities with a higher proportion of coastal cod. This bias has been compensated by treating all echo abundance above medium density as North-east Arctic cod and using the observed proportions of coastal cod on the echo abundance observed at lower densities. This procedure was applied for the period 1993 to 1998. A linear regression between the percentage reduction in the coastal cod and total echo abundance in each stratum gave a reasonably good fit ($R^2 = 0.5–0.8$) and this relationship was then used to correct the data prior to 1993. The average change to the time series is an increase in indices by age by approximately 25 percent with the largest relative changes to some of the low value indices. The overall trend with respect to North-east Arctic cod is rather similar to the time series previously used.

Abundance estimates at age from the Norwegian bottom trawl survey in the Svalbard area in the autumn are given in Table A5. The indices in Table A5 have been recalculated to account for length-dependent effective spread of trawl.

Abundance estimates from the Russian autumn survey (November-December) are given in Table A10 (acoustic estimates) and Table A11 (bottom trawl estimates). ICES Division IIb was not covered during the 1996 survey, and only part of Division IIa was covered, while the coverage in Sub-area I was as in previous years. For the survey in autumn 1997, only ICES Divisions IIa and IIb were covered while the south-western part of Sub-area I was covered in February-March 1998. However, due to the serious difference in both timing and limited coverage it was considered inappropriate to use the data from the February-March period and accordingly there were no data available for Sub-area I for the 1997 survey. At last year's Working Group meeting, the bottom trawl indices for 1996 were adjusted for area coverage by assuming the same fish distribution as in 1995 and adjusted accordingly. This year, the total bottom trawl indices for both 1996 and 1997 have been re-adjusted assuming that area distribution by age group is reasonably represented by the average during the period 1982–1995.

The abundance of 0-group cod, as estimated in the International 0-group survey (Anon. 1998) are provided in Tables A14 and A15.

The Norwegian bottom trawl and acoustic surveys in the winter of 1998 both showed that the abundance of 1-group cod (the 1997 year class) was quite high, but the year class is perhaps not as strong as in previous years. The results from the Russian surveys in late autumn 1997 / winter 1998 and the International 0-group survey confirm this.

The Norwegian acoustic and bottom trawl surveys in the Barents Sea, which were given the highest weight in last year's tuning, both indicate that the mortality on ages 1–6 was higher in 1994–1997 than in the previous years, while the other surveys show more variable results. The 1995–1996 year classes appear strong in both surveys, while the 1992–1994 year classes are about average. The 1990 year class is strong according to all the surveys (strongest or second strongest in all surveys except the Russian trawl/acoustic survey). The 1989 and 1991 year class is also above average according to all the surveys. The Lofoten survey shows a very low abundance of the 1988 and older year classes.

3.2.3 Age reading

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

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

Length at age and weight at age from the Norwegian survey of the Barents Sea in winter are given in Tables A6 and A7, respectively. Since the lowest values usually are found in the eastern part of the area, the figures for 1997 and 1998 have been adjusted in the same way as the abundance indices, using the ratio '1996-total value/1996-Norwegian zone value' as adjusting factor in each age group. The length at age and weight at age from the Lofoten survey are given in Tables A8 and A9, respectively. The numbers for the Lofoten survey have been changed from those given in last year's report as described in Section 3.2.2 and data for 1985–1989 have been included (Korsbrekke 1997). Length at age and weight at age from the Russian survey in October-December are given in Tables A12 and A13, respectively. No adjustment for incomplete coverage has been carried out for the Russian survey.

The data on size at age from the autumn 1997 Russian survey and the winter 1998 Norwegian survey were in good agreement with each other. For ages 1–7, the size at age in 1998 differ little from the 1997 values, while for older ages, the size at age has declined from 1997 to 1998. Size at age is at a low level for all ages.

3.2.5 Maturity at age (Table 3.5)

Russian maturity ogives are available from 1984 until present. Norwegian maturity at age ogives were obtained by combining the Barents Sea and Lofoten surveys (1985–1998) according to the method described in Marshall *et al.* (1998). The Norwegian maturity ogives tend to give a higher percent mature at age compared to the Russian ogives, which is consistent with the generally higher growth rates observed in cod sampled by the Norwegian surveys. Norwegian maturity ogives for 1998 are lower than the Russian ones, for reasons unknown. To represent the maturity composition of the stock, the percent mature at age for the Russian and Norwegian surveys were arithmetically averaged. This is consistent with the approach used to estimate the weight at age in stock (described in Section 3.3.2). These ogives were used for 1985–1998. As in previous assessments, Norwegian ogives were used for 1982–1983 and knife- edge maturation at age 8 was assumed for the historical period prior to 1982.

3.3 Data used in the assessment

3.3.1 Catch at age (Table 3.8)

For 1996, 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 1996 landings. For 1997, 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 for Germany and Spain. The UK (England & Wales) provided age compositions from 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 < 1% for 1996 and 1997. The number at age was adjusted to make the SOP fit exactly to the nominal catch for these years.

The age composition of the cod catches in 1997 was made up of several year classes, mainly 1990–1992. These year classes (age groups 5–7) together contributed 73% of the catch in numbers.

3.3.2 Weight at age (Tables 3.4 and 3.9–3.10).

For 1996 and 1997, the mean weight at age in the catch (Table 3.9) was calculated as a weighted average of the weight at age in the catch for Norway, Russia (trawl only), Germany, Spain, the UK and Iceland. The weight at age in the catch for these countries is given in Table 3.4. The weight at age in the catch in 1997 was higher than what was assumed by the Working Group last year for ages 3–4 and lower for age groups 5 and older. Stock weights at age a (W_a) at the start of year y (Table 3.10) were calculated as follows:

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

where

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

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

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

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

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

For age groups 12 and older, the time series weights were used. As data for the Lofoten survey now are available also for the period 1985–1989, the weight at age in the stock for those years was updated using the formula above.

The stock weights at age in 1998 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 (Tables 3.5 and 3.11)

As noted in Section 3.2.5, arithmetic averages of the Russian and Norwegian maturity at age values were used for 1985–1998.

3.3.5 Tuning data (Table 3.12)

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

Name	Place	Season	Age	Years
Russian bottom trawl	Total area	Autumn	1–8	1981–1997
Norwegian bottom trawl	Svalbard	Autumn	1–8	1983–1997
Norwegian trawl fleet	Total area	All year	9–14	1985–1997
Russian trawl fleet	Total area	All year	9–14	1985–1997
Norwegian bottom trawl	Barents Sea	Winter	1–8	1980–1997
Norwegian acoustic	Barents Sea + Lofoten	Winter	1–11	1984–1997

Surveys that were conducted during winter were allocated to the end of the previous year. This was done so that data from the 1998 surveys could be included in the assessment. Some of the survey indices have been multiplied by a factor 10 or 100. This was done to keep the dynamics of the surveys even for very low indices, because 1.0 is added to the indices before the logarithm is taken.

3.3.6 Recruitment indices (Table 3.6)

There were four indices of recruitment available for the 1997 year class: the Russian bottom trawl index in Division IIb, the Norwegian Barents Sea trawl and acoustic survey indices as well as an index of recruitment from the International 0-group survey.

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. Bogstad and Mehl (1997) describe the method used for calculation of the consumption.

The cod stomach content data were taken from the joint PINRO-IMR stomach content database (Mehl and Yaragina 1992). About 6,000 cod stomachs from the Barents Sea are analysed annually. The stomachs are sampled throughout the year, although sampling is less frequent in the second quarter of the year.

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

The number of cod at age was taken from the VPA, and thus an iterative procedure has to be applied (Section 3.4.3). It was assumed that the mature part of the cod stock is found outside the Barents Sea for three months during the first half of the year. There were very few samples of the stomach contents of cod in the spawning areas. Thus, consumption by cod in the spawning period was omitted from the calculations. It is believed that the cod generally eats very little during spawning time, although some predation by cod on herring has been observed close to the spawning areas. The geographical distribution of the cod stock by season is based on Norwegian survey data.

The consumption by cod of various prey species is shown in Table A16. The consumption of capelin increased from 1996 to 1997. This is consistent with the increase in capelin biomass from 1996 to 1997 (Gjøsæter WD 1998). The consumption of cod by cod decreased, but is still at a relatively high level.

3.3.8 Prediction data

The input data to the short-term prediction with management option table (1998–2000) are given in Table 3.22.

The stock number at age in 1998 was taken from the final VPA (Table 3.18) for ages 4 and older. The number at age 3 was taken from the XSA (Table 3.13). The fishing pattern for 1998 and later years was set to the average of the last 3 years from the final VPA, scaled to the 1997 level, and additional the natural mortality due to cannibalism was set to the 1995–1997 average. The weight at age in the catch in 1998 for ages 3–11 was calculated assuming the same ratio between weight at age in the catch and in the stock as the average ratio for 1995–1997. For age 12 and older the weight in the stock and in the catch in 1997 was set equal to the values used for the period 1946–1981. The average maturity ogive, stock and catch weights for the years 1996–1998 was used for 1999 onwards. Preliminary results from the 1998 August survey indicate that the size at age is about the same as in 1997. This is in accordance with the weight at age prediction.

The recruitment at age 3 in 1999 (472 million) was calculated by applying the predicted natural mortality at age 2 in 1998 to the XSA estimate of age 2 fish at the beginning of 1998. The recruitment at age 3 in year 2000, i.e., the abundance of the 1997 year class at age 3 was estimated using RCT3 (Section 3.5.2).

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

As last year, 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 investigate the effects of cannibalism.

3.4.2 Recruitment (Table 3.7)

The only year class which needs to be estimated by the RCT3 program is the 1997 year class. Only the age 1 survey indices and the index from the international 0-group survey were included in the estimation, together with the VPA estimate at age 3. The results are given in Table 3.7.

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

Cannibalism in North-east Arctic cod has been described by Bogstad *et al.* (1994). It may have a significant influence on the recruitment to the fishery, and should thus be taken into account in the assessment. Inclusion of cannibalism into the VPA for North-east Arctic cod has been discussed by Korzhev and Tretyak (1992). Tretyak (1984) discusses the age-dependency of natural mortality in general. A multispecies VPA for the Barents Sea for the period 1980–1996, including cod as predator and cod, herring, capelin, shrimp, polar cod and haddock as prey, was presented by Tretyak *et al.* (1997). This MSVPA was run on a quarterly basis, with stomach data obtained from the joint PINRO-IMR stomach content database. Possible discrepancies between the VPA with cannibalism presented here and the Barents Sea MSVPA may be due to different aggregation of data, use of different age -length keys and weight at age data, and differences in the stomach evacuation rate model used.

Work on unifying and improving Russian and Norwegian methods on consumption calculations is in progress (see also Dolgov, WD 1998). It should be noted that the mean ambient winter temperatures of ages 1–3 in 1991–1995 were 1–3 °C lower than those used in the consumption estimates (Ottersen *et al.*, 1998), a difference which would reduce the consumption estimates by 10–30%. When estimates of ambient temperature become available for more years and other seasons, they should be used in consumption estimates. It is worth noting that today the same temperature is used for all ages in a given area and season.

The VPA for this assessment was run on ages 1–15+, so that predation on 0-group was not considered here, although this was taken into account in the MSVPA. Consumption of cod by cod was calculated by age group and treated as an additional catch in the XSA, which was run iteratively until convergence. The procedure converges quickly, as verified by the Comprehensive Fisheries Evaluation Working Group (ICES CM 1997/Assess:15).

The tuning diagnostics from VPA with cannibalism, are given in Table 3.13 and the total fishing mortalities (true fishing mortality plus mortality from cannibalism) and population numbers in Tables 3.14 and 3.15. The fit between the survey for ages 1 and 2 and the VPA that incorporated cannibalism is considerably better than the fit with the VPA without cannibalism, as shown in the text table below:

Survey	R^2 age 1 no cann.	R^2 age 1 cann.	R^2 age 2 no cann.	R^2 age 2 cann.
Nor Bt Bar Sea	0.29	0.86	0.46	0.79
Nor Ac Bar Sea	0.42	0.85	0.77	0.90
Nor Bt Svalbard	0.25	0.75	0.33	0.68
Rus Bt Bar Sea	0.40	0.78	0.61	0.67

The change in the reference F in 1997 when cannibalism was incorporated was small (0.02). The abundance of age groups 3–7 at the beginning of 1998 decreased, however, when cannibalism is included in the analysis, while the abundance of age groups 8 and 9 increased when cannibalism was included, as seen in the text table below.

N_{98} (million)	No cannibalism	Cannibalism
Age 3	807	801
Age 4	465	416
Age 5	178	146
Age 6	143	106
Age 7	116	91
Age 8	79	83
Age 9	15	17
F5–10, 1997	0.77	0.79

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

Year	Age 0 cons.	Age 1 cons.	Age 2 cons.	Age 3 cons.	Age 4 cons.	Age 5 cons.	Age 6 cons.
1984	0	440	23	+	0	0	0
1985	1478	380	71	+	0	0	0
1986	52	418	393	101	0	0	0
1987	653	175	277	14	0	0	0
1988	29	418	23	2	0	0	0
1989	957	138	+	0	0	0	0
1990	0	63	29	0	0	0	0
1991	127	150	217	2	0	0	0
1992	4049	1015	150	4	0	0	0
1993	4138	20513	527	55	1	+	0
1994	9262	7760	688	125	49	7	+
1995	9112	16912	829	273	93	3	+
1996	2579	23579	1468	151	61	21	1
1997	3839	16730	1795	240	27	2	+

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 1993–1997 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 acoustic estimates of 0-group abundance made by Nakken *et al.* (1995) and Hylen (1997). Mortalities induced by cannibalism on age 1 in 1993–1997 are high (1.0–2.5). The mortalities induced by cannibalism in 1997 are close to those predicted in last year's assessment.

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

In order to build a matrix of natural mortality which includes predation, the fishing mortality estimated in the final XSA analyses was split into the mortality caused by the fishing fleet (true F) and the mortality caused by cod cannibalism (M2 in MSVPA terminology) by using the number caught by fishing and by cannibalism. The new natural mortality data matrix was prepared by adding 0.2 (M1) to the predation mortality (M2). This new M matrix (Table 3.16) was used together with the new true Fs to run the final VPA on ages 3–15+.

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

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

3.5 Results of the assessment

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

The average age 5–10 fishing mortalities for the years 1981–1989 were in the range 0.7 to 1.0 (Table 3.21). The lowest value occurred during 1989 and the highest in 1987. In 1990, fishing mortality dropped to 0.29 as a result of management measures brought into effect to control the amount of fishing effort. Age 5–10 F then increased, reaching a level of about 0.75 in the period 1994–1997. F_{5-10} in 1991–1997 was higher than calculated in last year's assessment. The assumed fishing mortality in 1998 is also higher than predicted last year (0.79 vs. 0.63), and the spawning stock biomass in 1998 is estimated to be 631,000 t, compared to 811,000 t in last year's assessment. The reason for this is that the 1989–1991 year classes are somewhat weaker than estimated in last year's assessment. Fig 3.3 shows the results of a retrospective analysis when cannibalism is not taken into account. The retrospective analysis was not run with cannibalism included for technical reasons. It is seen that the stock size has been overestimated considerably in recent years.

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

Due to the large SOP discrepancies, the SOP corrected values are given. Reconstruction of the time series on weight at age in the catch and in the stock and the maturation ogive for the period 1946–1981 is continuing. This might address the problem of SOP discrepancies, but has turned out to be a more complicated task than expected.

3.5.2 Recruitment (Table 3.7)

The results of the RCT3 analysis are given in Table 3.7. The 1997 year class estimate at age 3 is 836 million individuals.

3.6 Reference points and safe biological limits

3.6.1 Biomass reference points

Jakobsen (1993) discusses past, present and future management of North-east Arctic cod. He suggested that to reduce the likelihood of poor year classes, the spawning stock biomass should be kept well above a level of 500,000 t (MBAL). This can also be seen from the stock/recruitment plot given in Figure 3.4. It is suggested to use 500,000 t as B_{pa} and the lowest observed value in the time series (112,000 t) as B_{lim}, which is consistent with the suggestions made by the ICES Study group on the Precautionary Approach to Fisheries Management (SGPAFM) (ICES CM 1998/ACFM:10).

3.6.2 Fishing mortality reference points

The yield per recruit analysis carried out by the Arctic Fisheries Working Group in 1997 gave estimates of $F_{0.1} = 0.12$ and $F_{max} = 0.24$. These reference points were not recalculated at the present meeting. F_{low}, F_{med} and F_{high} were calculated to be 0.24, 0.45 and 0.90, respectively. The present exploitation level is $F_{97} = 0.79$ (*status quo*) which is inbetween F_{med} and F_{high}.

The SGPAFM (ICES CM 1998/ACFM:10) suggested the limit reference point $F_{lim} = F_{med}$ for Northeast Arctic cod, haddock and saithe. A precautionary fishing mortality (F_{pa}) is then defined as $F_{pa} = F_{lim}e^{-1.645\sigma}$ ($\sigma = 0.2$–0.3). The present WG, however, found that setting $F_{lim} = F_{med}$ did not correspond very well with the exploitation history for those fish stocks (Jakobsen, WD 1998). It was therefore decided to try to estimate F_{pa} and other reference points by the PASoft program package (MRAG 1997). Data input and analysis performed are described by Motos (WD 1998). The main results for cod are presented in Figure 3.5. The estimates for $F_{0.1}$, and F_{max} were exactly the same as the values already estimated (see above), while the values for F_{med} and F_{high} were close. The median value for F_{loss} was estimated at 0.70, and the 5 th percentile of this value could be used as a precautionary reference fishing mortality, giving $F_{pa} = 0.42$. The WG agreed to recommend using this value for F_{pa}.

3.7 Catch options (Table 3.23)

The management option table (Table 3.23) shows that the expected catches in 1998 will give a decrease in F_{5-10} from 0.79 in 1997 to 0.71 in 1998. Fishing at F_{pa}, F_{med} and F_{sq} in 1999 gives catches of 360,000, 386,000 and 582,000 t, respectively, compared to the expected catch in 1998 of 654,000 t.

In Figure 3.1D the catch level in 1999 and spawning stock biomass level in 2000 are plotted against the fishing mortality in 1999.

3.8 Medium-term forecasts and management scenarios

3.8.1 Input data (Table 3.22)

The input data were the same used as for the short-term predictions, using the same data for the years after 2000 as for 1999 and 2000 (Table 3.22). The recruitment at age 3 of the 1998 and later year classes was set equal to the long-term average of 613 million, adjusted upwards to account for increased mortality at ages 3–5 due to cannibalism, i.e., 1,235 million individuals.

3.8.2 Methods

It was decided to limit the risk analysis for North-east Arctic cod this year to a single-species analysis, where uncertainty in the initial stock estimate and the recruitment is taken into account. A formal harvest control rule (including reduction of F when the SSB falls below B_{pa}) has not been defined for this stock, but it was decided to compute the average yield and risk for the SSB to fall below B_{pa} for the following harvesting strategies: F = 0.33 (F_{pa} proposed by the Study Group on the Precautionary Approach to Fisheries Management), F_{pa} = 0.42, F_{med} and F_{sq}, and for fixed TACs of 300,000 t, 400,000 t and 500,000 t. A ceiling on F of 1.5 and a ceiling on the annual catch of 1.5 million tonnes was applied.

The uncertainty of the initial stock estimate was modelled using a lognormal distribution with a standard error on log scale of 0.3 at age 4 and older. This value was also used during the simulations to account for future assessment errors. The uncertainty on the younger year classes was assumed to increase linearly from a standard error on log scale of 0.3 at age 4 to 0.75 at age 1. For the 1998 and 1999 year classes, a standard error of 0.9 on log scale was used. The errors in numbers at age are assumed not to be correlated. No uncertainty was put on the natural mortality, but the uncertainty in number at age for the younger year classes should also be viewed as an error accounting for the uncertainty in cannibalism-induced M. The standard error assumed for age 4 and older fish is not inconsistent with the uncertainty on the abundance of the older age groups (6–9) due to different choices for the age above which catchability is assumed to be independent of stock size in the XSA (see last year's report). It is reasonable to believe that the uncertainty attached to the estimate of younger age groups is larger than that attached to older age groups, and thus the standard error was set higher on the younger age groups.

A modified version of the general purpose simulation spreadsheet used for studying harvest control rules for Norwegian Spring-spawning herring at the 1998 WGNPBW meeting was used in the simulations. 500 simulations were performed for each harvest control rule.

For the harvesting strategies mentioned, deterministic medium-term (single option) predictions were also performed using IFAP.

3.8.3 Results (Table 3.25 and Figure 3.6A-G)

The results of the deterministic medium-term predictions for all the harvesting strategies mentioned are given in Table 3.25. The text table below shows the results of the risk analysis.

Harvest control rule	Average yield 1999–2002	P(SSB < 500 000 t during 1998–2003)	P(SSB< 500 000 t in 2003)
F = 0.33	364	0.38	0.01
F = 0.42	408	0.48	0.11
F = 0.46	425	0.59	0.19
F = 0.79	498	0.97	0.86
TAC = 300,000 tonnes, F< 1.5	300	0.36	0.05
TAC = 400,000 tonnes, F< 1.5	397	0.51	0.31
TAC = 500,000 tonnes, F< 1.5	473	0.74	0.64

Figures 3.6A-G show the probability distribution of the spawning stock biomass in the period 1998–2003 and the yield in the period 1998–2002 for all the harvesting strategies studied.

3.9 Comments to the assessment and the forecasts

3.9.1 General comments

The present assessment is, in the main aspects, a repetition of the assessment made in 1997, updated by one year based on new catch and survey data from 1997/1998. The XSA settings and other routines have not been changed. No attempts have been made in the current assessment to resolve the methodological problems, although these are considered to be highly significant. The choice of age range for which catchability is stock size dependent creates large uncertainty in the assessment, as discussed in last year's report. In addition to the new data, there are some revisions of survey and catch data from earlier years (see Sections 3.2.2 and 3.3.1). The problems with area coverage in the surveys continue and unless resolved will undermine the usefulness of the tuning series even further.

The results confirm that the trend of overestimation of the stock continues and the assessment represents yet another downward revision of the stock size. It is indicated that in order to keep the SSB above the MBAL of 500,000 t, a reduction of the TAC to a level of about 400,000 t in the next few years is required. Although the Working Group recognises that the assessment is very uncertain, experience would indicate that it most likely gives an overestimate of the current stock size.

3.9.2 Potential improvements in prediction input

Both changes in growth, maturation and cannibalism in North-east Arctic cod have been associated with fluctuations in the abundance of capelin, i.e., cod growth and maturation is positively correlated with capelin abundance (Yaragina and Marshall, WD 1998) and cod may switch to preying on cod when the abundance of capelin is low (Bogstad and Mehl, 1997). Gjøsæter (WD 1998) has provided a short-term prediction of capelin biomass level (2.3 million t in 1998 and 5.2 million t in 1999, compared to the 1997 survey value of 0.9 million t). The value of 5.2 million t is comparable to the pre-collapse capelin stock size. Significant changes in growth, maturation and cannibalism could occur if this prognosis holds true. It is hoped that short-term predictions of capelin biomass can become a standard element of the information submitted to the WG. It should be noted that the AFWG meets in late August, while the capelin survey ends in early October. A report on the assessment of Barents Sea capelin is presented to the October meeting of ACFM. If the capelin survey abundance and associated predictions for stock development differs considerably from the prognosis used by the AFWG, then the predictions for growth, maturation and cannibalism should be adjusted to account for this.

Figure 3.7 shows the development in natural mortality due to cannibalism for cod (prey) age group and the abundance of capelin in the period 1984–1997. There seems to be an inverse relationship between capelin biomass and cod cannibalism. A first attempt at predicting cannibalism based on capelin abundance, cod abundance and cod size at age has been made (Bogstad, WD 1998), but was considered to be too preliminary to be used for predictions this year. The relationship between capelin abundance and cod growth/maturation is not as clear-cut as for cod cannibalism.

3.9.3 Potential improvements to biomass reference points.

In the previous assessment (ICES CM 1998/Assess:2) it was suggested that an improved understanding of recruitment variation in the NEA cod stock could be achieved using more sensitive measures of reproductive potential (e.g., total egg production, effective spawner biomass). In response to comments by ACFM regarding the applicability of this conclusion to the historical time period an analysis of the Russian liver condition index (LCI) database (Yaragina 1996) was undertaken. A preliminary analysis of the LCI data suggests that interannual variation in liver energy reserves influences the recruitment potential for this stock. Future research will examine the suitability of derivatives of the LCI index (e.g., total liver energy of the stock) as proxies for the reproductive potential of the stock.

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	251,448	317,585	170,966		739,999
1996	278,364	294,019	154,496		726,879
1997 [1]	272,394	323,674	158,764		754,832

[1] Provisional figures.

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

	Sub-area I		Division IIa		Division IIb	
Year	Trawl	Others	Trawl	Others	Trawl	Others
1967	238.0	84.8	38.7	90.0	121.1	-
1968	588.1	54.4	44.2	118.3	269.2	-
1969	633.5	45.9	119.7	135.9	262.3	-
1970	524.5	79.4	90.5	153.3	85.6	-
1971	253.1	59.4	74.5	245.1	56.9	-
1972	158.1	38.9	49.9	285.4	33.0	-
1973	459.0	33.7	39.4	172.4	88.2	-
1974	677.0	46.5	41.0	83.2	254.7	-
1975	526.3	35.4	33.7	86.6	147.4	-
1976	466.5	60.2	112.3	124.9	103.5	-
1977	471.5	66.7	100.9	156.2	110.0	-
1978	360.4	57.9	117.0	146.2	17.3	-
1979	161.5	33.7	114.9	120.5	8.1	-
1980	133.3	35.4	83.7	115.6	12.5	-
1981	91.5	45.1	77.2	167.9	17.2	-
1982	44.8	51.8	65.1	171.0	21.0	-
1983	36.6	28.2	56.6	143.7	24.9	-
1984	24.5	29.8	46.9	150.7	25.6	-
1985	72.4	40.2	60.7	112.8	21.5	-
1986	109.5	48.1	116.3	86.4	69.8	-
1987	126.3	19.8	167.9	77.5	129.9	1.7
1988	149.1	17.6	122.0	88.0	58.2	0.2
1989	144.4	19.5	68.9	81.2	19.1	0.1
1990	51.4	10.9	47.4	52.1	24.5	0.8
1991	58.9	12.1	73.0	84.0	40.0	1.2
1992	103.7	20.5	80.0	92.8	85.6	0.9
1993	165.1	30.7	155.5	113.9	66.3	0.2
1994	312.1	41.3	165.8	140.6	84.3	1.9
1995	218.1	33.3	174.3	143.3	160.3	10.7
1996	245.7	32.7	135.0	159.0	147.7	6.8
1997 [1]	234.6	37.8	149.5	174.2	151.2	7.6

[1] Provisional figures.

Table 3.3 North-East Arctic COD. Nominal catch (t) by countries (Sub-area I and Divisions IIa and IIb combined). (Data provided by Working Group members.)

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Norway	Poland	United Kingdom	Russia[2]		Others	Total all countries
1961	3,934	13,755	3,921	8,129	268,377	-	158,113	325,780		1,212	783,221
1962	3,109	20,482	1,532	6,503	225,615	-	175,020	476,760		245	909,266
1963	-	18,318	129	4,223	205,056	108	129,779	417,964		-	775,577
1964	-	8,634	297	3,202	149,878	-	94,549	180,550		585	437,695
1965	-	526	91	3,670	197,085	-	89,962	152,780		816	444,930
1966	-	2,967	228	4,284	203,792	-	103,012	169,300		121	483,704
1967	-	664	45	3,632	218,910	-	87,008	262,340		6	572,605
1968	-	-	225	1,073	255,611	-	140,387	676,758		-	1,074,084
1969	29,374	-	5,907	5,543	305,241	7,856	231,066	612,215		133	1,197,226
1970	26,265	44,245	12,413	9,451	377,606	5,153	181,481	276,632		-	933,246
1971	5,877	34,772	4,998	9,726	407,044	1,512	80,102	144,802		215	689,048
1972	1,393	8,915	1,300	3,405	394,181	892	58,382	96,653		166	565,287
1973	1,916	17,028	4,684	16,751	285,184	843	78,808	387,196		276	792,686
1974	5,717	46,028	4,860	78,507	287,276	9,898	90,894	540,801		38,453	1,102,434
1975	11,309	28,734	9,981	30,037	277,099	7,435	101,843	343,580		19,368	829,377
1976	11,511	20,941	8,946	24,369	344,502	6,986	89,061	343,057		18,090	867,463
1977	9,167	15,414	3,463	12,763	388,982	1,084	86,781	369,876		17,771	905,301
1978	9,092	9,394	3,029	5,434	363,088	566	35,449	267,138		5,525	698,715
1979	6,320	3,046	547	2,513	294,821	15	17,991	105,846		9,439	440,538
1980	9,981	1,705	233	1,921	232,242	3	10,366	115,194		8,789	380,434
						Spain					
1981	12,825	3,106	298	2,228	277,818	14,500	5,262	83,000		-	399,037
1982	11,998	761	302	1,717	287,525	14,515	6,601	40,311		-	363,730
1983	11,106	126	473	1,243	234,000	14,229	5,840	22,975		-	289,992
1984	10,674	11	686	1,010	230,743	8,608	3,663	22,256		-	277,651
1985	13,418	23	1,019	4,395	211,065	7,846	3,335	62,489		4,330	307,920
1986	18,667	591	1,543	10,092	232,096	5,497	7,581	150,541		3,505	430,113
1987	15,036	1	986	7,035	268,004	16,223	10,957	202,314		2,515	523,071
1988	15,329	2,551	605	2,803	223,412	10,905	8,107	169,365		1,862	434,939
1989	15,625	3,231	326	3,291	158,684	7,802	7,056	134,593		1,273	332,481
1990	9,584	592	169	1,437	88,737	7,950	3,412	74,609		510	187,000
1991	8,981	975	**Greenland**	2,613	126,226	3,677	3,981	119,427 [3]		3,278	269,158
1992	11,663	262	3,337	3,911	168,460	6,217	6,120	182,315	**Iceland**	1,209	383,494
1993	17,435	3,572	5,389	5,887	221,051	8,800	11,336	244,860	9,374	3,907	531,611
1994	22,826	1,962	6,882	8,283	318,395	14,929	15,579	291,925	36,737	28,568	746,086
1995	22,262	4,912	7,462	7,428	319,987	15,505	16,329	296,158	34,214	15,742	739,999
1996	17,758	3	6,529	6,529	319,158	15,871	16,061	305,317	23,005	14,851	726,879
1997 [1]	17,758	3	6,426	6,680	357,036	17,130	18,066	313,344	5,891	12,498	754,832

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

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

Norway

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1984	1.16	1.47	1.97	2.53	3.13	3.82	4.81	5.95	7.19	7.86	8.46	7.99	9.78	10.64
1985	0.76	1.47	1.90	2.49	3.32	4.21	5.01	5.94	7.10	8.20	8.92	9.73	9.85	9.26
1986	(1.20)	1.24	1.94	2.53	3.36	4.54	5.60	5.94	6.73	8.20	8.76	9.94	7.80	8.23
1987	0.56	0.92	1.45	2.24	3.04	4.17	5.33	6.62	6.99	8.33	8.58	9.58	8.27	10.67
1988	0.54	0.55	0.82	1.36	2.38	3.75	5.84	7.05	8.55	11.28	11.63	14.10	-	-
1989	0.36	0.86	1.06	1.34	1.96	3.22	5.07	8.09	9.45	11.60	10.54	-	18.61	17.11
1990	1.19	1.62	1.73	1.95	2.54	3.42	5.07	8.18	10.48	14.16	17.85	-	14.34	-
1991	1.05	1.47	1.86	2.34	3.00	3.66	4.60	6.02	8.97	11.75	17.32	-	-	-
1992	0.39	1.25	1.85	2.54	3.29	4.35	5.29	6.20	8.27	12.21	11.72	-	14.66	20.58
1993	0.53	0.87	1.73	2.44	3.39	4.30	5.47	6.29	7.10	7.78	10.00	16.14	18.99	17.41
1994	0.63	0.86	1.40	2.23	3.34	4.27	5.56	6.88	7.43	8.01	9.61	11.39	7.79	19.89
1995	0.49	0.81	1.29	1.87	2.80	4.12	5.11	5.91	7.90	8.69	9.23	11.52	17.46	24.33
1996	0.46	0.90	1.15	1.67	2.58	4.08	6.04	6.60	7.92	9.37	10.57	11.36	9.47	22.81
1997	0.61	0.95	1.25	1.63	2.29	3.45	5.32	7.21	7.36	8.02	10.86	7.80	12.63	-

Russia (trawl only)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1984	0.22	0.76	1.30	2.04	2.90	4.12	5.56	8.76	13.55	14.95	14.85	19.52	19.31	22.37
1985	0.29	0.77	1.23	1.75	2.64	3.93	5.35	6.72	9.87	9.00	13.72	15.10	15.20	19.25
1986	0.22	0.63	1.15	1.75	2.44	4.09	6.19	8.15	10.31	11.73	17.29	-	27.30	-
1987	0.24	0.41	0.92	1.51	2.14	2.95	5.62	7.13	11.17	10.90	12.29	-	-	-
1988	0.11	0.48	0.82	1.33	2.07	3.04	4.93	7.08	9.68	-	17.50	22.10	-	-
1989	0.22	0.46	0.87	1.25	1.84	2.71	4.34	6.59	9.14	12.47	14.32	13.60	-	-
1990	0.34	0.77	1.33	1.86	2.27	3.31	4.36	7.20	9.34	8.53	12.87	-	-	-
1991	0.26	0.55	0.93	1.59	2.45	3.37	4.78	6.74	11.61	17.63	9.45	19.20	15.40	19.40
1992	0.26	0.92	1.40	2.14	3.24	4.62	5.81	7.49	10.16	17.45	19.00	-	23.00	-
1993	0.20	0.65	1.30	2.03	2.76	4.36	5.97	6.94	8.15	11.12	15.24	17.28	-	22.30
1994	0.17	0.35	1.09	1.85	2.82	3.67	5.95	7.82	8.58	11.12	17.90	23.35	-	-
1995	0.16	0.29	0.75	1.69	2.53	3.99	5.71	7.92	9.33	10.50	12.14	18.80	-	-
1996	0.19	0.45	0.93	1.50	2.47	3.63	6.03	8.91	10.16	11.77	17.54	20.12	-	-
1997	0.20	0.49	0.94	1.45	2.12	3.40	5.07	8.04	10.72	11.54	15.60	18.53	25.88	-

Germany (Division IIa and IIb)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994	-	0.68	1.04	2.24	3.49	4.51	5.79	6.93	8.16	8.46	8.74	9.48	15.26	-
1995	-	0.44	0.84	1.50	2.72	3.81	4.46	4.81	7.37	7.69	8.25	9.47	-	-
1996	-	0.84	1.15	1.64	2.53	3.58	4.13	3.90	4.68	6.98	6.43	11.32	-	-
1997	-	0.43	0.92	1.42	2.01	3.15	4.04	5.16	4.82	3.96	7.04	8.80	-	-

Spain (Division IIb)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994	0.43	1.08	1.38	2.32	2.47	2.68	3.46	5.20	7.04	6.79	7.20	8.04	10.46	15.35
1995	0.42	0.51	0.98	1.99	3.41	4.95	5.52	8.62	9.21	11.42	9.78	8.08	-	-
1996	-	0.66	1.12	1.57	2.43	3.17	3.59	4.44	5.48	6.79	8.10	-	-	-
1997 [1]	0.51	0.65	1.22	1.68	2.60	3.39	4.27	6.67	7.88	11.34	13.33	10.03	8.69	-

[1] IIa and IIb combined

Iceland (Sub-area I)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994	0.42	0.85	1.44	2.77	3.54	4.08	5.84	6.37	7.02	7.48	7.37	-	-	-
1995	-	1.17	0.91	1.60	2.28	3.61	4.73	6.27	-	-	6.26	-	-	-
1996	-	0.36	0.99	1.55	2.83	3.79	4.81	5.34	7.25	7.68	9.08	8.98	10.52	-
1997	0.42	0.43	0.76	1.60	2.40	3.45	4.40	5.74	6.15	-	8.28	10.52	9.89	-

UK (England & Wales)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1995 [1]	-	-	1.47	2.11	3.47	5.57	6.43	7.17	8.12	8.05	10.17	10.08	-	-
1996 [2]	-	-	1.55	1.81	2.42	3.61	6.30	6.47	7.83	7.91	8.93	9.38	10.91	-
1997 [2]	-	-	1.93	2.17	3.07	4.17	4.89	6.46	-	12.27	8.44	-	-	-

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

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
1997	-	-	1	10	48	73	90	100
1998	-	-	2	16	51	89	97	96

Norway

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

Table 3.6

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

5,32,2 (No. of surveys, No. of years, VPA Column No.),,

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,	270,	1,	1,	155,	51.5,	108
1985,	196,	3,	10,	246,	741.8,	1302
1986,	158,	1,	2,	137,	33.4,	3
1987,	213,	1,	1,	17,	5.0,	2
1988,	416,	1,	1,	33,	9.4,	9
1989,	759,	1,	1,	38,	161.0,	350
1990,	1024,	6,	1,	123,	470.8,	187
1991,	831,	3,	6,	230,	131.6,	348
1992,	713,	10,	60,	294,	534.1,	1686
1993,	467,	2,	5,	209,	861.8,	1083
1994,	786,	16,	3,	227,	4892.4,	2644
1995,	-11,	25,	36,	240,	5788.8,	2404
1996,	-11,	10,	-11,	287,	5244.5,	1520
1997,	-11,	-11,	16,	160,	2814.5,	3082

R-1-1	Russian Bottom trawl survey, area I, age 1
R-2B-1	Russian IIb, age 1
INT0GP	International 0-group survey
N-BST1	Norwegian Barents Sea, Bottom trawl survey, age 1
N-BSA1	Norwegian Barents Sea Acoustic survey age 1

Table 3.7

Analysis by RCT3 ver3.1 of data from file :

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

Data for 5 surveys over 32 years : 1966 - 1997, Regression type = C, Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

Yearclass = 1995

	I-----------Regression----------				I-----------Prediction---------				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	1.51	4.18	.95	.353	25	3.26	9.09	1.361	.119
R-2B-1	2.52	2.34	2.65	.066	25	3.61	11.45	3.506	.018
INTOGP	.02	3.02	2.13	.098	29	240.00	8.29	2.533	.034
N-BST1	.51	3.58	.98	.328	15	8.66	7.96	1.235	.144
N-BSA1	.43	3.99	.88	.390	14	7.79	7.30	1.061	.195
					VPA Mean =		6.13	.670	.490

Yearclass = 1996

	I-----------Regression----------				I-----------Prediction---------				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	1.47	4.22	.95	.346	25	2.40	7.73	1.194	.150
R-2B-1									
INTOGP	.02	2.81	2.26	.086	29	287.00	9.39	2.841	.027
N-BST1	.51	3.54	.99	.324	15	8.57	7.92	1.257	.136
N-BSA1	.42	3.99	.87	.388	14	7.33	7.10	1.053	.193
					VPA Mean =		6.16	.659	.494

Yearclass = 1997

	I-----------Regression----------				I-----------Prediction---------				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1									
R-2B-1	2.80	1.86	3.14	.045	25	2.83	9.80	3.929	.016
INTOGP	.02	2.63	2.35	.078	29	160.00	6.41	2.758	.032
N-BST1	.52	3.49	.99	.319	15	7.94	7.60	1.249	.157
N-BSA1	.42	3.98	.87	.387	14	8.03	7.38	1.090	.206
					VPA Mean =		6.20	.646	.588

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1995	1264	7.14	.47	.54	1.30		
1996	996	6.90	.46	.41	.80		
1997	836	6.73	.50	.36	.54		

Table 3.8

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:26

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

YEAR,	1946,	1947,
AGE		
3,	4008,	710,
4,	10387,	13192,
5,	18906,	43890,
6,	16596,	52017,
7,	13843,	45501,
8,	15370,	13075,
9,	59845,	19718,
10,	22618,	47678,
11,	10093,	31392,
12,	9573,	9348,
13,	5460,	9330,
14,	1927,	4622,
+gp,	750,	4103,
0 TOTALNUM,	189376,	294576,
TONSLAND,	706000,	882017,
SOPCOF %,	67,	57,

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

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
AGE										
3,	140,	991,	1281,	24687,	24099,	47413,	11473,	3902,	10614,	17321,
4,	3872,	6808,	10954,	77924,	120704,	107659,	155171,	37652,	24172,	33931,
5,	31054,	35214,	29045,	64013,	113203,	112040,	146395,	201834,	129803,	27182,
6,	55983,	100497,	45233,	46867,	73827,	55500,	100751,	161336,	250472,	70702,
7,	77375,	83283,	62579,	37535,	49389,	22742,	40635,	84031,	86784,	87033,
8,	21482,	29727,	30037,	33673,	20562,	16863,	10713,	30451,	51091,	39213,
9,	15237,	13207,	19481,	23510,	24367,	10559,	11791,	13713,	14987,	17747,
10,	9815,	5606,	9172,	10589,	15651,	10553,	8557,	9481,	7465,	6219,
11,	30041,	8617,	6019,	4221,	8327,	5637,	6751,	4140,	3952,	3232,
12,	7945,	13154,	4133,	1288,	3565,	1752,	2370,	2406,	1655,	1220,
13,	4491,	3657,	6750,	1002,	647,	468,	896,	867,	1292,	347,
14,	3899,	1895,	1662,	3322,	467,	173,	268,	355,	448,	299,
+gp,	4205,	2167,	1450,	611,	1044,	156,	123,	128,	166,	173,
0 TOTALNUM,	265539,	304823,	227796,	329242,	455852,	391515,	495894,	550296,	582901,	304619,
TONSLAND,	774295,	800122,	731982,	827180,	876795,	695546,	826021,	1147841,	1343068,	792557,
SOPCOF %,	62,	68,	78,	88,	75,	84,	78,	82,	84,	83,

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Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:26

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

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE										
3,	31219,	32308,	37882,	45478,	42416,	13196,	5298,	15725,	55937,	34467,
4,	133576,	77942,	97865,	132655,	170566,	106984,	45912,	25999,	55644,	160048,
5,	71051,	148285,	64222,	123458,	167241,	205549,	97950,	78299,	34676,	69235,
6,	40737,	53480,	67425,	51167,	89460,	95498,	58575,	68511,	42539,	22061,
7,	38380,	18498,	23117,	38740,	28297,	35518,	19642,	25444,	37169,	26295,
8,	35786,	17735,	8429,	17376,	21996,	16221,	9162,	8438,	18500,	25139,
9,	13338,	23118,	7240,	5791,	7956,	11894,	6196,	3569,	5077,	11323,
10,	10475,	9483,	11675,	6778,	2728,	3884,	3553,	1467,	1495,	2329,
11,	3289,	3748,	4504,	5560,	2603,	1021,	783,	1161,	380,	687,
12,	1070,	997,	1843,	1682,	1647,	1025,	172,	131,	403,	316,
13,	252,	254,	354,	910,	392,	498,	387,	67,	77,	225,
14,	40,	161,	102,	280,	280,	129,	264,	91,	9,	40,
+gp,	141,	98,	226,	108,	103,	157,	131,	179,	70,	14,
0 TOTALNUM,	379354,	386107,	324884,	429983,	535685,	491574,	248025,	229081,	251976,	352179,
TONSLAND,	769313,	744607,	622042,	783221,	909266,	776337,	437695,	444930,	483711,	572605,
SOPCOF %,	88,	86,	88,	91,	92,	78,	82,	90,	94,	88,

Table 3.8 Continued

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	3709,	2307,	7164,	7754,	35536,	294262,	91855,	45282,	85337,	39594,
4,	174585,	24545,	10792,	13739,	45431,	131493,	437377,	59798,	114341,	168609,
5,	267961,	238511,	25813,	11831,	26832,	61000,	203772,	226646,	79993,	136335,
6,	107051,	181239,	137829,	9527,	12089,	20569,	47006,	118567,	118236,	52925,
7,	26701,	79363,	96420,	59290,	7918,	7248,	12630,	29522,	47872,	61821,
8,	16399,	26989,	31920,	52003,	34885,	8328,	4370,	9353,	13962,	23338,
9,	11597,	13463,	8933,	12093,	22315,	19130,	2523,	2617,	4051,	5659,
10,	3657,	5092,	3249,	2434,	4572,	4499,	5607,	1555,	936,	1521,
11,	657,	1913,	1232,	762,	1215,	677,	2127,	1928,	558,	610,
12,	122,	414,	260,	418,	353,	195,	322,	575,	442,	271,
13,	124,	121,	106,	149,	315,	81,	151,	231,	139,	122,
14,	70,	23,	39,	42,	121,	59,	83,	15,	26,	92,
+gp,	46,	46,	35,	25,	40,	55,	62,	37,	53,	54,
0 TOTALNUM,	612679,	574026,	323792,	170067,	191622,	547596,	807885,	496126,	465946,	490951,
TONSLAND,	1074084,	1197226,	933246,	689048,	565254,	792685,	1102433,	829377,	867463,	905301,
SOPCOF %,	96,	87,	97,	112,	108,	114,	103,	90,	102,	99,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	78822,	8600,	3911,	3407,	8948,	3108,	7027,	19282,	16942,	5570,
4,	45400,	77484,	17086,	9466,	20933,	19594,	14165,	38322,	55859,	100391,
5,	88495,	43677,	81986,	20803,	19345,	20473,	18839,	27216,	75486,	97318,
6,	56823,	31943,	40061,	63433,	28084,	17656,	20350,	20342,	27772,	62371,
7,	25407,	16815,	17664,	21788,	42496,	17004,	15415,	13588,	13337,	12901,
8,	31821,	8274,	7442,	9933,	8395,	18329,	8359,	4385,	4587,	3942,
9,	9408,	10974,	3508,	4267,	2878,	2545,	6054,	1904,	1082,	1021,
10,	1227,	1785,	3196,	1311,	708,	646,	764,	1062,	559,	435,
11,	913,	427,	678,	882,	271,	229,	221,	163,	455,	140,
12,	446,	103,	79,	109,	260,	74,	153,	59,	124,	233,
13,	748,	59,	24,	37,	27,	58,	56,	51,	29,	17,
14,	48,	38,	26,	3,	5,	20,	12,	45,	32,	21,
+gp,	51,	45,	8,	1,	5,	5,	12,	38,	1,	8,
0 TOTALNUM,	339609,	200224,	175669,	135440,	132355,	99741,	91427,	126457,	196265,	284368,
TONSLAND,	698715,	440538,	380434,	399038,	363730,	289992,	277651,	307920,	430113,	523071,
SOPCOF %,	100,	107,	97,	110,	108,	98,	95,	99,	94,	97,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	3988,	3874,	1541,	4927,	23082,	10706,	5848,	2770,	6997,	9906,
4,	21234,	19833,	5171,	8489,	37919,	46750,	63180,	36969,	24412,	30610,
5,	144215,	28126,	10615,	15565,	25781,	63886,	108060,	119167,	73690,	60870,
6,	59397,	83802,	15467,	18995,	21304,	32692,	58302,	98373,	103238,	80702,
7,	21302,	23501,	31161,	20909,	18390,	14562,	23735,	30632,	56465,	70167,
8,	3415,	4943,	6665,	27404,	13199,	9418,	9019,	7182,	11051,	29777,
9,	1200,	917,	830,	4193,	18518,	6359,	6154,	2813,	1969,	4740,
10,	320,	321,	163,	410,	2282,	12920,	4040,	1788,	883,	1139,
11,	67,	46,	41,	32,	185,	1931,	7822,	1326,	524,	361,
12,	60,	8,	14,	8,	73,	394,	967,	2118,	214,	214,
13,	51,	1,	9,	1,	3,	59,	102,	217,	807,	128,
14,	7,	9,	5,	1,	8,	23,	15,	41,	84,	221,
+gp,	15,	7,	2,	5,	4,	2,	4,	1,	2,	1,
0 TOTALNUM,	255271,	165388,	71684,	100939,	160748,	199702,	287248,	303397,	280336,	288836,
TONSLAND,	434939,	332481,	212000,	319158,	513494,	581611,	771086,	739999,	726879,	754832,
SOPCOF %,	96,	103,	100,	97,	100,	100,	100,	100,	100,	100,

Table 3.9

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:26

Table 2 Catch weights at age (kg)

	YEAR	1946	1947
	AGE		
	3	.6500	.6500
	4	1.0000	1.0000
	5	1.5500	1.5500
	6	2.3500	2.3500
	7	3.4500	3.4500
	8	4.7000	4.7000
	9	6.1700	6.1700
	10	7.7000	7.7000
	11	9.2500	9.2500
	12	10.8500	10.8500
	13	12.5000	12.5000
	14	13.9000	13.9000
	+gp	15.0000	15.0000
0	SOPCOFAC	.6735	.5708

Table 2 Catch weights at age (kg)

	YEAR	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
	AGE										
	3	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500
	4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	5	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500
	6	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500
	7	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500
	8	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000
	9	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700
	10	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000
	11	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500
	12	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500
	13	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000
	14	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000
	+gp	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
0	SOPCOFAC	.6152	.6799	.7781	.8813	.7499	.8396	.7790	.8170	.8448	.8346

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Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:26

Table 2 Catch weights at age (kg)

	YEAR	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
	AGE										
	3	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500
	4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	5	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500
	6	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500
	7	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500
	8	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000
	9	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700
	10	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000
	11	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500
	12	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500
	13	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000
	14	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000
	+gp	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
0	SOPCOFAC	.8831	.8562	.8819	.9069	.9175	.7829	.8184	.8965	.9415	.8787

Table 2 Catch weights at age (kg)

	YEAR	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
	AGE										
	3	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500	.6500
	4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	5	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500	1.5500
	6	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500	2.3500
	7	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500	3.4500
	8	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000	4.7000
	9	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700	6.1700
	10	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000	7.7000
	11	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500	9.2500
	12	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500
	13	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000	12.5000
	14	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000	13.9000
	+gp	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
0	SOPCOFAC	.9561	.8743	.9734	1.1182	1.0788	1.1430	1.0271	.9007	1.0236	.9928

Table 3.9 Continued

Table 2 Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.9000,	1.3500,	1.2500,	.9700,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.4600,	1.8400,	1.5600,	1.6100,	1.1000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	2.1900,	2.4300,	2.1400,	2.2100,	1.9200,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.7800,	3.1100,	3.1900,	2.9900,	2.5600,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.8400,	4.1800,	4.3100,	3.4400,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	5.0600,	5.7300,	5.4100,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.8200,	6.6900,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,
0 SOPCOFAC,	1.0037,	1.0713,	.9731,	1.1050,	1.0767,	.9837,	.9538,	.9936,	.9390,	.9670,

Table 2 Catch weights at age (kg)

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	.5200,	.5200,	1.1000,	.9800,	1.0100,	.7400,	.6400,	.5300,	.7600,	.6800,
4,	.8200,	.9000,	1.5300,	1.4900,	1.5500,	1.4800,	1.2000,	.9800,	1.0200,	1.0300,
5,	1.3400,	1.2700,	1.8900,	1.9800,	2.3000,	2.1500,	2.0700,	1.7500,	1.5500,	1.4900,
6,	2.2700,	1.9100,	2.3600,	2.6300,	3.2600,	2.9000,	3.0400,	2.6600,	2.5200,	2.1900,
7,	3.4800,	3.0100,	3.3800,	3.4500,	4.5100,	4.2200,	3.8300,	4.0700,	3.8800,	3.4400,
8,	5.3800,	4.8900,	4.7500,	4.6700,	5.6000,	5.6400,	5.5600,	5.3900,	5.9000,	5.2000,
9,	7.0600,	7.6800,	7.8900,	6.3000,	6.5800,	6.5100,	7.0400,	6.4200,	6.8600,	7.2700,
10,	8.9000,	9.3600,	10.1400,	9.6200,	8.8600,	7.3000,	7.7500,	8.3200,	8.1600,	7.8500,
11,	9.2500,	10.5700,	13.2400,	11.7500,	12.2100,	8.3000,	8.2000,	9.1600,	9.7000,	8.3000,
12,	10.8500,	10.8500,	16.9400,	17.3200,	11.7200,	10.3600,	9.4100,	9.6300,	10.3400,	11.4600,
13,	12.5000,	12.5000,	12.5000,	19.2000,	12.5000,	14.7100,	10.8000,	11.2700,	11.0400,	10.7400,
14,	13.9000,	13.9000,	13.9000,	15.4000,	14.6600,	12.8000,	9.5600,	17.2700,	9.6700,	12.4800,
+gp,	15.0000,	15.0000,	15.0000,	19.4000,	20.5800,	11.7500,	19.8900,	21.1100,	24.3300,	15.0000,
0 SOPCOFAC,	.9588,	1.0344,	.9984,	.9690,	1.0008,	1.0013,	1.0005,	1.0001,	1.0003,	.9999,

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Table 3.10

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:26

Table 3 Stock weights at age (kg)

YEAR,	1946,	1947,
AGE		
3,	.6500,	.6500,
4,	1.0000,	1.0000,
5,	1.5500,	1.5500,
6,	2.3500,	2.3500,
7,	3.4500,	3.4500,
8,	4.7000,	4.7000,
9,	6.1700,	6.1700,
10,	7.7000,	7.7000,
11,	9.2500,	9.2500,
12,	10.8500,	10.8500,
13,	12.5000,	12.5000,
14,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,

Table 3 Stock weights at age (kg)

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
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,

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Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:26

Table 3 Stock weights at age (kg)

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
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 3.10 cont.

Table 3 Stock weights at age (kg)

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
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,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.3600,	.5300,	.4600,	.3200,	.2100,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0100,	1.2000,	.9100,	.9300,	.5000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.6300,	1.9000,	1.7100,	1.5800,	1.2500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.5300,	2.9100,	2.8900,	2.5400,	2.0500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.9700,	4.0700,	3.9900,	3.4300,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	5.8500,	5.7500,	4.4700,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	7.6900,	6.5800,	6.5200,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	10.1200,	6.8300,	9.3000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	14.2800,	11.0000,	13.1500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	13.4800,	12.5500,
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,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	.1900,	.3000,	.3900,	.4800,	.4500,	.3500,	.2400,	.2000,	.1900,	.1900,
4,	.3600,	.5100,	.7200,	1.1400,	.9300,	1.1800,	.7600,	.5000,	.4900,	.5200,
5,	.7400,	.8600,	1.1900,	1.7300,	1.7800,	1.8300,	1.4200,	1.1500,	.9700,	1.0700,
6,	1.8000,	1.4900,	1.7000,	2.4400,	2.7300,	2.8200,	2.4700,	2.1100,	2.0500,	1.8800,
7,	2.8900,	2.6900,	2.4800,	3.2400,	3.9100,	4.0100,	3.8900,	3.4900,	3.5300,	3.3700,
8,	5.3000,	4.6300,	3.5700,	4.5600,	5.1700,	5.4700,	5.5200,	5.0100,	5.5000,	5.2500,
9,	7.8100,	7.0500,	4.7100,	7.0100,	6.7700,	6.7600,	6.6600,	7.1300,	7.7700,	8.9300,
10,	12.1100,	9.9800,	7.8000,	10.7200,	9.5900,	8.5600,	7.6600,	8.9100,	10.1600,	12.1500,
11,	13.1100,	9.2500,	8.9600,	9.4500,	12.4300,	10.8500,	8.1100,	10.1000,	10.6700,	11.3600,
12,	10.8500,	26.0000,	10.8500,	10.8500,	17.8000,	14.7100,	10.1000,	10.6800,	12.0800,	12.6700,
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,

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Table 3.11

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Table 5 Proportion mature at age

YEAR,	1946,	1947,
AGE		
3,	.0000,	.0000,
4,	.0000,	.0000,
5,	.0000,	.0000,
6,	.0000,	.0000,
7,	.0000,	.0000,
8,	1.0000,	1.0000,
9,	1.0000,	1.0000,
10,	1.0000,	1.0000,
11,	1.0000,	1.0000,
12,	1.0000,	1.0000,
13,	1.0000,	1.0000,
14,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

1

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Table 5 Proportion mature at age

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.11 cont.

Table 5 Proportion mature at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0500,	.0800,	.0500,	.0100,	.0500,	.0100,
5,	.0000,	.0000,	.0000,	.0000,	.1000,	.1000,	.1800,	.0900,	.0800,	.0700,
6,	.0000,	.0000,	.0000,	.0000,	.3400,	.3000,	.3100,	.3600,	.1900,	.1800,
7,	.0000,	.0000,	.0000,	.0000,	.6500,	.7300,	.5600,	.5500,	.5300,	.2200,
8,	1.0000,	1.0000,	1.0000,	1.0000,	.8200,	.8800,	.9000,	.8500,	.7100,	.4600,
9,	1.0000,	1.0000,	1.0000,	1.0000,	.9200,	.9700,	.9900,	.9600,	.6200,	.5000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	.9000,	.7500,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0200,	.0000,	.0100,	.0400,	.0100,	.0300,	.0100,	.0000,	.0000,	.0000,
5,	.0500,	.0500,	.0500,	.0600,	.1200,	.0900,	.1100,	.0700,	.0200,	.0200,
6,	.3300,	.1800,	.2100,	.2800,	.4300,	.3000,	.3300,	.3300,	.2600,	.1400,
7,	.5300,	.4100,	.5800,	.6500,	.7500,	.6100,	.6000,	.6200,	.6300,	.5600,
8,	.6200,	.6900,	.7700,	.8300,	.9300,	.9100,	.8100,	.7400,	.8300,	.8200,
9,	1.0000,	.8500,	.8600,	.9700,	.9700,	.9700,	.9700,	.9500,	.9800,	.9500,
10,	1.0000,	1.0000,	.9800,	1.0000,	1.0000,	.9900,	.9900,	.9800,	1.0000,	.9500,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9900,	1.0000,	1.0000,	.9500,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

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Table 3.12

Cod in the North-East Arctic (Areas I and II) (run name: XSABJA11)
106
FLT01: FLT43: Russian Trawl/Acoustic survey (ages 1-8) (Catch: Unknown) (
(Catch: Unknown) (Effort: Unknown)
1982 1997
1 1 0.90 1.00
1 8

1	6	181	141	51	13	26	7	2
1	89	43	56	73	47	20	8	11
1	92	142	162	86	50	31	11	4
1	49	430	303	405	188	49	19	6
1	22	91	565	161	106	30	8	3
1	2	40	59	426	54	31	6	1
1	2	25	77	78	190	25	6	1
1	1	6	34	88	111	155	114	26
1	31	78	38	44	66	60	113	18
1	59	98	110	62	68	77	56	46
1	78	395	485	182	69	53	52	40
1	28	131	647	597	334	91	34	33
1	33	120	300	475	500	180	61	14
1	64	46	124	267	287	126	27	8
1	134	99	68	113	164	114	44	10
1	48	184	174	76	59	33	14	5

FLT02: FLT45: Norwegian Svalbard Bottom Trawl Survey (ages 1-8) (Catch: U
(Catch: Unknown) (Effort: Unknown)
1983 1997
1 1 0.75 0.85
1 8

1	173.7	25.4	9.3	7.4	1.7	1.4	0.7	0.9
1	598.4	106.8	6.3	3.3	3.4	1.3	0.3	0.3
1	280.6	447.7	81.1	21.5	9.8	3.9	0.7	0.3
1	49.8	182.3	260.6	32.5	11.0	1.9	0.7	0.2
1	48.7	112.3	128.0	103.5	12.5	3.9	0.4	0.1
1	3.6	16.8	31.0	27.5	29.2	6.8	0.4	0.4
1	4.5	2.6	13.5	10.7	9.3	13.9	2.3	0.3
1	80.9	8.9	7.3	11.5	17.4	11.8	14.3	1.4
1	134.2	92.1	20.6	6.3	9.9	11.5	9.7	13.6
1	112.9	125.1	85.9	42.6	11.5	5.2	4.1	2.4
1	178.1	135.6	126.5	48.8	21.0	2.4	2.8	1.6
1	88.4	174.5	90.7	43.8	38.9	18.6	4.2	1.6
1	448.1	67.1	108.6	83.0	69.3	33.7	11.5	2.8
1	548.2	192.5	60.0	38.1	35.1	31.9	17.7	2.3
1	245.9	206.4	55.0	18.2	10.3	10.2	6.9	2.0

FLT03: FLT52: Norwegian trawl catch and effort age 9 - 14 (Catch: Thous
(Catch: Unknown) (Effort: Unknown)
1985 1997
1 1 0.00 1.00
9 14

0.45	269	84	13	18	25	9
0.58	93	100	44	21	3	0
0.95	277	121	25	70	7	13
1.01	167	73	13	14	33	0
0.76	156	73	20	0	0	4
0.51	34	16	0	0	0	0
0.66	149	5	1	0	0	0
0.42	1506	185	34	17	0	2
0.41	814	2060	466	58	5	1
0.84	744	453	932	138	10	0
0.71	422	55	27	204	0	0
0.68	296	187	90	31	131	6
0.98	403	99	42	22	30	31

Table 3.12 Continued

FLT04: FLT53: Russian trawl catch and effort ages 9 - 14 (Catch: Thousa
(Catch: Unknown) (Effort: Unknown)
1985 1997
1 1 0.00 1.00
9 14

0.70	178	99	2	1	0	1
1.52	184	0	29	0	0	0
2.40	174	43	0	0	0	0
2.77	271	78	0	0	0	0
2.12	266	91	15	2	1	0
1.11	346	61	13	3	0	0
1.56	953	56	2	1	2	0
4.35	3871	482	0	0	0	0
2.68	1818	2042	245	33	2	1
2.95	1209	926	454	0	0	0
3.83	518	452	326	386	0	0
3.71	308	123	100	0	0	0
4.89	906	164	30	30	30	0

FLT05: FLT54: Norwegian Barents Sea Trawl survey shifted swept area corre
(Catch: Unknown) (Effort: Unknown)
1980 1997
1 1 0.99 1.00
1 8

1	343	164	233	400	384	48	10	3
1	29	283	277	236	155	160	14	2
1	190	223	371	333	135	46	30	6
1	3932	1159	262	189	106	32	5	2
1	7276	1444	995	157	64	25	2	1
1	4615	6571	1371	750	233	55	6	2
1	4574	2334	3655	461	113	14	4	1
1	729	1852	953	1895	191	36	6	1
1	136	365	649	352	779	87	8	2
1	508	233	301	336	197	239	13	4
1	2247	323	191	175	161	93	97	5
1	5289	1496	495	184	118	75	40	27
1	3310	3118	1526	690	142	69	42	22
1	4968	2763	2976	1459	469	88	23	12
1	5038	2882	2312	2492	704	180	22	7
1	7155	1776	1160	1369	1075	245	29	4
1	10964	2586	686	794	570	302	67	12
1	6863	4241	1941	443	304	200	111	13

FLT06: FLT61: Norwegian Barents Sea and Lofoten acoustic survey (Catch: M
(Catch: Unknown) (Effort: Unknown)
1984 1997
1 1 0.99 1.00
1 11

1	7680.0	1790.0	1270.0	216.8	164.5	193.6	34.1	14.5	13.1	4.5	0.0
1	5900.0	5950.0	1240.0	584.9	103.0	75.4	30.1	4.6	0.0	4.0	0.8
1	720.0	960.0	2560.0	547.7	190.4	12.3	38.3	3.4	0.0	0.3	0.3
1	290.0	640.0	420.0	765.7	134.3	45.6	3.5	3.1	0.5	0.0	0.0
1	90.0	200.0	430.0	270.4	701.9	177.3	32.0	6.8	1.2	0.0	0.6
1	450.0	160.0	240.0	271.3	246.0	670.2	78.5	14.9	3.2	0.0	0.0
1	2340.0	550.0	310.0	270.0	300.0	338.3	468.7	37.5	1.9	1.7	0.0
1	5790.0	1820.0	480.0	207.4	162.3	288.0	248.7	816.0	41.7	16.1	2.2
1	4320.0	3000.0	1630.0	848.7	285.8	243.5	232.2	264.4	449.5	47.4	7.1
1	6860.0	3580.0	3430.0	1827.8	688.5	193.6	102.1	77.8	44.9	175.3	26.1
1	2800.0	1810.0	1610.0	2204.9	1042.4	303.4	42.7	37.2	35.6	21.5	79.6
1	3350.0	960.0	700.0	874.1	894.3	450.0	66.5	10.9	5.5	8.0	13.0
1	4700.0	1820.0	540.0	514.0	419.5	495.6	205.0	25.0	7.2	0.0	7.5
1	5540.0	3790.0	1870.0	450.5	333.0	320.6	250.5	52.4	5.1	1.8	0.2

Table 3.13

Lowestoft VPA Version 3.1
27-Aug-98 11:01:49
Extended Survivors Analysis
Arctic Cod (run: XSABJA11/X11)

CPUE data from file /users/fish/ifad/ifapwork/afwg/cod_arct/FLEET.X11

Catch data for 36 years. 1962 to 1997. Ages 1 to 15.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT01: FLT43: Russia,	1982,	1997,	1,	8,	.900,	1.000
FLT02: FLT45: Norweg,	1983,	1997,	1,	8,	.750,	.850
FLT03: FLT52: Norweg,	1985,	1997,	9,	14,	.000,	1.000
FLT04: FLT53: Russia,	1985,	1997,	9,	14,	.000,	1.000
FLT05: FLT54: Norweg,	1980,	1997,	1,	8,	.990,	1.000
FLT06: FLT61: Norweg,	1984,	1997,	1,	11,	.990,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 6

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

Catchability independent of age for ages >= 13

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00231

Final year F values

Age	1,	2,	3,	4,	5,	6,	7,	8,	9,	10
Iteration 29,	2.3350,	1.1083,	.4344,	.3076,	.4299,	.5926,	.5695,	.9604,	.9368,	1.2411
Iteration 30,	2.3350,	1.1083,	.4344,	.3076,	.4299,	.5926,	.5695,	.9604,	.9368,	1.2410

Age	11,	12,	13,	14
Iteration 29,	1.0872,	.9761,	.5597,	1.1160
Iteration 30,	1.0870,	.9756,	.5590,	1.1153

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Table 3.13 (Cont'd)

Regression weights

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

Fishing mortalities

Age,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1,	.889,	.207,	.047,	.091,	.452,	2.511,	1.743,	1.936,	2.104,	2.335
2,	.122,	.002,	.061,	.229,	.125,	.450,	.625,	.954,	.991,	1.108
3,	.032,	.027,	.008,	.018,	.040,	.073,	.188,	.552,	.463,	.434
4,	.122,	.150,	.046,	.055,	.132,	.092,	.171,	.291,	.329,	.308
5,	.376,	.235,	.112,	.189,	.235,	.347,	.333,	.286,	.355,	.430
6,	.677,	.392,	.196,	.300,	.429,	.529,	.622,	.530,	.425,	.593
7,	1.134,	.631,	.246,	.443,	.534,	.592,	.964,	.797,	.672,	.570
8,	1.059,	.911,	.364,	.356,	.562,	.583,	.944,	.915,	.770,	.960
9,	1.144,	.961,	.364,	.411,	.435,	.587,	.998,	.911,	.696,	.937
10,	1.021,	1.201,	.431,	.307,	.412,	.624,	.966,	.937,	.845,	1.241
11,	1.041,	.374,	.450,	.138,	.221,	.749,	1.023,	1.056,	.810,	1.087
12,	1.167,	.311,	.185,	.146,	.534,	1.032,	1.146,	.890,	.461,	.976
13,	.931,	.046,	.696,	.018,	.074,	1.193,	.847,	.887,	1.102,	.559
14,	1.000,	.402,	.339,	.147,	.194,	1.288,	1.247,	1.062,	1.123,	1.115

Table 3.13 cont.

1

XSA population numbers (Thousands)

YEAR ,	AGE 1,	2,	3,	4,	5,	6,	7,	8,	9,	10,
1988 ,	7.85E+05,	2.21E+05,	1.98E-05,	2.05E+05,	5.08E+05,	1.33E+05,	3.47E+04,	5.79E+03,	1.95E+03,	5.53E+02,
1989 ,	8.19E+05,	2.64E+05,	1.60E+05,	1.57E+05,	1.49E+05,	2.86E+05,	5.55E+04,	9.14E+03,	1.64E+03,	5.07E+02,
1990 ,	1.51E+06,	5.46E+05,	2.16E+05,	1.27E+05,	1.11E+05,	9.59E+04,	1.58E+05,	2.42E+04,	3.01E+03,	5.14E+02,
1991 ,	1.91E+06,	1.18E+06,	4.20E+05,	1.75E+05,	9.97E+04,	8.10E+04,	6.45E+04,	1.01E+05,	1.38E+04,	1.71E+03,
1992 ,	3.09E+06,	1.43E+06,	7.68E+05,	3.38E+05,	1.36E+05,	6.75E+04,	4.91E+04,	3.39E+04,	5.80E+04,	7.47E+03,
1993 ,	2.47E+07,	1.61E+06,	1.03E+06,	6.04E+05,	2.42E+05,	8.79E+04,	3.60E+04,	2.36E+04,	1.58E+04,	3.08E+04,
1994 ,	1.04E+07,	1.64E+06,	8.40E+05,	7.86E+05,	4.51E+05,	1.40E+05,	4.24E+04,	1.63E+04,	1.08E+04,	7.21E+03,
1995 ,	2.18E+07,	1.49E+06,	7.19E+05,	5.70E+05,	5.42E+05,	2.65E+05,	6.16E+04,	1.32E+04,	5.20E+03,	3.25E+03,
1996 ,	2.97E+07,	2.58E+06,	4.70E+05,	3.39E+05,	3.49E+05,	3.34E+05,	1.28E+05,	2.27E+04,	4.34E+03,	1.71E+03,
1997 ,	2.05E+07,	2.96E+06,	7.84E+05,	2.42E+05,	2.00E+05,	2.00E+05,	1.79E+05,	5.33E+04,	8.61E+03,	1.77E+03,

Estimated population abundance at 1st Jan 1998

,	.00E+00,	1.62E+06,	8.01E+05,	4.16E+05,	1.46E+05,	1.06E+05,	9.06E+04,	8.27E+04,	1.67E+04,	2.76E+03,

Taper weighted geometric mean of the VPA populations:

,	3.81E+06,	9.75E+05,	4.61E+05,	3.04E+05,	2.10E+05,	1.23E+05,	5.57E+04,	1.89E+04,	6.09E+03,	2.10E+03,

Standard error of the weighted Log(VPA populations) :

,	1.5579,	.8442,	.6706,	.6416,	.6434,	.6304,	.6872,	.8283,	1.0337,	1.2279,

YEAR ,	11,	AGE 12,	13,	14,
1988 ,	1.14E+02,	9.63E+01,	9.31E+01,	1.22E+01,
1989 ,	1.63E+02,	3.31E+01,	2.46E+01,	3.00E+01,
1990 ,	1.25E+02,	9.18E+01,	1.98E+01,	1.92E+01,
1991 ,	2.74E+02,	6.53E+01,	6.25E+01,	8.10E+00,
1992 ,	1.03E+03,	1.95E+02,	4.62E+01,	5.02E+01,
1993 ,	4.05E+03,	6.76E+02,	9.36E+01,	3.51E+01,
1994 ,	1.35E+04,	1.57E+03,	1.97E+02,	2.33E+01,
1995 ,	2.25E+03,	3.97E+03,	4.08E+02,	6.93E+01,
1996 ,	1.04E+03,	6.40E+02,	1.34E+03,	1.38E+02,
1997 ,	6.02E+02,	3.80E+02,	3.30E+02,	3.63E+02,

Estimated population abundance at 1st Jan 1998

,	4.19E+02,	1.66E+02,	1.17E+02,	1.55E+02,

Table 3.13 (Continued)

Taper weighted geometric mean of the VPA populations:

,   7.40E+02, 3.01E+02, 1.12E+02, 4.11E+01,

Standard error of the weighted Log(VPA populations) :

,   1.4063,   1.3297,   1.2125,   1.0650,

1

Log catchability residuals.

Fleet : FLT01: FLT43: Russia

Age	1980	1981	1982	1983	1984	1985	1986	1987
1	99.99	99.99	-.21	1.82	1.06	1.05	.67	-.49
2	99.99	99.99	1.83	-.21	.54	.76	.62	.24
3	99.99	99.99	1.00	.24	.18	.39	.19	-.15
4	99.99	99.99	.06	.38	.34	.73	-.19	-.07
5	99.99	99.99	-1.36	-.07	.02	1.23	-.02	-.89
6	99.99	99.99	-.37	-.33	.18	.68	.25	-.21
7	99.99	99.99	-1.77	-.76	.15	.69	-.10	-.24
8	99.99	99.99	-1.17	-.23	-.18	.75	.13	-1.04
9	No data for this fleet at this age							
10	No data for this fleet at this age							
11	No data for this fleet at this age							
12	No data for this fleet at this age							
13	No data for this fleet at this age							
14	No data for this fleet at this age							

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-.73	-1.93	.28	.64	.70	-.58	-.20	-.22	.25	-.07
2	.19	-1.30	.20	-.24	.67	-.13	-.08	-.53	-.40	.08
3	.32	-.05	-.29	-.18	.30	.23	-.03	-.27	-.33	-.19
4	-.14	.24	-.16	-.21	.02	.33	-.06	-.09	-.20	-.19
5	-.37	.18	-.17	.04	-.21	.91	.68	-.11	-.16	-.57
6	-.88	-.09	-.13	.39	.32	.69	.99	-.09	-.52	-1.09
7	-.70	1.30	-.12	.26	.55	.49	1.26	-.09	-.44	-2.02
8	-.87	1.79	-.07	-.57	.58	.77	.62	.25	-.21	-1.57
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

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

Age	6	7	8
Mean Log q	-6.8686	-6.7008	-6.5986
S.E(Log q)	.6135	.9233	.8923

Table 3.13 (Continued)

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,	.814,	11.35,	.78,	16,	.85,	-10.73,
2,	.85,	.669,	9.50,	.67,	16,	.61,	-8.73,
3,	.72,	2.059,	9.24,	.85,	16,	.30,	-7.75,
4,	.77,	1.824,	8.50,	.87,	16,	.26,	-7.27,
5,	1.01,	-.034,	6.92,	.57,	16,	.59,	-6.97,

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6,	1.81,	-1.640,	2.94,	.29,	16,	1.03,	-6.87,
7,	2.80,	-1.728,	-.92,	.09,	16,	2.38,	-6.70,
8,	1.41,	-.887,	5.27,	.32,	16,	1.27,	-6.60,

1

Fleet : FLT02: FLT45: Norweg

Age	1980	1981	1982	1983	1984	1985	1986	1987
1	99.99,	99.99,	99.99,	1.36,	1.64,	1.49,	.26,	1.14
2	99.99,	99.99,	99.99,	-.10,	.49,	.64,	1.02,	1.05
3	99.99,	99.99,	99.99,	-.29,	-1.40,	.26,	.47,	1.23
4	99.99,	99.99,	99.99,	-.01,	-.78,	-.15,	-.05,	.21
5	99.99,	99.99,	99.99,	-1.08,	-.45,	.34,	-.27,	-.35
6	99.99,	99.99,	99.99,	-.93,	-.94,	.19,	-.49,	-.30
7	99.99,	99.99,	99.99,	-1.05,	-1.35,	-.49,	-.42,	-.84
8	99.99,	99.99,	99.99,	-.62,	-.69,	-.16,	-.50,	-1.24
9	No data for this fleet at this age							
10	No data for this fleet at this age							
11	No data for this fleet at this age							
12	No data for this fleet at this age							
13	No data for this fleet at this age							
14	No data for this fleet at this age							

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-1.44,	-1.77,	.06,	.30,	-.08,	-.30,	-.59,	.23,	.22,	.05
2	.47,	-.90,	-.85,	-.12,	-.18,	-.09,	.13,	-.19,	-.08,	-.12
3	.46,	.05,	-.71,	-.60,	-.13,	-.12,	-.09,	.42,	.35,	-.25
4	.44,	.00,	.20,	-.57,	.28,	-.22,	-.52,	.37,	.31,	.07
5	-.33,	-.19,	.56,	.22,	.08,	.10,	.01,	.30,	.19,	-.27
6	-.15,	-.43,	.35,	.57,	.06,	-.89,	.76,	.65,	.28,	-.22
7	-1.31,	-.43,	.04,	.71,	.19,	.17,	.71,	1.21,	.81,	-.55
8	.32,	-.55,	-.42,	.42,	-.06,	-.08,	.57,	1.32,	.46,	-.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									

Table 3.13 cont'd.

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

Age ,	6,	7,	8
Mean Log q,	-9.0318,	-8.9955,	-8.8873,
S.E(Log q),	.5533,	.7842,	.6513,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	.88,	.626,	10.23,	.75,	15,	.93,	-9.57,
2,	.61,	1.781,	10.90,	.68,	15,	.58,	-9.01,
3,	.74,	.935,	9.97,	.58,	15,	.58,	-8.90,
4,	.77,	1.279,	9.93,	.75,	15,	.38,	-9.10,
5,	.87,	.741,	9.46,	.78,	15,	.36,	-9.05,

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
6,	.79,	.970,	9.59,	.70,	15,	.44,	-9.03,
7,	.73,	1.111,	9.53,	.63,	15,	.56,	-9.00,
8,	.89,	.484,	8.99,	.68,	15,	.60,	-8.89,

1

Fleet : FLT03: FLT52: Norweg

Age ,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987
1 ,	No data for this fleet at this age							
2 ,	No data for this fleet at this age							
3 ,	No data for this fleet at this age							
4 ,	No data for this fleet at this age							
5 ,	No data for this fleet at this age							
6 ,	No data for this fleet at this age							
7 ,	No data for this fleet at this age							
8 ,	No data for this fleet at this age							
9 ,	99.99,	99.99,	99.99,	99.99,	99.99,	1.03,	.19,	.88
10 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.05,	1.02,	1.31
11 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.00,	.15,	.39
12 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.50,	.70,	.57
13 ,	99.99,	99.99,	99.99,	99.99,	99.99,	1.00,	-.89,	.47
14 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.27,	99.99,	.95

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1 ,	No data for this fleet at this age									
2 ,	No data for this fleet at this age									
3 ,	No data for this fleet at this age									
4 ,	No data for this fleet at this age									
5 ,	No data for this fleet at this age									
6 ,	No data for this fleet at this age									
7 ,	No data for this fleet at this age									
8 ,	No data for this fleet at this age									
9 ,	.30,	.62,	-1.37,	-1.65,	-.31,	.46,	.21,	.51,	.29,	-.36
10 ,	.68,	1.12,	-.33,	-3.01,	-.38,	.74,	.10,	-1.06,	.81,	-.06
11 ,	.62,	.70,	99.99,	-2.78,	-.09,	1.42,	.30,	-1.27,	.65,	.18
12 ,	.25,	99.99,	99.99,	99.99,	.35,	.57,	-.08,	-.55,	-.75,	-.72
13 ,	.99,	99.99,	99.99,	99.99,	99.99,	.10,	-.81,	99.99,	.17,	-.50
14 ,	99.99,	.07,	99.99,	99.99,	-.64,	-.49,	99.99,	99.99,	-.63,	-.33

Table 3.13 (Cont'd)

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,	-2.1701,	-2.1639,	-2.2507,	-1.5770,	-1.5242,	-1.5242,
S.E(Log q),	.7989,	1.1839,	1.1480,	.5811,	.7111,	.6032,

Regression statistics :

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
9,	1.33,	-1.064,	.02,	.54,	13,	1.05,	-2.17,
10,	1.10,	-.310,	1.59,	.49,	13,	1.37,	-2.16,
11,	.88,	.491,	2.79,	.67,	12,	1.06,	-2.25,
12,	1.33,	-1.447,	.04,	.75,	10,	.72,	-1.58,
13,	1.13,	-.404,	1.05,	.69,	8,	.87,	-1.52,
14,	1.18,	-.546,	1.26,	.70,	7,	.71,	-1.73,

1

Fleet : FLT04: FLT53: Russia

Age ,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987
1 ,	No data for this fleet at this age							
2 ,	No data for this fleet at this age							
3 ,	No data for this fleet at this age							
4 ,	No data for this fleet at this age							
5 ,	No data for this fleet at this age							
6 ,	No data for this fleet at this age							
7 ,	No data for this fleet at this age							
8 ,	No data for this fleet at this age							
9 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.82,	.55,	.13
10 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.54,	99.99,	.11
11 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-1.06,	.02,	99.99
12 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.78,	99.99,	99.99
13 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
14 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.03,	99.99,	99.99

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
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 ,	.42,	.77,	.82,	-.01,	-1.06,	.03,	.09,	-.33,	-.73,	-.51
10 ,	.50,	1.08,	.99,	-.69,	-.99,	-.39,	.32,	.13,	-.54,	-.40
11 ,	99.99,	.63,	1.44,	-1.70,	99.99,	.14,	-.43,	.79,	.30,	-.51
12 ,	99.99,	.31,	.28,	-.83,	99.99,	.17,	99.99,	.45,	99.99,	.03
13 ,	99.99,	.03,	99.99,	.09,	99.99,	-.35,	99.99,	99.99,	99.99,	.23
14 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.03,	99.99,	99.99,	99.99,	99.99

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

Table 3.13 (cont'd)

Age ,	9,	10,	11,	12,	13,	14
Mean Log q,	-2.8150,	-2.9277,	-3.4967,	-3.6232,	-3.8652,	-3.8652,
S.E(Log q),	.6072,	.6708,	.9242,	.5082,	.2591,	.0476,

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,	1.63,	-2.827,	-.88,	.69,	13,	.76,	-2.82,
10,	1.39,	-1.888,	1.06,	.74,	12,	.83,	-2.93,
11,	1.06,	-.252,	3.29,	.71,	10,	1.05,	-3.50,
12,	.89,	.923,	3.84,	.95,	7,	.46,	-3.62,
13,	.93,	.408,	3.91,	.96,	4,	.29,	-3.87,
14,	.00,	.000,	.00,	.00,	0,	.00,	.00,

1

Fleet : FLT05: FLT54: Norweg

Age ,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987
1 ,	.10,	-2.05,	-1.28,	.97,	.71,	.86,	1.17,	.52
2 ,	-.33,	.06,	-.18,	.20,	.09,	.46,	.82,	.98
3 ,	.01,	.02,	.27,	-.09,	.10,	.10,	.20,	.47
4 ,	.35,	.28,	.47,	.11,	-.19,	.13,	-.43,	-.05
5 ,	-.10,	.05,	.30,	.09,	-.30,	.62,	-.66,	-.42
6 ,	-.38,	.11,	-.24,	-.30,	-.47,	.36,	-.93,	-.48
7 ,	-.55,	-.09,	-.10,	-1.01,	-1.33,	-.23,	-.56,	.00
8 ,	-.61,	-.67,	.49,	-1.38,	-1.00,	.21,	-.40,	-.48
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 ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1 ,	-1.13,	-.63,	-.12,	.40,	-.17,	-.18,	.05,	-.23,	-.04,	.13
2 ,	.21,	-.38,	-.83,	-.37,	-.10,	-.08,	.06,	.04,	-.21,	.10
3 ,	.46,	.08,	-.58,	-.51,	-.24,	-.01,	.09,	.00,	-.04,	.21
4 ,	-.01,	.24,	-.10,	-.37,	-.02,	-.09,	.08,	.06,	.22,	.12
5 ,	-.02,	-.02,	.01,	-.07,	-.19,	.29,	-.01,	.11,	.09,	.20
6 ,	-.06,	-.10,	-.14,	-.09,	.14,	.22,	.56,	.14,	.01,	.28
7 ,	-.17,	-.66,	-.08,	.13,	.54,	.30,	.47,	.20,	.19,	.26
8 ,	.38,	.47,	-.82,	-.58,	.52,	.30,	.48,	.11,	.52,	-.06
9 ,	No data for this fleet at this age									
10 ,	No data for this fleet at this age									
11 ,	No data for this fleet at this age									
12 ,	No data for this fleet at this age									
13 ,	No data for this fleet at this age									
14 ,	No data for this fleet at this age									

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

Age ,	6,	7,	8
Mean Log q,	-6.4000,	-6.8727,	-7.1001,
S.E(Log q),	.3507,	.4580,	.5512,

Table 3.13 (Cont'd)

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,	1.250,	7.39,	.86,	18,	.65,	-5.95,
2,	.72,	1.694,	8.02,	.79,	18,	.46,	-5.81,
3,	.76,	1.701,	7.56,	.83,	18,	.32,	-5.82,
4,	.72,	2.812,	7.77,	.91,	18,	.21,	-5.87,
5,	.81,	1.420,	7.24,	.85,	18,	.28,	-6.09,

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6,	.86,	.994,	7.16,	.83,	18,	.30,	-6.40,
7,	.83,	1.030,	7.57,	.78,	18,	.38,	-6.87,
8,	1.16,	-.664,	6.67,	.64,	18,	.65,	-7.10,

1

Fleet : FLT06: FLT61: Norweg

Age	1980	1981	1982	1983	1984	1985	1986	1987
1	99.99,	99.99,	99.99,	99.99,	1.02,	1.33,	-.18,	-.07
2	99.99,	99.99,	99.99,	99.99,	.42,	.51,	.34,	.39
3	99.99,	99.99,	99.99,	99.99,	.40,	.14,	.04,	-.03
4	99.99,	99.99,	99.99,	99.99,	-.01,	.03,	-.24,	-.59
5	99.99,	99.99,	99.99,	99.99,	.16,	-.43,	-.47,	-1.01
6	99.99,	99.99,	99.99,	99.99,	.74,	-.11,	-1.85,	-1.03
7	99.99,	99.99,	99.99,	99.99,	.17,	.04,	.36,	-1.88
8	99.99,	99.99,	99.99,	99.99,	-.01,	-.64,	-.86,	-1.03
9	99.99,	99.99,	99.99,	99.99,	.34,	99.99,	99.99,	-1.48
10	99.99,	99.99,	99.99,	99.99,	.42,	-.58,	-1.91,	99.99
11	99.99,	99.99,	99.99,	99.99,	99.99,	-.71,	-2.42,	99.99
12	No data for this fleet at this age							
13	No data for this fleet at this age							
14	No data for this fleet at this age							

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-1.31,	-.54,	.14,	.73,	.31,	.41,	-.17,	-.59,	-.45,	.26
2	.04,	-.37,	-.22,	-.06,	.01,	.23,	-.13,	-.24,	-.33,	.11
3	.27,	.04,	-.08,	-.41,	-.08,	.20,	-.07,	-.27,	-.10,	.29
4	-.22,	.07,	.18,	-.35,	.25,	.28,	.24,	-.12,	-.01,	.19
5	-.08,	-.07,	.30,	-.14,	.18,	.61,	.40,	.01,	-.25,	.15
6	-.14,	.15,	.36,	.47,	.61,	.22,	.30,	-.04,	-.28,	-.03
7	-.13,	-.20,	.16,	.62,	.91,	.46,	-.21,	-.30,	-.03,	-.27
8	-.08,	.10,	-.49,	1.15,	1.32,	.48,	.47,	-.57,	-.43,	-.35
9	-.52,	.44,	-1.28,	.34,	1.30,	.45,	1.01,	-.22,	.02,	-.77
10	99.99,	99.99,	-.18,	.74,	.45,	.56,	.25,	.03,	99.99,	-.55
11	.68,	99.99,	99.99,	.21,	.14,	.60,	.78,	.80,	.77,	-2.03
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

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

Age	6	7	8	9	10	11
Mean Log q,	-5.6148,	-5.5359,	-5.4174,	-5.5289,	-4.9047,	-4.7005,
S.E(Log q),	.6066,	.6262,	.7296,	.8585,	.7238,	1.1642,

Table 3.13 (Cont'd)

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1,	.87,	.955,	7.41,	.85,	14,	.67,	-6.23,
2,	.68,	2.919,	8.54,	.90,	14,	.29,	-6.01,
3,	.75,	2.219,	7.75,	.89,	14,	.23,	-5.96,
4,	.84,	1.178,	7.03,	.85,	14,	.27,	-5.96,
5,	1.03,	-.122,	5.75,	.71,	14,	.42,	-5.91,

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6,	1.04,	-.134,	5.34,	.50,	14,	.67,	-5.61,
7,	.89,	.417,	6.12,	.62,	14,	.58,	-5.54,
8,	.67,	2.147,	6.88,	.82,	14,	.42,	-5.42,
9,	.65,	2.666,	6.69,	.87,	12,	.43,	-5.53,
10,	.77,	1.457,	5.62,	.87,	10,	.52,	-4.90,
11,	.81,	.771,	5.15,	.71,	10,	.97,	-4.70,

1

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: FLT43: Russia,	1506558.,	.919,	.000,	.00,	1,	.038,	2.402
FLT02: FLT45: Norweg,	1703990.,	1.001,	.000,	.00,	1,	.032,	2.291
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	1856324.,	.704,	.000,	.00,	1,	.065,	2.214
FLT06: FLT61: Norweg,	2105550.,	.735,	.000,	.00,	1,	.060,	2.103
P shrinkage mean ,	974794.,	.84,,,,				.469,	2.805
F shrinkage mean ,	3095465.,	1.00,,,,				.335,	1.773

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1622695.,	.52,	.24,	6,	.452,	2.335

Age 2 Catchability dependent on age and year class strength

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: FLT43: Russia,	877653.,	.636,	.039,	.06,	2,	.081,	1.048
FLT02: FLT45: Norweg,	718658.,	.600,	.070,	.12,	2,	.093,	1.182
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	875020.,	.480,	.031,	.06,	2,	.143,	1.050
FLT06: FLT61: Norweg,	879234.,	.314,	.085,	.27,	2,	.344,	1.047
P shrinkage mean ,	460855.,	.67,,,,				.234,	1.510
F shrinkage mean ,	1834085.,	1.00,,,,				.105,	.635

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
800980.,	.24,	.13,	10,	.549,	1.108

Table 3.13 (Cont'd)

Age 3 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
FLT01: FLT43: Russia,	338155.,	.290,	.040,	.14,	3,	.246,	.512
FLT02: FLT45: Norweg,	340964.,	.471,	.062,	.13,	3,	.081,	.509
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	480585.,	.297,	.111,	.37,	3,	.223,	.386
FLT06: FLT61: Norweg,	470269.,	.233,	.199,	.85,	3,	.334,	.393
P shrinkage mean ,	303508.,	.64,,,,				.082,	.557
F shrinkage mean ,	746600.,	1.00,,,,				.034,	.265

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
415890.,	.14,	.08,	14,	.531,	.434

1
Age 4 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
FLT01: FLT43: Russia,	113215.,	.215,	.049,	.23,	4,	.258,	.381
FLT02: FLT45: Norweg,	161014.,	.314,	.084,	.27,	4,	.125,	.282
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	154979.,	.215,	.042,	.20,	4,	.256,	.292
FLT06: FLT61: Norweg,	151149.,	.193,	.099,	.51,	4,	.296,	.298
P shrinkage mean ,	210058.,	.64,,,,				.047,	.223
F shrinkage mean ,	231690.,	1.00,,,,				.019,	.204

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
145692.,	.11,	.05,	18,	.466,	.308

Age 5 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
FLT01: FLT43: Russia,	80551.,	.207,	.067,	.32,	5,	.197,	.536
FLT02: FLT45: Norweg,	106525.,	.249,	.147,	.59,	5,	.170,	.429
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	125606.,	.181,	.039,	.22,	5,	.305,	.375
FLT06: FLT61: Norweg,	101775.,	.181,	.074,	.41,	5,	.259,	.445
P shrinkage mean ,	123221.,	.63,,,,				.050,	.381
F shrinkage mean ,	155183.,	1.00,,,,				.020,	.313

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
106303.,	.10,	.05,	22,	.505,	.430

Table 3.13 (Cont'd

1
Age 6 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
FLT01: FLT43: Russia,	71647.,	.195,	.173,	.89,	6,	.201,	.704
FLT02: FLT45: Norweg,	99117.,	.231,	.099,	.43,	6,	.167,	.553
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	102857.,	.161,	.048,	.30,	6,	.346,	.538
FLT06: FLT61: Norweg,	85122.,	.167,	.067,	.40,	6,	.263,	.621
F shrinkage mean ,	109939.,	1.00,,,,				.024,	.511

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
90600.,	.09,	.05,	25,	.574,	.593

Age 7 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
FLT01: FLT43: Russia,	71376.,	.194,	.261,	1.34,	7,	.189,	.636
FLT02: FLT45: Norweg,	75919.,	.222,	.152,	.69,	7,	.162,	.608
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	90578.,	.155,	.046,	.29,	7,	.350,	.531
FLT06: FLT61: Norweg,	88424.,	.163,	.091,	.56,	7,	.274,	.541
F shrinkage mean ,	60360.,	1.00,,,,				.026,	.719

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
82729.,	.09,	.07,	29,	.749,	.570

1
Age 8 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
FLT01: FLT43: Russia,	15271.,	.222,	.265,	1.19,	8,	.171,	1.017
FLT02: FLT45: Norweg,	16796.,	.253,	.155,	.61,	8,	.176,	.957
FLT03: FLT52: Norweg,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: FLT53: Russia,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT05: FLT54: Norweg,	16317.,	.172,	.057,	.33,	8,	.343,	.975
FLT06: FLT61: Norweg,	16788.,	.187,	.087,	.46,	8,	.248,	.957
F shrinkage mean ,	23564.,	1.00,,,,				.062,	.762

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
16706.,	.11,	.07,	33,	.591,	.960

Table 3.13 cont.

Age 9 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
FLT01: FLT43: Russia,	2920.,	.241,	.177,	.74,	8,	.120,	.904
FLT02: FLT45: Norweg,	3887.,	.276,	.199,	.72,	8,	.128,	.744
FLT03: FLT52: Norweg,	1934.,	.834,	.000,	.00,	1,	.062,	1.169
FLT04: FLT53: Russia,	1661.,	.634,	.000,	.00,	1,	.108,	1.276
FLT05: FLT54: Norweg,	3370.,	.188,	.147,	.78,	8,	.243,	.821
FLT06: FLT61: Norweg,	2115.,	.263,	.148,	.57,	9,	.228,	1.108
F shrinkage mean ,	3970.,	1.00,,,,				.111,	.732

Table 3.13 (Cont'd)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2764.,	.17,	.08,	36,	.492,	.937

1
Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: FLT43: Russia,	421.,	.247,	.196,	.80,	8,	.069,	1.237
FLT02: FLT45: Norweg,	562.,	.287,	.337,	1.18,	8,	.072,	1.041
FLT03: FLT52: Norweg,	472.,	.734,	.175,	.24,	2,	.082,	1.158
FLT04: FLT53: Russia,	248.,	.498,	.157,	.31,	2,	.195,	1.641
FLT05: FLT54: Norweg,	403.,	.192,	.127,	.66,	8,	.137,	1.268
FLT06: FLT61: Norweg,	299.,	.364,	.091,	.25,	10,	.239,	1.491
F shrinkage mean ,	898.,	1.00,,,,				.206,	.764

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
419.,	.25,	.10,	39,	.385,	1.241

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

Year class = 1986

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: FLT43: Russia,	182.,	.218,	.110,	.50,	8,	.055,	1.028
FLT02: FLT45: Norweg,	223.,	.243,	.079,	.33,	8,	.055,	.901
FLT03: FLT52: Norweg,	247.,	.758,	.184,	.24,	3,	.116,	.844
FLT04: FLT53: Russia,	102.,	.521,	.054,	.10,	3,	.224,	1.437
FLT05: FLT54: Norweg,	193.,	.169,	.081,	.48,	8,	.105,	.990
FLT06: FLT61: Norweg,	81.,	.501,	.355,	.71,	10,	.162,	1.620
F shrinkage mean ,	277.,	1.00,,,,				.283,	.780

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
166.,	.33,	.11,	41,	.333,	1.087

1
Age 12 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
FLT01: FLT43: Russia,	163.,	.217,	.087,	.40,	8,	.027,	.784
FLT02: FLT45: Norweg,	156.,	.240,	.117,	.49,	8,	.026,	.807
FLT03: FLT52: Norweg,	66.,	.531,	.251,	.47,	4,	.252,	1.368
FLT04: FLT53: Russia,	126.,	.441,	.050,	.11,	4,	.343,	.933
FLT05: FLT54: Norweg,	149.,	.167,	.096,	.58,	8,	.051,	.834
FLT06: FLT61: Norweg,	178.,	.394,	.111,	.28,	11,	.089,	.735
F shrinkage mean ,	152.,	1.00,,,,				.212,	.821

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
117.,	.29,	.07,	44,	.229,	.976

Table 3.13 cont.

Age 13 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
FLT01: FLT43: Russia,	159.,	.225,	.104,	.46,	8,	.013,	.547
FLT02: FLT45: Norweg,	199.,	.245,	.161,	.66,	8,	.013,	.459
FLT03: FLT52: Norweg,	83.,	.459,	.123,	.27,	5,	.195,	.872
FLT04: FLT53: Russia,	198.,	.288,	.046,	.16,	4,	.622,	.461
FLT05: FLT54: Norweg,	178.,	.171,	.101,	.59,	8,	.026,	.501
FLT06: FLT61: Norweg,	226.,	.333,	.134,	.40,	11,	.036,	.414
F shrinkage mean ,	90.,	1.00,,,,				.094,	.829

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
155.,	.22,	.06,	45,	.287,	.559

1

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

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: FLT43: Russia,	90.,	.250,	.117,	.47,	8,	.012,	1.173
FLT02: FLT45: Norweg,	103.,	.269,	.147,	.55,	8,	.013,	1.080
FLT03: FLT52: Norweg,	75.,	.480,	.102,	.21,	6,	.441,	1.296
FLT04: FLT53: Russia,	119.,	.432,	.269,	.62,	4,	.078,	.988
FLT05: FLT54: Norweg,	88.,	.187,	.096,	.51,	8,	.025,	1.188
FLT06: FLT61: Norweg,	148.,	.272,	.173,	.64,	11,	.030,	.853
F shrinkage mean ,	122.,	1.00,,,,				.401,	.971

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
98.,	.45,	.05,	46,	.120,	1.115

1

Table 3.14

Run title : Arctic Cod (run: XSABJA11/X11)

At 22-Aug-98 12:58:35

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0001,	.0000,	.0008,	.0000,
2,	.0000,	.0013,	.0013,	.0019,	.0023,	.0140,	.0302,	.0017,	.0049,	.0157,
3,	.0242,	.0228,	.0406,	.0212,	.0390,	.1949,	.2125,	.0829,	.1647,	.1330,
4,	.2057,	.2209,	.1416,	.1022,	.1661,	.1981,	.4952,	.2086,	.3098,	.5657,
5,	.4073,	.4798,	.3821,	.2277,	.2965,	.3516,	.5356,	.5202,	.4765,	.7526,
6,	.4649,	.5367,	.5703,	.2355,	.3844,	.3903,	.5050,	.7002,	.5706,	.6798,
7,	.3984,	.7676,	.6192,	.5174,	.3140,	.4205,	.4432,	.7012,	.6935,	.6759,
8,	.5186,	.9268,	.8375,	.8320,	.6674,	.6424,	.4861,	.7020,	.8843,	.9060,
9,	.7784,	1.1442,	.9598,	.9326,	1.1402,	1.0097,	.4055,	.6122,	.7731,	1.2160,
10,	.7309,	.9990,	.9964,	.7684,	1.2436,	.7421,	.9799,	.4724,	.4603,	.7656,
11,	.5904,	1.1652,	.7073,	.6722,	1.2207,	.5912,	1.0088,	1.2006,	.3074,	.6260,
12,	.3900,	.9659,	.4561,	.5555,	.7818,	.6319,	.6318,	.8564,	1.0504,	.2401,
13,	1.3487,	.8623,	.7110,	.5185,	1.1510,	.4038,	1.7923,	1.4780,	.5108,	.9852,
14,	.7754,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,	.7742,
+gp,	.7754,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,	.7742,
0 FBAR 5-10,	.5497,	.8090,	.7276,	.5856,	.6743,	.5928,	.5592,	.6180,	.6430,	.8327,

1

Run title : Arctic Cod (run: XSABJA11/X11)

At 22-Aug-98 12:58:35

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	.0000,	.0000,	.0001,	.0000,	.0000,	.0000,	.2617,	.3706,	.5248,	.5415,
2,	.0036,	.0014,	.0023,	.0012,	.0005,	.0002,	.0421,	.0625,	.8367,	.8177,
3,	.1449,	.0484,	.0309,	.0239,	.0640,	.0203,	.0209,	.0440,	.1357,	.0845,
4,	.2223,	.2072,	.1282,	.0973,	.1996,	.1946,	.1214,	.1467,	.1713,	.1644,
5,	.6688,	.3460,	.3533,	.2274,	.2945,	.3063,	.2907,	.3606,	.4785,	.5068,
6,	.8474,	.5442,	.6219,	.5115,	.5465,	.4809,	.5712,	.5886,	.7788,	.9656,
7,	.8459,	.6578,	.6704,	.8507,	.7905,	.7716,	1.0745,	.9898,	1.0268,	1.1052,
8,	.9344,	.7531,	.6992,	1.0669,	.9976,	1.0067,	1.1989,	1.1089,	1.1944,	1.0413,
9,	1.2944,	1.0530,	.8719,	1.2339,	1.1227,	1.0047,	1.2058,	1.0341,	.9469,	.9827,
10,	.9904,	.9515,	1.0903,	1.0082,	.6800,	.8402,	1.0071,	.6956,	1.0499,	1.4906,
11,	1.8534,	1.2705,	1.3375,	1.0959,	.5789,	.4857,	.7990,	.6029,	.7463,	.8396,
12,	1.5007,	1.3531,	.8482,	.8023,	1.2631,	.3031,	.7139,	.5090,	1.4646,	1.1834,
13,	2.4659,	.8280,	1.6961,	1.4858,	.4657,	1.1746,	.3964,	.5520,	.5082,	.8140,
14,	1.6430,	1.1042,	1.1930,	1.1387,	.8306,	.7693,	.8330,	.6491,	.8315,	.8812,
+gp,	1.6430,	1.1042,	1.1930,	1.1387,	.8306,	.7693,	.8330,	.6491,	.8315,	.8812,
0 FBAR 5-10,	.9302,	.7176,	.7178,	.8164,	.7386,	.7351,	.8914,	.7963,	.9125,	1.0154,

Table 8 Fishing mortality (F) at age

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
1,	.8889,	.2067,	.0472,	.0909,	.4519,	2.5114,	1.7427,	1.9358,	2.1040,	2.3350,	2.1249,
2,	.1221,	.0018,	.0613,	.2292,	.1246,	.4500,	.6247,	.9543,	.9910,	1.1083,	1.0179,
3,	.0317,	.0271,	.0079,	.0182,	.0400,	.0729,	.1881,	.5525,	.4631,	.4344,	.4833,
4,	.1218,	.1503,	.0459,	.0550,	.1325,	.0923,	.1715,	.2909,	.3288,	.3076,	.3091,
5,	.3763,	.2353,	.1121,	.1895,	.2353,	.3474,	.3330,	.2863,	.3553,	.4299,	.3572,
6,	.6773,	.3919,	.1963,	.3002,	.4285,	.5292,	.6216,	.5296,	.4246,	.5926,	.5156,
7,	1.1345,	.6313,	.2458,	.4432,	.5343,	.5919,	.9641,	.7971,	.6721,	.5695,	.6796,
8,	1.0586,	.9110,	.3636,	.3557,	.5621,	.5829,	.9438,	.9154,	.7705,	.9604,	.8821,
9,	1.1441,	.9607,	.3637,	.4109,	.4348,	.5867,	.9982,	.9113,	.6962,	.9368,	.8481,
10,	1.0215,	1.2010,	.4312,	.3074,	.4122,	.6239,	.9658,	.9367,	.8447,	1.2410,	1.0074,
11,	1.0415,	.3740,	.4501,	.1384,	.2211,	.7491,	1.0231,	1.0560,	.8105,	1.0870,	.9845,
12,	1.1667,	.3111,	.1847,	.1456,	.5339,	1.0320,	1.1458,	.8899,	.4613,	.9756,	.7756,
13,	.9306,	.0461,	.6961,	.0179,	.0745,	1.1925,	.8468,	.8866,	1.1018,	.5590,	.8491,
14,	1.0000,	.4021,	.3395,	.1468,	.1936,	1.2881,	1.2475,	1.0616,	1.1226,	1.1153,	1.0998,
+gp,	1.0000,	.4021,	.3395,	.1468,	.1936,	1.2881,	1.2475,	1.0616,	1.1226,	1.1153,	
0 FBAR 5-10,	.9021,	.7219,	.2855,	.3345,	.4345,	.5437,	.8044,	.7294,	.6272,	.7884,	

1

Table 3.15

Run title : Arctic Cod (run: XSABJA11/X11)

At 22-Aug-98 12:58:36

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	29709,	61125,	153495,	274668,	80209,	96777,	92827,	52661,	97960,	30123,
2,	13789,	24323,	50044,	125671,	224876,	65670,	79234,	75990,	43115,	80139,
3,	17124,	11290,	19889,	40919,	102691,	183687,	53017,	62940,	62108,	35127,
4,	103775,	13684,	9034,	15636,	32800,	80861,	123765,	35095,	47433,	43128,
5,	88517,	69166,	8983,	6420,	11558,	22744,	54305,	61754,	23323,	28489,
6,	31822,	48225,	35047,	5019,	4186,	7035,	13102,	26023,	30052,	11857,
7,	8981,	16367,	23084,	16223,	3247,	2333,	3899,	6473,	10578,	13906,
8,	4479,	4937,	6219,	10175,	7918,	1942,	1255,	2049,	2629,	4329,
9,	2370,	2183,	1600,	2204,	3625,	3326,	836,	632,	832,	889,
10,	779,	891,	569,	502,	710,	949,	992,	456,	280,	314,
11,	163,	307,	269,	172,	190,	168,	370,	305,	233,	145,
12,	42,	74,	78,	108,	72,	46,	76,	110,	75,	140,
13,	19,	23,	23,	41,	51,	27,	20,	33,	38,	22,
14,	14,	4,	8,	9,	20,	13,	15,	3,	6,	19,
+gp,	9,	8,	7,	5,	6,	12,	11,	7,	12,	11,
0 TOTAL,	301590,	252607,	308351,	497773,	472160,	465590,	423723,	324532,	318675,	248639,

1

Run title : Arctic Cod (run: XSABJA11/X11)

At 22-Aug-98 12:58:36

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	21233,	23915,	23822,	25494,	57752,	77878,	211187,	135642,	113093,	46350,
2,	24663,	17384,	19580,	19501,	20872,	47283,	63760,	133086,	76661,	54783,
3,	64591,	20120,	14212,	15994,	15947,	17080,	38704,	50049,	102363,	27186,
4,	25177,	45751,	15694,	11282,	12787,	12246,	13703,	31031,	39214,	73171,
5,	20054,	16505,	30446,	11303,	8381,	8575,	8254,	9937,	21939,	27051,
6,	10989,	8411,	9561,	17509,	7372,	5111,	5168,	5053,	5673,	11132,
7,	4919,	3855,	3996,	4203,	8595,	3495,	2587,	2390,	2296,	2132,
8,	5792,	1728,	1635,	1674,	1470,	3192,	1323,	723,	727,	673,
9,	1432,	1863,	666,	665,	471,	444,	955,	327,	195,	180,
10,	216,	321,	532,	228,	159,	126,	133,	234,	95,	62,
11,	120,	66,	102,	146,	68,	66,	44,	40,	96,	27,
12,	63,	15,	15,	22,	40,	31,	33,	16,	18,	37,
13,	90,	12,	3,	5,	8,	9,	19,	13,	8,	3,
14,	7,	6,	4,	0,	1,	4,	2,	10,	6,	4,
+gp,	7,	7,	1,	0,	1,	1,	2,	9,	0,	1,
0 TOTAL,	179352,	139960,	120271,	108028,	133924,	175542,	345875,	368560,	362384,	242793,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 62-95	AMST 62-95
AGE													
1,	78468,	81946,	150943,	191189,	308825,	2467236,	1039636,	2184328,	2967812,	2047198,	0,	98911,	260385,
2,	22030,	26411,	54562,	117890,	142938,	160911,	163941,	148995,	258079,	296351,	162269,	58496,	78548,
3,	19800,	15999,	21586,	42017,	76759,	103320,	84003,	71869,	46973,	78435,	80098,	42618,	56326,
4,	20455,	15705,	12749,	17533,	33781,	60374,	78641,	56980,	33865,	24203,	41589,	32954,	43062,
5,	50824,	14826,	11064,	9970,	13587,	24226,	45072,	54239,	34877,	19958,	14569,	22438,	28645,
6,	13342,	28561,	9593,	8097,	6754,	8791,	14014,	26450,	33352,	20016,	10630,	12339,	15135,
7,	3470,	5549,	15801,	6455,	4910,	3602,	4240,	6162,	12752,	17859,	9060,	5757,	7058,
8,	578,	914,	2416,	10118,	3393,	2356,	1632,	1324,	2273,	5331,	8273,	2446,	3248,
9,	195,	164,	301,	1375,	5804,	1583,	1077,	520,	434,	861,	1671,	938,	1342,
10,	55,	51,	51,	171,	747,	3076,	721,	325,	171,	177,	276,	322,	488,
11,	11,	16,	13,	27,	103,	405,	1350,	225,	104,	60,	42,	117,	192,
12,	10,	3,	9,	7,	20,	68,	157,	397,	64,	38,	17,	44,	74,
13,	9,	2,	2,	6,	5,	9,	20,	41,	134,	33,	12,	16,	26,
14,	1,	3,	2,	1,	5,	4,	2,	7,	14,	36,	15,	6,	10,
+gp,	3,	2,	1,	4,	3,	0,	1,	0,	0,	0,	10,		
0 TOTAL,	209301,	190153,	279094,	404860,	597625,	2835960,	1434505,	2551864,	3390900,	2510557,	328531,		

1

Table 3.16

At 22-Aug-98 13:10:27

Table 4 Natural Mortality (M) at age

YEAR,	1946,	1947,
AGE		
3,	.2000,	.2000,
4,	.2000,	.2000,
5,	.2000,	.2000,
6,	.2000,	.2000,
7,	.2000,	.2000,
8,	.2000,	.2000,
9,	.2000,	.2000,
10,	.2000,	.2000,
11,	.2000,	.2000,
12,	.2000,	.2000,
13,	.2000,	.2000,
14,	.2000,	.2000,
+gp,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
14,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

1

Run title : Arctic Cod (run: SVPBJA02/V02)

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Table 4 Natural Mortality (M) at age

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
14,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
14,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 3.16 cont.

Table 4 Natural Mortality (M) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2007,	.2005,	.3164,	.2609,
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,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	.2091,	.2000,	.2000,	.2051,	.2061,	.2611,	.3796,	.7463,	.6418,	.6159,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2027,	.2749,	.4080,	.4350,	.3449,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2024,	.2215,	.2070,	.2778,	.2152,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2042,	.2001,	.2048,	.2020,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
14,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

1

Table 3.17

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1946,	1947,
AGE		
3,	.0061,	.0019,
4,	.0200,	.0248,
5,	.0532,	.1102,
6,	.0993,	.2023,
7,	.1825,	.4274,
8,	.2024,	.2622,
9,	.3147,	.4311,
10,	.3048,	.4450,
11,	.3259,	.9118,
12,	.3237,	.5694,
13,	.3622,	.6033,
14,	.3270,	.5970,
+gp,	.3270,	.5970,
0 FBAR 5-10,	.1928,	.3130,

Table 8 Fishing mortality (F) at age

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
AGE										
3,	.0004,	.0023,	.0020,	.0254,	.0226,	.0334,	.0198,	.0159,	.0269,	.0240,
4,	.0125,	.0210,	.0322,	.1610,	.1663,	.1328,	.1456,	.0836,	.1290,	.1126,
5,	.0749,	.1504,	.1172,	.2649,	.3696,	.2293,	.2683,	.2855,	.4541,	.2093,
6,	.1999,	.3651,	.2932,	.2803,	.5537,	.3120,	.3322,	.5317,	.6884,	.4816,
7,	.5195,	.5109,	.4079,	.4224,	.5356,	.3276,	.3960,	.5111,	.6171,	.5471,
8,	.3679,	.3862,	.3488,	.4020,	.4333,	.3515,	.2527,	.5857,	.6813,	.6365,
9,	.5528,	.4061,	.4728,	.5075,	.5729,	.4160,	.4450,	.5923,	.6503,	.5366,
10,	.3973,	.4043,	.5515,	.5125,	.7663,	.5266,	.7096,	.7926,	.7674,	.6246,
11,	.5630,	.7344,	1.0403,	.5341,	1.0159,	.7076,	.7754,	.9373,	.9519,	.9381,
12,	.6207,	.5184,	1.0011,	.6563,	1.2718,	.6083,	.7511,	.7142,	1.3983,	.9166,
13,	.5977,	.6603,	.5544,	.7174,	.8383,	.5386,	.7379,	.6943,	1.1371,	1.5109,
14,	.5500,	.5480,	.7310,	.5890,	.9050,	.5630,	.6890,	.7510,	.9930,	.9180,
+gp,	.5500,	.5480,	.7310,	.5890,	.9050,	.5630,	.6890,	.7510,	.9930,	.9180,
0 FBAR 5-10,	.3521,	.3705,	.3652,	.3983,	.5386,	.3605,	.4006,	.5498,	.6431,	.5059,

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Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE										
3,	.0717,	.0534,	.0543,	.0561,	.0662,	.0312,	.0174,	.0225,	.0398,	.0298,
4,	.2588,	.2562,	.2262,	.2714,	.3055,	.2360,	.1445,	.1109,	.1036,	.1525,
5,	.3618,	.5090,	.3474,	.4932,	.6486,	.7385,	.3525,	.3894,	.2117,	.1811,
6,	.5511,	.5106,	.4602,	.5160,	.8237,	1.0025,	.4812,	.4470,	.3797,	.2024,
7,	.5274,	.5241,	.4341,	.5271,	.6079,	.9645,	.5734,	.3980,	.4673,	.4284,
8,	.4561,	.4979,	.4840,	.6873,	.6546,	.8753,	.7205,	.5218,	.5672,	.6742,
9,	.4632,	.6068,	.3890,	.7346,	.8022,	.9358,	1.0530,	.6979,	.6973,	.8395,
10,	.7143,	.7125,	.7213,	.7772,	.9720,	1.3019,	.8351,	.7809,	.7263,	.8296,
11,	.8179,	.6097,	.9184,	.9483,	.8010,	1.3726,	1.0823,	.7375,	.4721,	.9097,
12,	.9897,	.6349,	.7006,	1.1525,	.8511,	.8909,	.9420,	.5148,	.6223,	.9372,
13,	.4801,	.6784,	.4870,	.9410,	.9633,	.6872,	1.0812,	1.3471,	.6584,	.8824,
14,	.7000,	.6530,	.6470,	.9210,	.8860,	1.0510,	1.0120,	.8250,	.6390,	.8890,
+gp,	.7000,	.6530,	.6470,	.9210,	.8860,	1.0510,	1.0120,	.8250,	.6390,	.8890,
0 FBAR 5-10,	.5123,	.5602,	.4727,	.6226,	.7515,	.9697,	.6693,	.5392,	.5082,	.5259,

Table 3.17 (cont'd.)

Table 8 Fishing mortality (F) at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	.0244,	.0230,	.0409,	.0213,	.0393,	.1960,	.2137,	.0836,	.1659,	.1339,
4,	.2069,	.2218,	.1422,	.1028,	.1672,	.1995,	.4961,	.2100,	.3118,	.5667,
5,	.4088,	.4809,	.3829,	.2286,	.2977,	.3533,	.5373,	.5215,	.4782,	.7532,
6,	.4671,	.5384,	.5713,	.2368,	.3853,	.3919,	.5072,	.7016,	.5724,	.6810,
7,	.4012,	.7688,	.6214,	.5195,	.3159,	.4217,	.4455,	.7036,	.6962,	.6783,
8,	.5221,	.9271,	.8390,	.8338,	.6701,	.6437,	.4875,	.7042,	.8867,	.9089,
9,	.7795,	1.1416,	.9599,	.9343,	1.1369,	1.0102,	.4089,	.6136,	.7769,	1.2139,
10,	.7333,	.9966,	.9938,	.7720,	1.2387,	.7436,	.9818,	.4778,	.4636,	.7737,
11,	.5924,	1.1604,	.7081,	.6731,	1.2199,	.5939,	1.0065,	1.1997,	.3136,	.6315,
12,	.3923,	.9634,	.4587,	.5585,	.7819,	.6391,	.6365,	.8546,	1.0522,	.2469,
13,	1.3452,	.8615,	.7109,	.5224,	1.1459,	.4069,	1.7817,	1.4679,	.5124,	.9914,
14,	.7750,	1.0390,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,	.6260,	.7740,
+gp,	.7750,	1.0390,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,	.6260,	.7740,
0 FBAR 5-10,	.5520,	.8089,	.7281,	.5875,	.6741,	.5941,	.5614,	.6204,	.6457,	.8348,

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.1458,	.0488,	.0312,	.0240,	.0646,	.0205,	.0205,	.0439,	.0196,	.0237,
4,	.2237,	.2085,	.1293,	.0982,	.2010,	.1960,	.1225,	.1482,	.1724,	.1651,
5,	.6693,	.3480,	.3551,	.2292,	.2968,	.3086,	.2929,	.3632,	.4816,	.5076,
6,	.8467,	.5463,	.6240,	.5140,	.5491,	.4846,	.5744,	.5918,	.7812,	.9661,
7,	.8455,	.6595,	.6733,	.8521,	.7926,	.7748,	1.0748,	.9909,	1.0273,	1.1040,
8,	.9357,	.7539,	.7021,	1.0663,	.9977,	1.0074,	1.1970,	1.1087,	1.1912,	1.0421,
9,	1.2916,	1.0536,	.8715,	1.2275,	1.1192,	1.0047,	1.2013,	1.0337,	.9505,	.9805,
10,	.9912,	.9536,	1.0907,	1.0034,	.6796,	.8392,	1.0069,	.6971,	1.0481,	1.4826,
11,	1.8482,	1.2630,	1.3306,	1.0970,	.5783,	.4871,	.7976,	.6080,	.7487,	.8403,
12,	1.4947,	1.3556,	.8597,	.8009,	1.2609,	.3042,	.7140,	.5104,	1.4580,	1.1783,
13,	2.4485,	.8311,	1.6895,	1.4783,	.4675,	1.1709,	.3977,	.5541,	.5105,	.8156,
14,	1.6430,	1.1040,	1.1830,	1.1390,	.8310,	.7690,	.8330,	.6490,	.8320,	.8810,
+gp,	1.6430,	1.1040,	1.1830,	1.1390,	.8310,	.7690,	.8330,	.6490,	.8320,	.8810,
0 FBAR 5-10,	.9300,	.7192,	.7195,	.8154,	.7392,	.7365,	.8912,	.7976,	.9133,	1.0138,

Table 8 Fishing mortality (F) at age

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
3,	.0228,	.0274,	.0080,	.0132,	.0342,	.0119,	.0085,	.0055,	.0205,	.0170,	.0143,
4,	.1225,	.1512,	.0463,	.0555,	.1334,	.0903,	.0971,	.0830,	.0935,	.1620,	.1128,
5,	.3768,	.2363,	.1129,	.1907,	.2372,	.3468,	.3131,	.2803,	.2785,	.4140,	.3243,
6,	.6766,	.3926,	.1974,	.3018,	.4306,	.5321,	.6189,	.5313,	.4209,	.5910,	.5144,
7,	1.1307,	.6307,	.2471,	.4446,	.5360,	.5944,	.9638,	.7976,	.6742,	.5700,	.6806,
8,	1.0565,	.9080,	.3649,	.3574,	.5635,	.5856,	.9436,	.9159,	.7720,	.9600,	.8826,
9,	1.1435,	.9580,	.3654,	.4127,	.4371,	.5891,	.9975,	.9116,	.7005,	.9370,	.8497,
10,	1.0142,	1.1969,	.4334,	.3097,	.4149,	.6267,	.9648,	.9363,	.8469,	1.2410,	1.0080,
11,	1.0351,	.3736,	.4536,	.1401,	.2236,	.7520,	1.0227,	1.0505,	.8121,	1.0870,	.9832,
12,	1.1583,	.3118,	.1850,	.1479,	.5384,	1.0311,	1.1442,	.8918,	.4619,	.9760,	.7766,
13,	.9254,	.0463,	.6923,	.0179,	.0759,	1.1932,	.8489,	.8888,	1.1018,	.5590,	.8499,
14,	1.0000,	.4020,	.3400,	.1470,	.1940,	1.2880,	1.2480,	1.0620,	1.1230,	1.1150,	1.1000,
+gp,	1.0000,	.4020,	.3400,	.1470,	.1940,	1.2880,	1.2480,	1.0620,	1.1230,	1.1150,	
0 FBAR 5-10,	.8997,	.7204,	.2869,	.3361,	.4365,	.5458,	.8003,	.7288,	.6155,	.7855,	

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Table 3.18

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

Table 10 Stock number at age (start of year)

Numbers*10**-3

YEAR,	1946,	1947,
AGE		
3,	729759,	419945,
4,	577378,	593856,
5,	402340,	463337,
6,	193326,	312345,
7,	91289,	143315,
8,	92234,	62274,
9,	243263,	61677,
10,	94499,	145389,
11,	39824,	57041,
12,	37987,	23537,
13,	19708,	22500,
14,	7582,	11233,
+gp,	2951,	9971,
0 TOTAL,	2532138,	2326421,

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

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
AGE										
3,	440689,	466660,	705512,	1085887,	1190838,	1592006,	644331,	272941,	440230,	805056,
4,	343181,	360680,	381173,	576467,	866758,	953215,	1260619,	517173,	219942,	350846,
5,	474296,	277476,	289152,	302188,	401768,	600907,	683389,	892276,	389461,	158284,
6,	339774,	360304,	195448,	210551,	189840,	227305,	391157,	427856,	549073,	202487,
7,	208895,	227780,	204758,	119357,	130245,	89345,	136226,	229741,	205835,	225835,
8,	76524,	101732,	111891,	111493,	64051,	62414,	52717,	75066,	112827,	90922,
9,	39226,	43365,	56609,	64632,	61067,	33999,	35956,	33524,	34216,	46738,
10,	32812,	18477,	23654,	28887,	31856,	28193,	18363,	18865,	15181,	14620,
11,	76281,	18056,	10097,	11156,	14166,	12121,	13632,	7395,	6992,	5770,
12,	18764,	35568,	7093,	2921,	5355,	4200,	4890,	5140,	2371,	2210,
13,	10905,	8259,	17340,	2134,	1241,	1229,	1971,	1889,	2060,	480,
14,	10077,	4911,	3494,	8155,	853,	439,	587,	733,	773,	541,
+gp,	10868,	5616,	3048,	1500,	1906,	396,	269,	264,	286,	313,
0 TOTAL,	2082292,	1928882,	2009268,	2525328,	2959943,	3605768,	3244011,	2482864,	1979245,	1904101,

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Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

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

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE										
3,	497100,	684731,	790432,	918947,	729959,	473301,	338955,	778090,	1582377,	1292664,
4,	643484,	378824,	531451,	612962,	711327,	559366,	375592,	272729,	622846,	1245045,
5,	256655,	406694,	240046,	347043,	382559,	429087,	361707,	266135,	199849,	459765,
6,	105123,	146333,	200146,	138853,	173517,	163745,	167870,	208175,	147618,	132409,
7,	102422,	49602,	71903,	103421,	67855,	62337,	49195,	84947,	109007,	82674,
8,	106986,	49487,	24045,	38137,	49982,	30249,	19454,	22702,	46716,	55931,
9,	39388,	55509,	24627,	12133,	15704,	21266,	10321,	7749,	11030,	21692,
10,	22376,	20292,	24772,	13665,	4765,	5765,	6830,	2948,	3157,	4496,
11,	6409,	8968,	8147,	9860,	5143,	1476,	1284,	2426,	1105,	1250,
12,	1849,	2316,	3991,	2662,	3127,	1890,	306,	356,	950,	564,
13,	723,	563,	1005,	1622,	689,	1093,	635,	98,	174,	417,
14,	87,	366,	234,	506,	518,	215,	450,	176,	21,	74,
+gp,	305,	223,	518,	195,	191,	262,	223,	347,	162,	26,
0 TOTAL,	1782907,	1803908,	1921318,	2200006,	2145336,	1750051,	1332822,	1646877,	2725013,	3297008,

Table 3.18 (cont'd.)

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	169748,	111969,	197050,	404979,	1015583,	1818301,	524950,	622071,	614249,	347734,
4,	1027225,	135629,	89589,	154864,	324567,	799410,	1223748,	347112,	468461,	426029,
5,	875147,	683854,	88953,	63624,	114402,	224808,	536113,	610053,	230362,	280788,
6,	314070,	476086,	346146,	49658,	41444,	69546,	129276,	256486,	296491,	116914,
7,	88545,	161181,	227518,	160064,	32085,	23081,	38479,	63735,	104118,	136945,
8,	44102,	48535,	61173,	100065,	77949,	19153,	12395,	20179,	25821,	42493,
9,	23334,	21422,	15724,	21644,	35588,	32653,	8238,	6232,	8170,	8710,
10,	7671,	9762,	5600,	4930,	6962,	9348,	9735,	4481,	2762,	3076,
11,	1606,	3017,	2648,	1697,	1865,	1652,	3638,	2986,	2275,	1423,
12,	412,	727,	774,	1068,	709,	451,	747,	1089,	737,	1361,
13,	181,	228,	227,	401,	500,	266,	195,	323,	379,	211,
14,	141,	39,	79,	91,	194,	130,	145,	27,	61,	186,
+gp,	93,	77,	71,	54,	64,	121,	108,	66,	124,	109,
0 TOTAL,	2552275,	1651526,	1035552,	963140,	1651913,	2998918,	2487768,	1934840,	1754009,	1365978,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	639598,	198977,	140420,	158140,	157700,	168676,	382058,	495587,	1015473,	269542,
4,	249014,	452629,	155146,	111435,	126397,	121040,	135293,	306241,	388149,	725649,
5,	197913,	163016,	300830,	111622,	82698,	84639,	81457,	97999,	216197,	267475,
6,	108250,	82974,	94239,	172673,	72668,	50319,	50897,	49756,	55798,	109359,
7,	48445,	38005,	39337,	41338,	84557,	34355,	25376,	23462,	22540,	20916,
8,	56897,	17029,	16091,	16426,	14436,	31338,	12962,	7092,	7131,	6606,
9,	14019,	18274,	6560,	6529,	4630,	4358,	9370,	3206,	1916,	1774,
10,	2118,	3155,	5217,	2247,	1566,	1238,	1307,	2308,	934,	606,
11,	1162,	644,	995,	1435,	674,	650,	438,	391,	941,	268,
12,	619,	150,	149,	215,	392,	310,	327,	161,	174,	364,
13,	871,	114,	32,	52,	79,	91,	187,	131,	79,	33,
14,	64,	62,	41,	5,	10,	41,	23,	103,	62,	39,
+gp,	68,	73,	12,	2,	10,	10,	23,	87,	2,	15,
0 TOTAL,	1319038,	975100,	759069,	622118,	545818,	497064,	699717,	986524,	1709395,	1402647,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 46-95	AMST 46-95
AGE													
3,	196123,	158316,	213294,	415672,	759461,	1023895,	830925,	712753,	467097,	786426,	0,	487625,	612873,
4,	202772,	155533,	126120,	173238,	334154,	597240,	779242,	563661,	336066,	240869,	417631,	379125,	473090,
5,	503674,	146873,	109469,	98591,	134174,	239405,	445553,	537178,	344968,	198103,	145090,	262881,	324226,
6,	131815,	282911,	94942,	80055,	66703,	86655,	138234,	261049,	329993,	197777,	105593,	150838,	185373,
7,	34076,	54860,	156418,	63806,	48470,	35504,	41674,	60695,	125626,	176517,	89491,	74530,	94111,
8,	5678,	9006,	23906,	100031,	33491,	23218,	16043,	13014,	22382,	52411,	81729,	34061,	46402,
9,	1908,	1616,	2974,	13588,	57290,	15607,	10584,	5112,	4264,	8468,	16430,	15266,	26694,
10,	545,	498,	508,	1690,	7363,	30258,	7089,	3196,	1682,	1733,	2716,	6255,	14301,
11,	113,	162,	123,	269,	1015,	3981,	13255,	2212,	1026,	590,	410,	2524,	7403,
12,	95,	33,	91,	64,	192,	664,	1537,	3903,	633,	373,	163,	991,	3711,
13,	92,	24,	20,	62,	45,	92,	194,	401,	1310,	327,	115,	388,	2043,
14,	12,	30,	19,	8,	50,	34,	23,	68,	135,	356,	153,	149,	1076,
+gp,	26,	23,	8,	40,	25,	3,	6,	2,	3,	2,	96,		
0 TOTAL,	1076926,	809884,	727890,	947114,	1442433,	2056598,	2284361,	2163243,	1635186,	1663951,	859617,		

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Table 3.19

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

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

YEAR,	1946,	1947,
AGE		
3,	319484,	155796,
4,	388881,	338946,
5,	420031,	409900,
6,	305996,	418940,
7,	212127,	282202,
8,	291975,	167054,
9,	1010923,	217200,
10,	490091,	638956,
11,	248106,	301148,
12,	277601,	145755,
13,	165923,	160524,
14,	70979,	89115,
+gp,	29812,	85369,
0 TOTALBIO,	4231928,	3410905,

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

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
AGE										
3,	176218,	206222,	356818,	622063,	530483,	868813,	326239,	144950,	241749,	436727,
4,	211118,	245213,	296587,	508055,	650012,	800311,	981969,	422544,	185815,	292811,
5,	452256,	292401,	348728,	412806,	467015,	782000,	825113,	1129969,	509998,	204758,
6,	491203,	575651,	357378,	436076,	334564,	448482,	716032,	821488,	1090111,	397132,
7,	443354,	534265,	549654,	362914,	336980,	258795,	366094,	647579,	599943,	650250,
8,	221258,	325070,	409188,	461829,	225761,	246292,	193003,	288253,	448006,	356647,
9,	148890,	181907,	271768,	351454,	282562,	176126,	172812,	168998,	178355,	240672,
10,	155427,	96725,	141720,	196032,	183954,	182264,	110144,	118685,	98753,	93950,
11,	434074,	113551,	72674,	90949,	98267,	94131,	98226,	55885,	54641,	44543,
12,	125243,	262369,	59878,	27933,	43569,	38256,	41332,	45565,	21737,	20009,
13,	83856,	70184,	168648,	23508,	11630,	12898,	18222,	19295,	21757,	5003,
14,	86166,	46410,	37788,	99898,	8888,	5126,	6357,	8320,	9072,	6276,
+gp,	100283,	57272,	35576,	19828,	21441,	4989,	3149,	3237,	3628,	3919,
0 TOTALBIO,	3129348,	3007241,	3106405,	3613345,	3245128,	3918484,	3858694,	3874768,	3463562,	2752694,

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Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

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

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
AGE										
3,	285346,	381075,	453124,	541705,	435351,	240863,	180309,	453419,	968383,	738326,
4,	568267,	324350,	468709,	555894,	652676,	437940,	307381,	244505,	586415,	1094041,
5,	351314,	539731,	328145,	487835,	544073,	520710,	458827,	369820,	291647,	626205,
6,	218163,	294433,	414814,	295924,	374144,	301268,	322850,	438584,	326611,	273421,
7,	312051,	146520,	218779,	323583,	214797,	168376,	138900,	262739,	354078,	250631,
8,	444057,	199144,	99670,	162555,	215547,	111306,	74827,	95656,	206720,	230991,
9,	214619,	293243,	134012,	67891,	88905,	102726,	52116,	42861,	64072,	117605,
10,	152155,	133780,	168225,	95425,	33668,	34751,	43038,	20352,	22886,	30424,
11,	52356,	71026,	66464,	82711,	43650,	10690,	9719,	20116,	9627,	10162,
12,	17715,	21516,	38187,	26198,	31131,	16055,	2720,	3464,	9704,	5382,
13,	7986,	6021,	11079,	18382,	7897,	10697,	6495,	1096,	2051,	4585,
14,	1064,	4362,	2865,	6374,	6608,	2341,	5121,	2197,	272,	902,
+gp,	4047,	2865,	6851,	2653,	2623,	3075,	2742,	4664,	2286,	341,
0 TOTALBIO,	2629140,	2418064,	2410924,	2667130,	2651070,	1960798,	1605043,	1959473,	2844753,	3383015,

Table 3.19 (cont'd.)

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	105490,	63635,	124673,	294342,	712126,	1350917,	350451,	364192,	408673,	224408,
4,	982109,	118586,	87204,	173164,	350133,	913732,	1256863,	312641,	479503,	422977,
5,	1296900,	926783,	134206,	110270,	191291,	398284,	853462,	851681,	365477,	432104,
6,	705648,	978220,	791785,	130487,	105065,	186806,	312019,	542887,	713176,	272779,
7,	292065,	486201,	764038,	617475,	119411,	91016,	136346,	198050,	367673,	469074,
8,	198178,	199451,	279857,	525879,	395218,	102895,	59833,	85423,	124218,	198286,
9,	137648,	115564,	94433,	149321,	236875,	230278,	52204,	34635,	51595,	53353,
10,	56473,	58988,	41973,	42443,	57829,	82270,	76990,	31077,	21772,	23514,
11,	14203,	24397,	23841,	17554,	18610,	17463,	34567,	24878,	21541,	13065,
12,	4275,	6898,	8173,	12956,	8296,	5591,	8321,	10640,	8181,	14664,
13,	2164,	2491,	2764,	5598,	6745,	3794,	2501,	3642,	4852,	2613,
14,	1879,	469,	1067,	1420,	2916,	2069,	2066,	336,	868,	2567,
+gp,	1333,	1013,	1033,	912,	1040,	2081,	1665,	895,	1910,	1626,
0 TOTALBIO,	3798363,	2982694,	2355045,	2081821,	2205558,	3387193,	3147287,	2460978,	2569439,	2131032,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	417294,	138563,	88822,	113581,	110368,	59731,	193145,	226506,	305129,	54738,
4,	249945,	484922,	150980,	123133,	136093,	120252,	154859,	276890,	338959,	350863,
5,	307912,	270702,	453765,	191176,	138015,	135707,	147625,	166503,	320753,	323321,
6,	255339,	208899,	215514,	448378,	183868,	125225,	141275,	142871,	133080,	216795,
7,	167762,	140472,	132069,	157588,	314097,	116589,	96091,	94877,	84447,	69376,
8,	268414,	85745,	73595,	85308,	73054,	144879,	58109,	41222,	38504,	28556,
9,	86824,	120797,	39387,	44510,	30759,	26451,	55142,	24497,	11839,	11186,
10,	16371,	26024,	39093,	19116,	12986,	9376,	9596,	23203,	5988,	5454,
11,	10785,	6378,	8959,	14668,	6717,	5914,	3864,	5545,	9719,	3408,
12,	6746,	1741,	1574,	2582,	4582,	3305,	3383,	1741,	2205,	4422,
13,	10925,	1524,	385,	713,	1065,	1119,	2230,	1628,	931,	401,
14,	893,	917,	549,	73,	144,	555,	306,	1421,	805,	524,
+gp,	1023,	1172,	182,	26,	156,	150,	331,	1295,	27,	215,
0 TOTALBIO,	1800236,	1487856,	1204874,	1200853,	1011905,	749253,	865957,	1008198,	1252386,	1069259,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	35729,	49129,	83048,	193335,	342016,	358832,	199515,	142560,	88775,	149405,
4,	69992,	82052,	90658,	191367,	310998,	705665,	592497,	281850,	164722,	125239,
5,	357370,	130658,	130055,	165273,	239010,	438684,	632977,	617797,	334720,	211949,
6,	227495,	436046,	161137,	189276,	182238,	244688,	341596,	550850,	676689,	371781,
7,	94423,	152653,	387281,	200320,	189662,	142559,	162188,	211841,	443592,	594799,
8,	28852,	43132,	85205,	441995,	173277,	127170,	88596,	65205,	123140,	275127,
9,	14285,	11786,	13984,	92301,	388144,	105643,	70521,	36452,	33140,	75613,
10,	6327,	5139,	3953,	17551,	70668,	259686,	54330,	28477,	17094,	21050,
11,	1417,	1548,	1101,	2467,	12624,	43254,	107544,	22342,	10950,	6707,
12,	985,	882,	988,	673,	3416,	9786,	15528,	41684,	7654,	4724,
13,	1101,	315,	245,	751,	566,	1147,	2426,	5009,	16377,	4084,
14,	160,	428,	264,	108,	694,	478,	316,	945,	1875,	4952,
+gp,	370,	360,	114,	585,	374,	45,	91,	25,	48,	24,
0 TOTALBIO,	838507,	914127,	958034,	1496006,	1913687,	2437636,	2268126,	2005037,	1918777,	1845453,

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Table 3.20

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

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

YEAR,	1946,	1947,
AGE		
3,	0,	0,
4,	0,	0,
5,	0,	0,
6,	0,	0,
7,	0,	0,
8,	291975,	167054,
9,	1010923,	217200,
10,	490091,	638956,
11,	248106,	301148,
12,	277601,	145755,
13,	165923,	160524,
14,	70979,	89115,
+gp,	29812,	85369,
0 TOTSPBIO,	2585409,	1805121,

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

YEAR,	1948,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,
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,	221258,	325070,	409188,	461829,	225761,	246292,	193003,	288253,	448006,	356647,
9,	148890,	181907,	271768,	351454,	282562,	176126,	172812,	168998,	178355,	240672,
10,	155427,	96725,	141720,	196032,	183954,	182264,	110144,	118685,	98753,	93950,
11,	434074,	113551,	72674,	90949,	98267,	94131,	98226,	55885,	54641,	44543,
12,	125243,	262369,	59878,	27933,	43569,	38256,	41332,	45565,	21737,	20009,
13,	83856,	70184,	168648,	23508,	11630,	12898,	18222,	19295,	21757,	5003,
14,	86166,	46410,	37788,	99898,	8988,	5126,	6357,	8320,	9072,	6276,
+gp,	100283,	57272,	35576,	19828,	21441,	4989,	3149,	3237,	3628,	3919,
0 TOTSPBIO,	1355197,	1153489,	1197240,	1271431,	876072,	760081,	643244,	708237,	835948,	771019,

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Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Traditional vpa using file input for terminal F

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

YEAR,	1958,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,
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,	444057,	199144,	99670,	162555,	215547,	111306,	74927,	95656,	206720,	230991,
9,	214619,	293243,	134012,	67891,	88905,	102726,	52116,	42861,	64072,	117605,
10,	152155,	133780,	168225,	95425,	33668,	34751,	43038,	20352,	22886,	30424,
11,	52356,	71026,	66464,	82711,	43650,	10690,	9719,	20116,	9627,	10162,
12,	17715,	21516,	38187,	26198,	31131,	16055,	2720,	3464,	9704,	5382,
13,	7986,	6021,	11079,	18382,	7897,	10697,	6495,	1096,	2051,	4585,
14,	1064,	4362,	2865,	6374,	6608,	2341,	5121,	2197,	272,	902,
+gp,	4047,	2865,	6851,	2653,	2623,	3075,	2742,	4664,	2286,	341,
0 TOTSPBIO,	894000,	731956,	527354,	462188,	430028,	291642,	196777,	190406,	317618,	400391,

Table 3.20 (cont'd.)

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
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,	198178,	199451,	279857,	525879,	395218,	102895,	59833,	85423,	124218,	198286,
9,	137648,	115564,	94433,	149321,	236875,	230278,	52204,	34635,	51595,	53353,
10,	56473,	58988,	41973,	42443,	57829,	82270,	76990,	31077,	21772,	23514,
11,	14203,	24397,	23841,	17554,	18610,	17463,	34567,	24878,	21541,	13065,
12,	4275,	6898,	8173,	12956,	8296,	5591,	8321,	10640,	8181,	14664,
13,	2164,	2491,	2764,	5598,	6745,	3794,	2501,	3642,	4852,	2613,
14,	1879,	469,	1067,	1420,	2916,	2069,	2066,	336,	868,	2567,
+gp,	1333,	1013,	1033,	912,	1040,	2081,	1665,	895,	1910,	1626,
0 TOTSPBIO,	416152,	409271,	453141,	756083,	727531,	446440,	238147,	191527,	234937,	309689,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	0,	0,	0,	0,	0,	597,	0,	0,	0,	0,
4,	0,	0,	0,	0,	6805,	9620,	7743,	2769,	16948,	3509,
5,	0,	0,	0,	0,	13801,	13571,	26572,	14985,	25660,	22632,
6,	0,	0,	0,	0,	62515,	37568,	43795,	51434,	25285,	39023,
7,	0,	0,	0,	0,	204163,	85110,	53811,	52182,	44757,	15263,
8,	268414,	85745,	73595,	85308,	59904,	127494,	52298,	35039,	27338,	13136,
9,	86824,	120797,	39387,	44510,	28299,	25657,	54591,	23517,	7340,	5593,
10,	16371,	26024,	39093,	19116,	12986,	9376,	9596,	20883,	5389,	4090,
11,	10785,	6378,	8959,	14668,	6717,	5914,	3864,	5545,	9719,	3408,
12,	6746,	1741,	1574,	2582,	4582,	3305,	3383,	1741,	2205,	4422,
13,	10925,	1524,	385,	713,	1065,	1119,	2230,	1628,	931,	401,
14,	893,	917,	549,	73,	144,	555,	306,	1421,	805,	524,
+gp,	1023,	1172,	182,	26,	156,	150,	331,	1295,	27,	215,
0 TOTSPBIO,	401982,	244299,	163724,	166996,	401138,	320036,	258521,	212438,	166405,	112217,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	0,	0,	0,	0,	3420,	0,	0,	0,	0,	0,
4,	1400,	0,	907,	7655,	3110,	21170,	5925,	0,	0,	0,
5,	17868,	6533,	6503,	9916,	28681,	39482,	69627,	43246,	6694,	4239,
6,	75074,	78488,	33839,	52997,	78362,	73406,	112727,	181781,	175939,	52049,
7,	50044,	62588,	224623,	130208,	142246,	86961,	97313,	131342,	279463,	333088,
8,	17888,	29761,	65608,	366856,	161148,	115725,	71763,	48252,	102206,	225604,
9,	14285,	10018,	12027,	89532,	376499,	102473,	68405,	34629,	32477,	71832,
10,	6327,	5139,	3874,	17551,	70668,	257089,	53787,	27908,	17094,	19997,
11,	1417,	1548,	1101,	2467,	12624,	43254,	106468,	22342,	10950,	6371,
12,	985,	882,	988,	673,	3416,	9786,	15528,	41684,	7654,	4724,
13,	1101,	315,	245,	751,	566,	1147,	2426,	5009,	16377,	4084,
14,	160,	428,	264,	108,	694,	478,	316,	945,	1875,	4952,
+gp,	370,	360,	114,	585,	374,	45,	91,	25,	48,	24,
0 TOTSPBIO,	186920,	196059,	350092,	679301,	881810,	751016,	604377,	537162,	650778,	726965,

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Table 3.21

Run title : Arctic Cod (run: SVPBJA02/V02)

At 22-Aug-98 13:10:27

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

,	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 5-10,
,							
1946,	729759,	4231927,	2585409,	706000,	.2731,	.6735,	.1928,
1947,	419945,	3410905,	1805121,	892017,	.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,	111969,	2982695,	409271,	1197226,	2.9253,	.8743,	.8089,
1970,	197050,	2355046,	453141,	933246,	2.0595,	.9734,	.7281,
1971,	404979,	2081821,	756084,	689048,	.9113,	1.1182,	.5875,
1972,	1015583,	2205557,	727531,	565254,	.7769,	1.0788,	.6741,
1973,	1818301,	3387193,	446440,	792685,	1.7756,	1.1430,	.5941,
1974,	524950,	3147288,	238147,	1102433,	4.6292,	1.0271,	.5614,
1975,	622070,	2460978,	191527,	829377,	4.3303,	.9007,	.6204,
1976,	614249,	2569439,	234937,	867463,	3.6923,	1.0236,	.6457,
1977,	347734,	2131031,	309689,	905301,	2.9233,	.9928,	.8348,
1978,	639598,	1800235,	401981,	698715,	1.7382,	1.0037,	.9300,
1979,	198977,	1487857,	244299,	440538,	1.8033,	1.0713,	.7192,
1980,	140420,	1204874,	163724,	380434,	2.3236,	.9731,	.7195,
1981,	158140,	1200853,	166996,	399038,	2.3895,	1.1050,	.8154,
1982,	157700,	1011905,	401138,	363730,	.9067,	1.0767,	.7392,
1983,	168676,	749254,	320036,	289992,	.9061,	.9837,	.7365,
1984,	382058,	865957,	258521,	277651,	1.0740,	.9538,	.8912,
1985,	495587,	1008198,	212438,	307920,	1.4495,	.9936,	.7976,
1986,	1015473,	1252386,	166405,	430113,	2.5847,	.9390,	.9133,
1987,	269542,	1069259,	112217,	523071,	4.6612,	.9670,	1.0138,
1988,	196123,	838506,	186920,	434939,	2.3269,	.9588,	.8997,
1989,	158316,	914128,	196059,	332481,	1.6958,	1.0344,	.7204,
1990,	213294,	958034,	350092,	212000,	.6056,	.9984,	.2869,
1991,	415672,	1496005,	679301,	319158,	.4698,	.9690,	.3361,
1992,	759461,	1913688,	881810,	513494,	.5823,	1.0008,	.4365,
1993,	1023895,	2437637,	751016,	581611,	.7744,	1.0013,	.5458,
1994,	830929,	2268125,	604376,	771086,	1.2758,	1.0005,	.8003,
1995,	712752,	2005038,	537162,	739999,	1.3776,	1.0001,	.7288,
1996,	467097,	1918776,	650779,	726879,	1.1169,	1.0003,	.6155,
1997,	786425,	1845453,	726965,	754832,	1.0383,	.9999,	.7855,
Arith. Mean ,	613407,	2336693,	589461,	680788,	1.6441		.6185,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			
1							

Table 3.22

The SAS System

14:09 Wednesday, August 26, 1998

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

Prediction with management option table: Input data

Year: 1998								
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	800980.00	0.6680	0.0000	0.0000	0.0000	0.210	0.0158	0.640
4	417631.00	0.3960	0.0100	0.0000	0.0000	0.530	0.1248	1.050
5	145090.00	0.2334	0.0400	0.0000	0.0000	1.140	0.3588	1.600
6	105593.00	0.2023	0.2000	0.0000	0.0000	1.930	0.5692	2.290
7	89491.000	0.2000	0.4500	0.0000	0.0000	2.940	0.7530	3.510
8	81729.000	0.2000	0.8300	0.0000	0.0000	4.580	0.9765	5.360
9	16430.000	0.2000	0.9300	0.0000	0.0000	7.420	0.9401	7.410
10	2716.000	0.2000	0.9800	0.0000	0.0000	10.370	1.1153	9.020
11	410.000	0.2000	1.0000	0.0000	0.0000	11.740	1.0879	9.770
12	163.000	0.2000	1.0000	0.0000	0.0000	10.850	0.8593	10.850
13	115.000	0.2000	1.0000	0.0000	0.0000	12.500	0.9404	12.500
14	153.000	0.2000	1.0000	0.0000	0.0000	13.900	1.2171	13.900
15+	96.000	0.2000	1.0000	0.0000	0.0000	15.000	1.2171	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	492000.00	0.6680	0.0000	0.0000	0.0000	0.200	0.0158	0.700
4	.	0.3960	0.0000	0.0000	0.0000	0.510	0.1248	1.030
5	.	0.2334	0.0300	0.0000	0.0000	1.060	0.3588	1.550
6	.	0.2023	0.2000	0.0000	0.0000	1.950	0.5692	2.330
7	.	0.2000	0.5500	0.0000	0.0000	3.280	0.7530	3.610
8	.	0.2000	0.8300	0.0000	0.0000	5.110	0.9765	5.490
9	.	0.2000	0.9500	0.0000	0.0000	8.040	0.9401	7.180
10	.	0.2000	0.9800	0.0000	0.0000	10.890	1.1153	8.350
11	.	0.2000	1.0000	0.0000	0.0000	11.260	1.0879	9.260
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.8593	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.9404	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	1.2171	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	1.2171	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	836000.00	0.6680	0.0000	0.0000	0.0000	0.200	0.0158	0.700
4	.	0.3960	0.0000	0.0000	0.0000	0.510	0.1248	1.030
5	.	0.2334	0.0300	0.0000	0.0000	1.060	0.3588	1.550
6	.	0.2023	0.2000	0.0000	0.0000	1.950	0.5692	2.330
7	.	0.2000	0.5500	0.0000	0.0000	3.280	0.7530	3.610
8	.	0.2000	0.8300	0.0000	0.0000	5.110	0.9765	5.490
9	.	0.2000	0.9500	0.0000	0.0000	8.040	0.9401	7.180
10	.	0.2000	0.9800	0.0000	0.0000	10.890	1.1153	8.350
11	.	0.2000	1.0000	0.0000	0.0000	11.260	1.0879	9.260
12	.	0.2000	1.0000	0.0000	0.0000	10.850	0.8593	10.850
13	.	0.2000	1.0000	0.0000	0.0000	12.500	0.9404	12.500
14	.	0.2000	1.0000	0.0000	0.0000	13.900	1.2171	13.900
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	1.2171	15.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANLPS04
Date and time: 26AUG98:14:47

Table 3.23
14:09 Wednesday, August 26, 1998

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

Prediction with management option table

Year: 1998					Year: 1999					Year: 2000	
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
0.9050	0.7108	1557831	631234	654000	0.0000	0.0000	1389049	575882	0	1964382	924364
.	.	.	.	.	0.0500	0.0393	.	575882	39618	1915018	887329
.	.	.	.	.	0.1000	0.0785	.	575882	77840	1867515	851880
.	.	.	.	.	0.1500	0.1178	.	575882	114722	1821796	817945
.	.	.	.	.	0.2000	0.1571	.	575882	150319	1777785	785458
.	.	.	.	.	0.2500	0.1964	.	575882	184683	1735411	754355
.	.	.	.	.	0.3000	0.2356	.	575882	217865	1694605	724573
.	.	.	.	.	0.3500	0.2749	.	575882	249912	1655303	696055
.	.	.	.	.	0.4000	0.3142	.	575882	280871	1617442	668744
.	.	.	.	.	0.4500	0.3535	.	575882	310784	1580962	642588
.	.	.	.	.	0.5000	0.3927	.	575882	339693	1545806	617534
.	.	.	.	.	0.5500	0.4320	.	575882	367640	1511920	593535
.	.	.	.	.	0.6000	0.4713	.	575882	394662	1479251	570545
.	.	.	.	.	0.6500	0.5106	.	575882	420795	1447750	548518
.	.	.	.	.	0.7000	0.5498	.	575882	446076	1417369	527413
.	.	.	.	.	0.7500	0.5891	.	575882	470537	1388062	507188
.	.	.	.	.	0.8000	0.6284	.	575882	494211	1359786	487807
.	.	.	.	.	0.8500	0.6677	.	575882	517128	1332499	469231
.	.	.	.	.	0.9000	0.7069	.	575882	539318	1306160	451425
.	.	.	.	.	0.9500	0.7462	.	575882	560810	1280733	434357
.	.	.	.	.	1.0000	0.7855	.	575882	581630	1256179	417993
.	.	.	.	.	1.0500	0.8248	.	575882	601804	1232465	402304
.	.	.	.	.	1.1000	0.8640	.	575882	621357	1209557	387259
.	.	.	.	.	1.1500	0.9033	.	575882	640313	1187422	372832
.	.	.	.	.	1.2000	0.9426	.	575882	658694	1166031	358995
.	.	.	.	.	1.2500	0.9819	.	575882	676522	1145353	345723
.	.	.	.	.	1.3000	1.0211	.	575882	693819	1125361	332991
.	.	.	.	.	1.3500	1.0604	.	575882	710603	1106028	320777
.	.	.	.	.	1.4000	1.0997	.	575882	726895	1087327	309057
.	.	.	.	.	1.4500	1.1390	.	575882	742713	1069235	297811
.	.	.	.	.	1.5000	1.1782	.	575882	758074	1051728	287019
.	.	.	.	.	1.5500	1.2175	.	575882	772995	1034783	276661
.	.	.	.	.	1.6000	1.2568	.	575882	787492	1018378	266718
.	.	.	.	.	1.6500	1.2960	.	575882	801582	1002493	257173
.	.	.	.	.	1.7000	1.3353	.	575882	815278	987108	248008
.	.	.	.	.	1.7500	1.3746	.	575882	828595	972204	239209
.	.	.	.	.	1.8000	1.4139	.	575882	841546	957762	230758
.	.	.	.	.	1.8500	1.4531	.	575882	854146	943765	222642
.	.	.	.	.	1.9000	1.4924	.	575882	866406	930197	214847
.	.	.	.	.	1.9500	1.5317	.	575882	878339	917041	207358
.	.	.	.	.	2.0000	1.5710	.	575882	889955	904281	200163
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANLPS04
Date and time : 26AUG98:14:47
Computation of ref. F: Simple mean, age 5 - 10
Basis for 1998 : TAC constraints

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

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	3.362	12678.602	1.138	10793.734	1.138	10793.734
0.0500	0.0393	0.057	390.330	3.082	9375.810	0.877	7549.845	0.877	7549.845
0.1000	0.0785	0.095	576.137	2.896	7369.498	0.709	5598.042	0.709	5598.042
0.1500	0.1178	0.123	668.458	2.761	6037.253	0.591	4316.362	0.591	4316.362
0.2000	0.1571	0.144	713.717	2.658	5098.131	0.504	3424.257	0.504	3424.257
0.2500	0.1964	0.162	733.801	2.575	4406.870	0.437	2776.812	0.437	2776.812
0.3000	0.2356	0.176	739.906	2.507	3880.956	0.384	2291.818	0.384	2291.818
0.3500	0.2749	0.188	738.102	2.450	3470.169	0.341	1919.327	0.341	1919.327
0.4000	0.3142	0.199	731.826	2.401	3142.295	0.305	1627.365	0.305	1627.365
0.4500	0.3535	0.208	723.085	2.358	2875.793	0.276	1394.603	0.276	1394.603
0.5000	0.3927	0.216	713.081	2.321	2655.765	0.251	1206.331	0.251	1206.331
0.5500	0.4320	0.224	702.542	2.287	2471.619	0.229	1052.125	0.229	1052.125
0.6000	0.4713	0.230	691.914	2.257	2315.643	0.210	924.426	0.210	924.426
0.6500	0.5106	0.237	681.465	2.230	2182.109	0.194	817.639	0.194	817.639
0.7000	0.5498	0.242	671.356	2.205	2066.689	0.180	727.557	0.180	727.557
0.7500	0.5891	0.248	661.677	2.182	1966.060	0.167	650.966	0.167	650.966
0.8000	0.6284	0.252	652.474	2.161	1877.635	0.156	585.376	0.156	585.376
0.8500	0.6677	0.257	643.766	2.141	1799.377	0.146	528.839	0.146	528.839
0.9000	0.7069	0.261	635.551	2.123	1729.662	0.137	479.813	0.137	479.813
0.9500	0.7462	0.265	627.818	2.106	1667.185	0.129	437.062	0.129	437.062
1.0000	0.7855	0.269	620.549	2.090	1610.883	0.122	399.592	0.122	399.592
1.0500	0.8248	0.273	613.721	2.075	1559.888	0.115	366.593	0.115	366.593
1.1000	0.8640	0.276	607.309	2.060	1513.481	0.109	337.402	0.109	337.402
1.1500	0.9033	0.280	601.289	2.047	1471.065	0.103	311.472	0.103	311.472
1.2000	0.9426	0.283	595.636	2.034	1432.139	0.098	288.349	0.098	288.349
1.2500	0.9819	0.286	590.326	2.022	1396.283	0.093	267.652	0.093	267.652
1.3000	1.0211	0.289	585.335	2.010	1363.137	0.089	249.063	0.089	249.063
1.3500	1.0604	0.292	580.641	1.999	1332.398	0.085	232.313	0.085	232.313
1.4000	1.0997	0.294	576.224	1.989	1303.804	0.081	217.173	0.081	217.173
1.4500	1.1390	0.297	572.064	1.979	1277.130	0.078	203.448	0.078	203.448
1.5000	1.1782	0.300	568.144	1.969	1252.179	0.075	190.971	0.075	190.971
1.5500	1.2175	0.302	564.446	1.960	1228.784	0.072	179.600	0.072	179.600
1.6000	1.2568	0.304	560.956	1.951	1206.795	0.069	169.208	0.069	169.208
1.6500	1.2960	0.307	557.659	1.942	1186.084	0.066	159.691	0.066	159.691
1.7000	1.3353	0.309	554.542	1.934	1166.535	0.064	150.954	0.064	150.954
1.7500	1.3746	0.311	551.592	1.926	1148.049	0.062	142.916	0.062	142.916
1.8000	1.4139	0.313	548.798	1.918	1130.534	0.059	135.505	0.059	135.505
1.8500	1.4531	0.315	546.150	1.911	1113.912	0.057	128.659	0.057	128.659
1.9000	1.4924	0.317	543.638	1.903	1098.112	0.055	122.323	0.055	122.323
1.9500	1.5317	0.319	541.253	1.896	1083.070	0.054	116.449	0.054	116.449
2.0000	1.5710	0.321	538.988	1.890	1068.730	0.052	110.993	0.052	110.993
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDBJA01
Date and time : 26AUG98:14:48
Computation of ref. F: Simple mean, age 5 - 10
F-0.1 factor : 0.1583
F-max factor : 0.3097
F-0.1 reference F : 0.1244
F-max reference F : 0.2433
Recruitment : Single recruit

Table 3.25

The SAS System

14:09 Wednesday, August 26, 1998

Cod in the North-East Arctic (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
1998	0.9050	0.7109	215594	654012	1660597	1557831	158083	631234	158083	631234
1999	0.4201	0.3300	101625	293015	1354039	1389034	116248	575871	116248	575871
2000	0.4201	0.3300	115034	338041	1639185	1602602	134441	658083	134441	658083
2001	0.4201	0.3300	126886	382398	2176230	1864658	163359	762136	163359	762136
2002	0.4201	0.3300	147422	442235	2461131	2136200	182960	885647	182960	885647
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 26AUG98:14:11
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

The SAS System 14:09 Wednesday, August 26, 1998

Cod in the North-East Arctic (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
1998	0.9050	0.7109	215594	654012	1660597	1557831	158083	631234	158083	631234
1999	0.5347	0.4200	125859	359183	1354039	1389034	116248	575871	116248	575871
2000	0.5347	0.4200	136484	388089	1618149	1522146	125017	600761	125017	600761
2001	0.5347	0.4200	146359	418172	2140595	1712749	144518	650010	144518	650010
2002	0.5347	0.4200	168438	468642	2415575	1923512	155604	718591	155604	718591
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 26AUG98:14:11
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

The SAS System 14:09 Wednesday, August 26, 1998

Cod in the North-East Arctic (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
1998	0.9050	0.7109	215594	654012	1660597	1557831	158083	631234	158083	631234
1999	0.5856	0.4600	136203	386967	1354039	1389034	116248	575871	116248	575871
2000	0.5856	0.4600	145009	406423	1609192	1488527	121083	577057	121083	577057
2001	0.5856	0.4600	153749	429200	2125990	1652517	137014	606352	137014	606352
2002	0.5856	0.4600	176445	475294	2397475	1842784	145127	656476	145127	656476
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 26AUG98:14:11
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factors

The SAS System 14:09 Wednesday, August 26, 1998

Cod in the North-East Arctic (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
1998	0.9050	0.7109	215594	654012	1660597	1557831	158083	631234	158083	631234
1999	1.0000	0.7855	211963	581622	1354039	1389034	116248	575871	116248	575871
2000	1.0000	0.7855	196981	493344	1544056	1256172	93970	417987	93970	417987
2001	1.0000	0.7855	194992	456460	2029139	1285869	90927	353629	90927	353629
2002	1.0000	0.7855	223890	477911	2285120	1396328	86277	331920	86277	331920
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 26AUG98:14:11
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : F factor

Table 3.25 (cont'd.)

The SAS System 14:09 Wednesday, August 26, 1998

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	0.9050	0.7108	215589	654000	1660597	1557831	158083	631234	158083	631234
1999	0.4318	0.3392	104157	300000	1354042	1389049	116249	575882	116249	575882
2000	0.3689	0.2898	101900	300000	1636987	1594101	133445	651990	133445	651990
2001	0.3093	0.2429	97837	300000	2185948	1901331	167896	787556	167896	787556
2002	0.2459	0.1932	95198	300000	2494238	2278071	201293	993030	201293	993030
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 26AUG98:14:11
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : TAC constraint

The SAS System 14:09 Wednesday, August 26, 1998

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	0.9050	0.7108	215589	654000	1660597	1557831	158083	631234	158083	631234
1999	0.6101	0.4792	141091	400000	1354042	1389049	116249	575882	116249	575882
2000	0.5839	0.4586	143408	400000	1604968	1472809	119244	566028	119244	566028
2001	0.5430	0.4265	143375	400000	2123991	1642400	135744	598356	135744	598356
2002	0.4661	0.3661	146013	400000	2404805	1866660	148264	671971	148264	671971
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRBJA01
Date and time : 26AUG98:14:34
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : TAC constraints

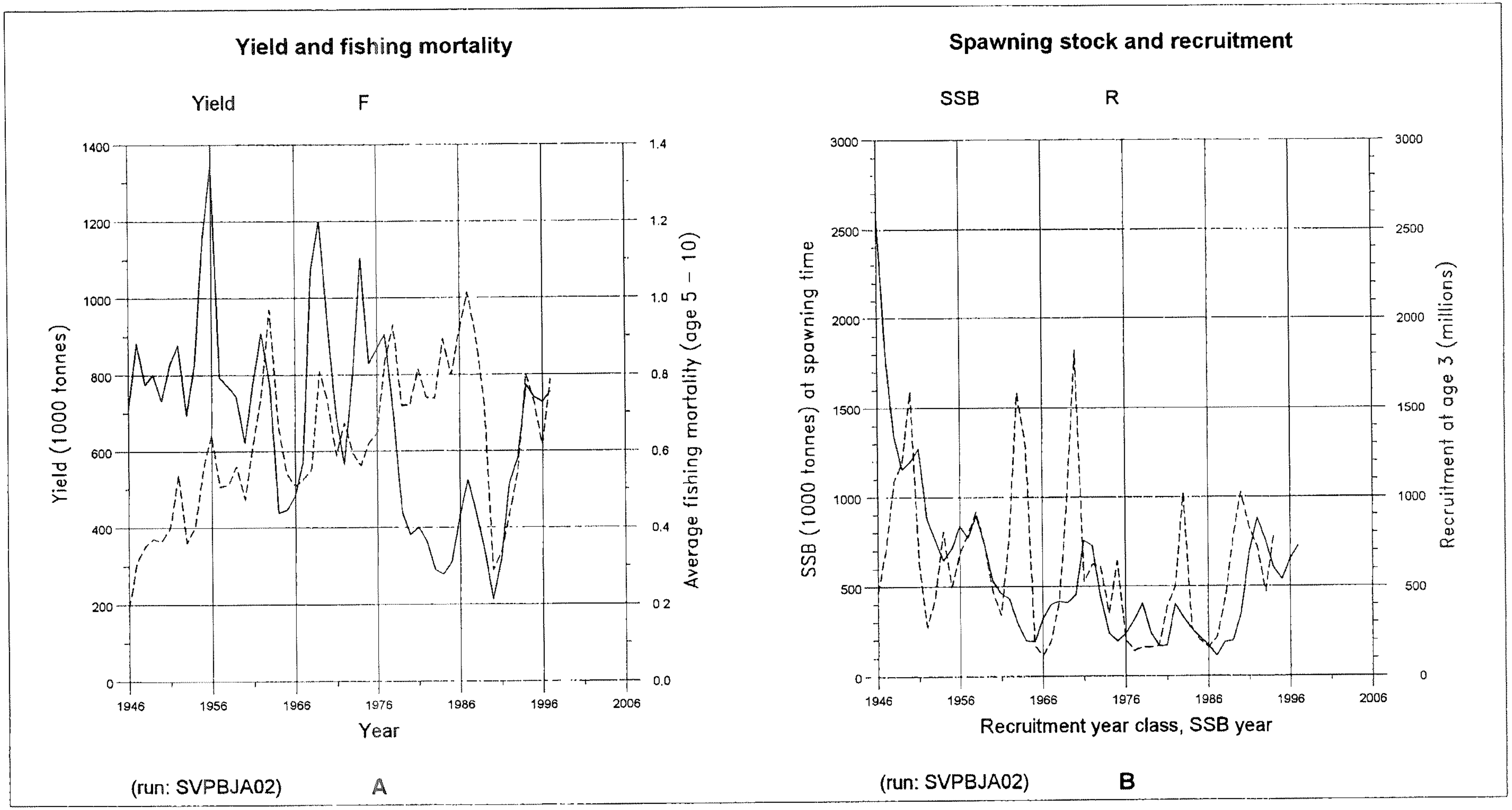
The SAS System 14:09 Wednesday, August 26, 1998

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

Single option prediction: Summary table

							1 January		Spawning time	
Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	0.9050	0.7108	215589	654000	1660597	1557831	158083	631234	158083	631234
1999	0.8125	0.6382	179438	500000	1354042	1389049	116249	575882	116249	575882
2000	0.8941	0.7023	191090	500000	1571920	1352884	105233	483096	105233	483096
2001	0.9757	0.7664	203296	500000	2056353	1387408	103803	422715	103803	422715
2002	0.9676	0.7600	224822	500000	2299644	1460117	94876	380123	94876	380123
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

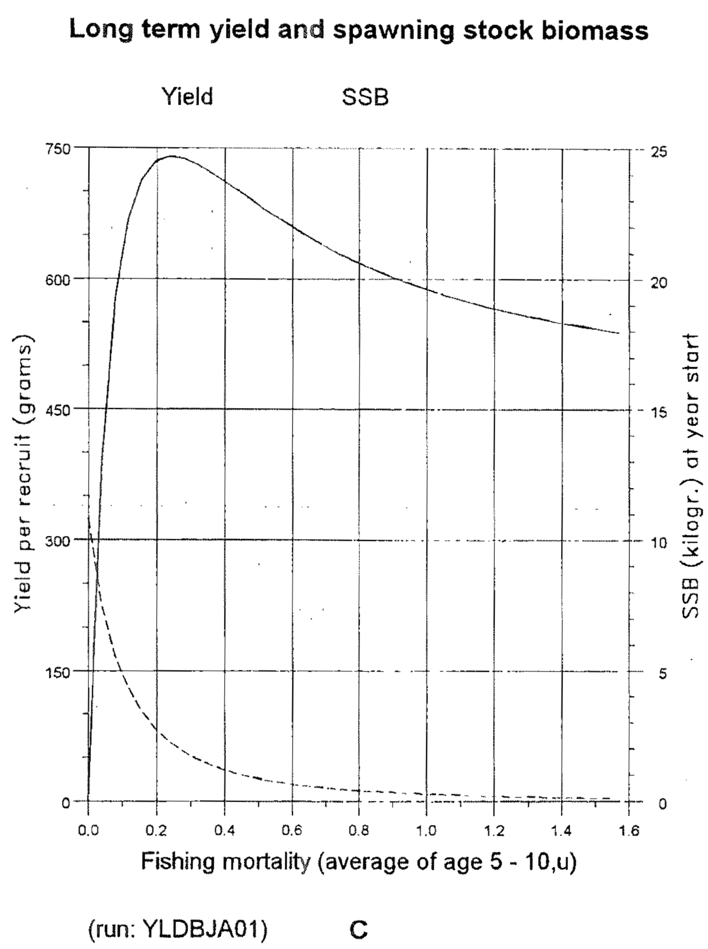
Notes: Run name : SPRBJA01
Date and time : 26AUG98:14:34
Computation of ref. F: Simple mean, age 5 - 10
Prediction basis : TAC constraints



Yield and fishing mortality
Yield
F
Yield (1000 tonnes)
Average fishing mortality (age 5 – 10)
Year
(run: SVPBJA02)
A
Spawning stock and recruitment
SSB
R
SSB (1000 tonnes) at spawning time
Recruitment at age 3 (millions)
Recruitment year class, SSB year
(run: SVPBJA02)
B

Fig. 3.1 AB

Fish Stock Summary
Cod in the North-East Arctic (Areas I and II)
24-8-1998



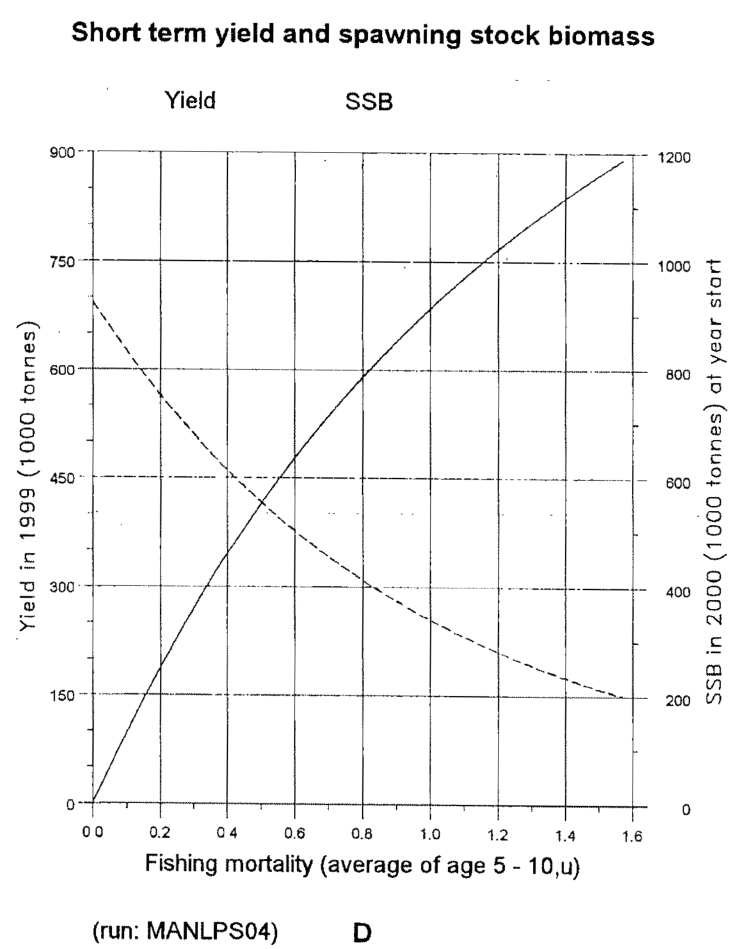


Figure 3.1.C,D

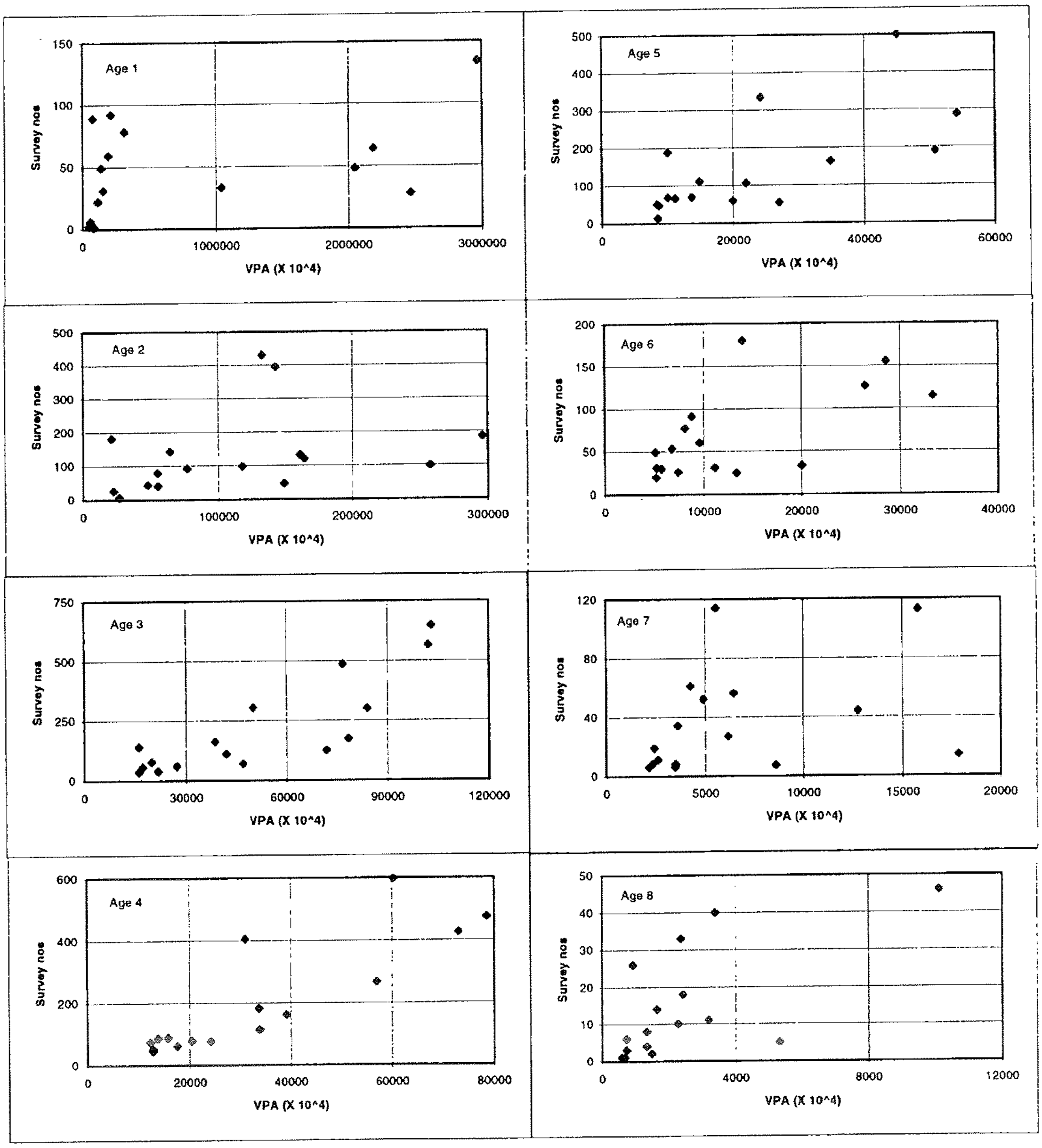


Figure 3.2A (FLT43) Northeast Arctic cod abundance index from the Russian trawl acoustic survey plotted against the VPA results by age.

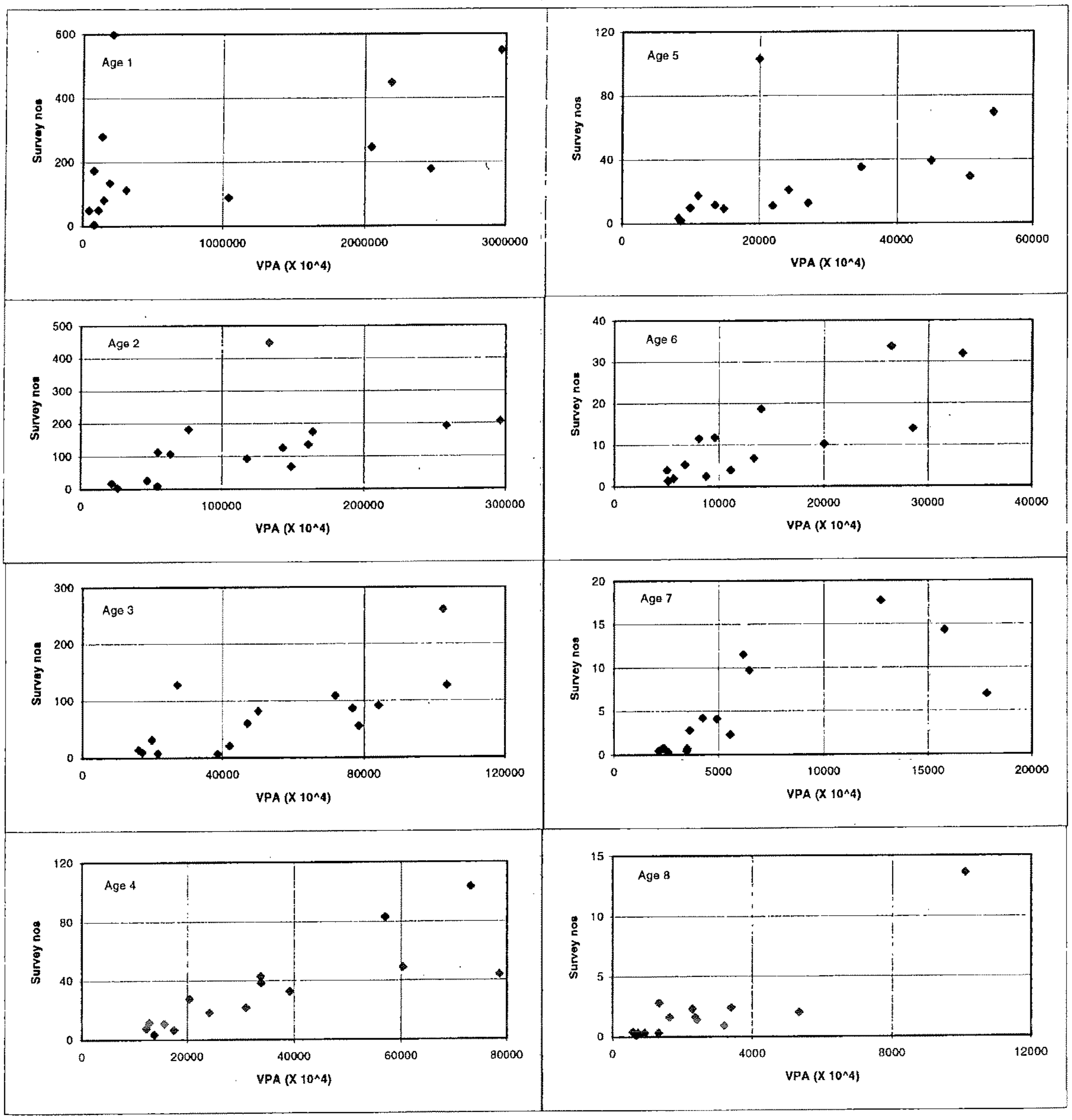


Figure 3.2B (FLT45) Northeast Arctic cod abundance index from the Norwegian Svalbard bottom trawl survey plotted against the VPA results by age.

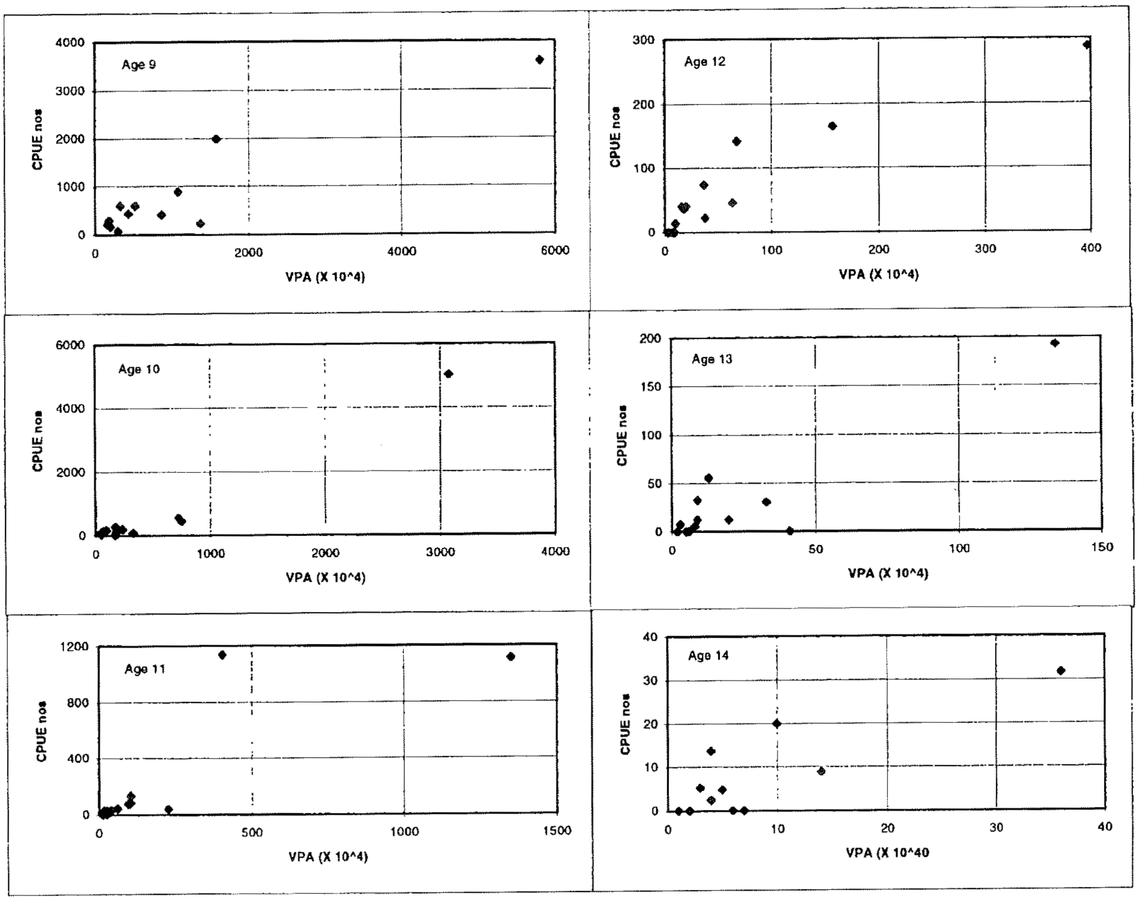


Figure 3.2C (FLT52) Northeast Arctic cod abundance index from the Norwegian trawl catch and effort plotted against the VPA results by age.

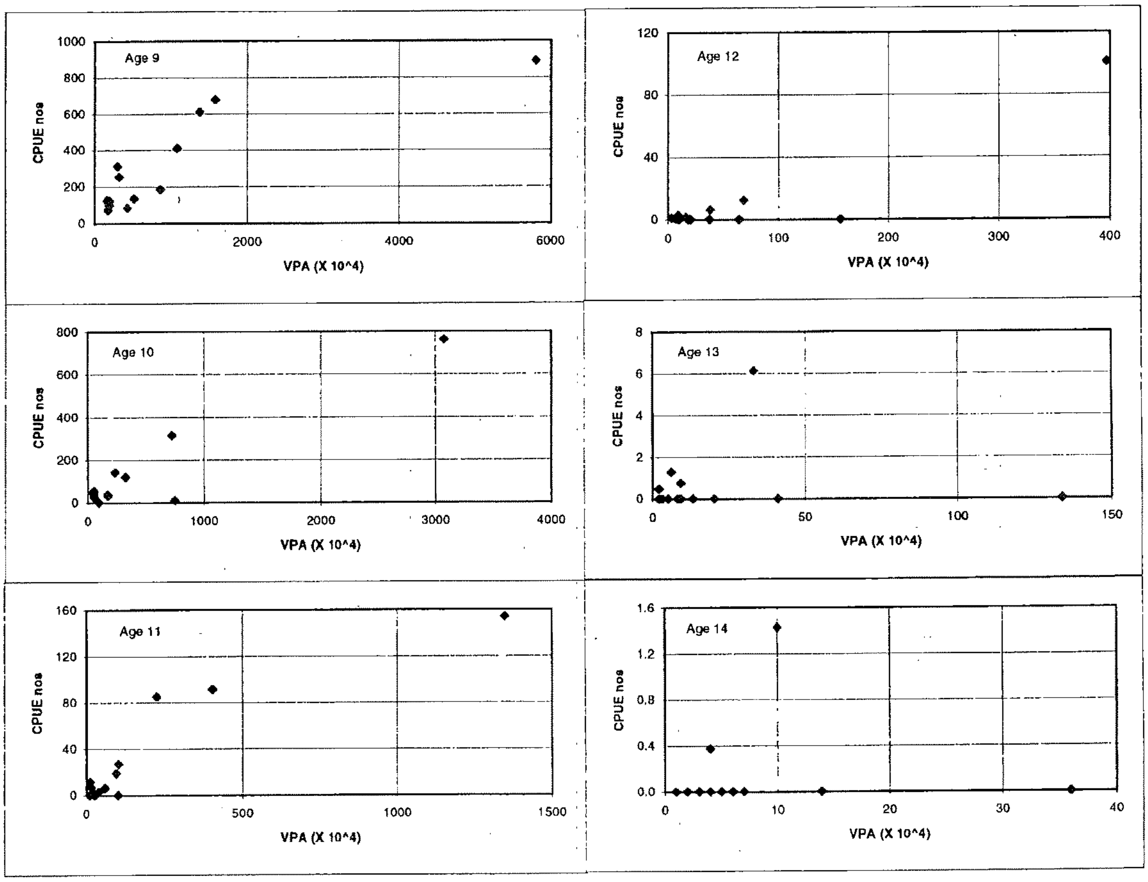


Figure 3.2D (FLT53) Northeast Arctic cod abundance index from the Russian trawl catch and effort plotted against the VPA results by age.

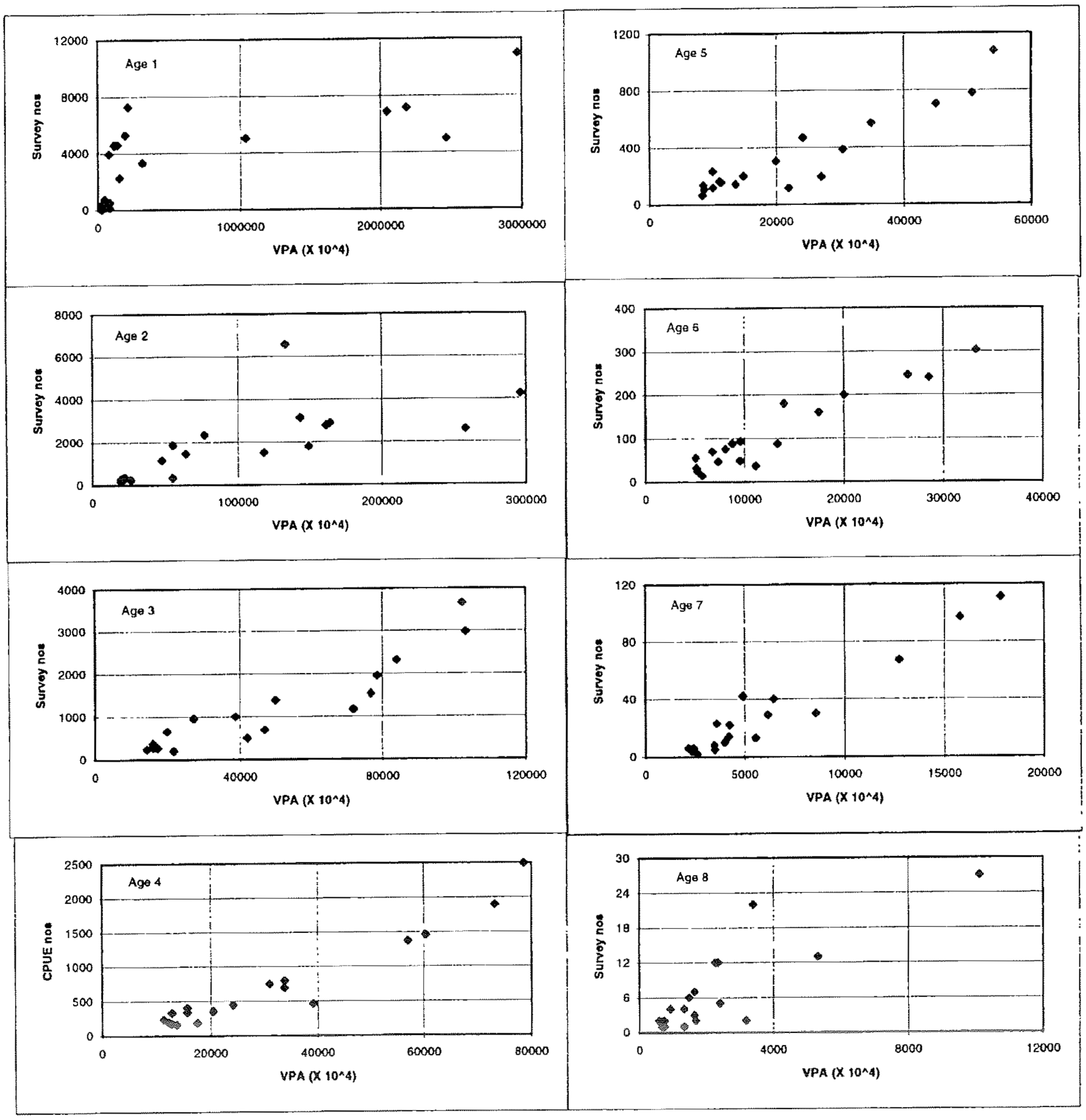


Figure 3.2E (FLT54) Northeast Arctic cod abundance index from the Norwegian Barents Sea trawl trawl survey (corrected for changed swept area) plotted against the VPA results by age.

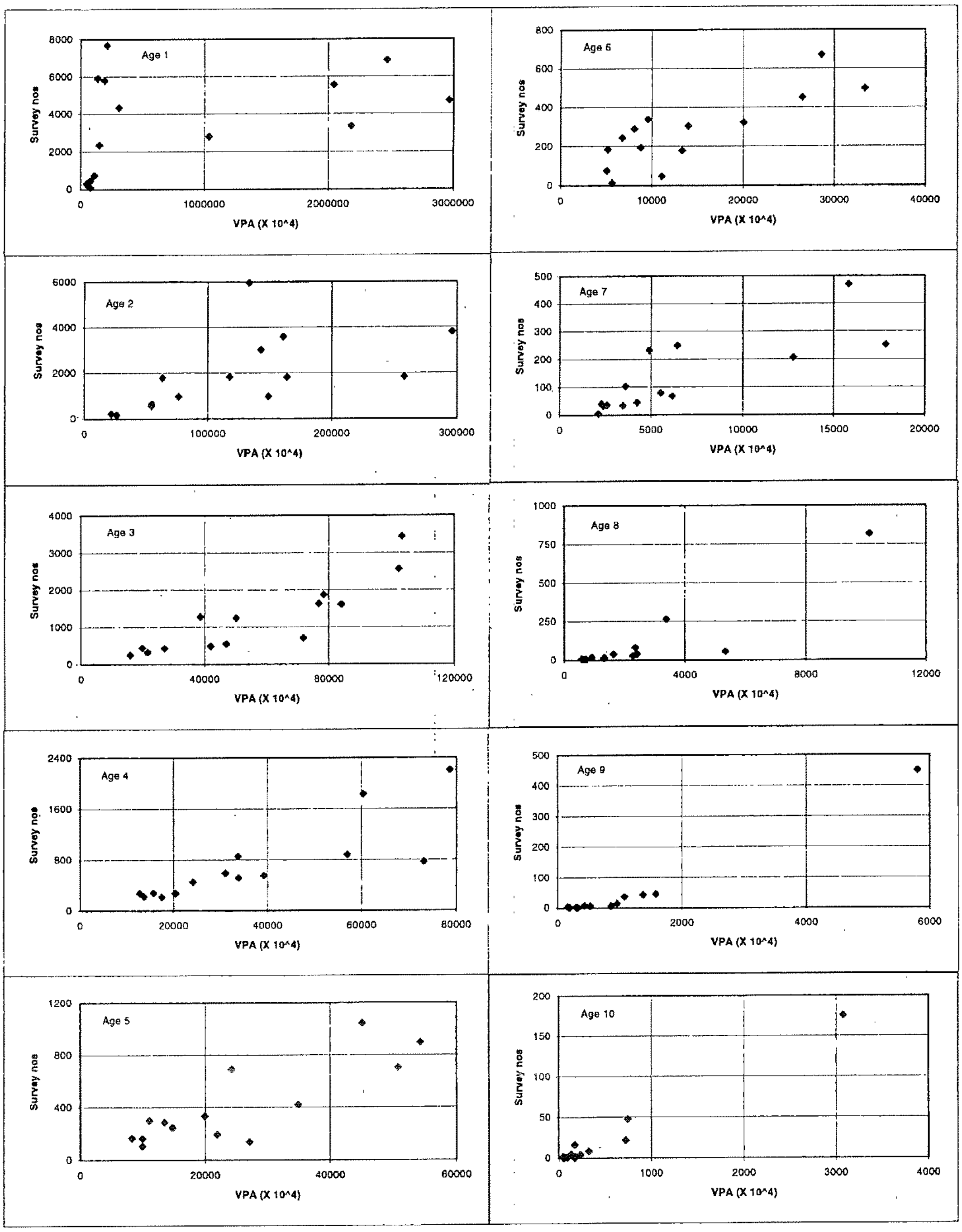
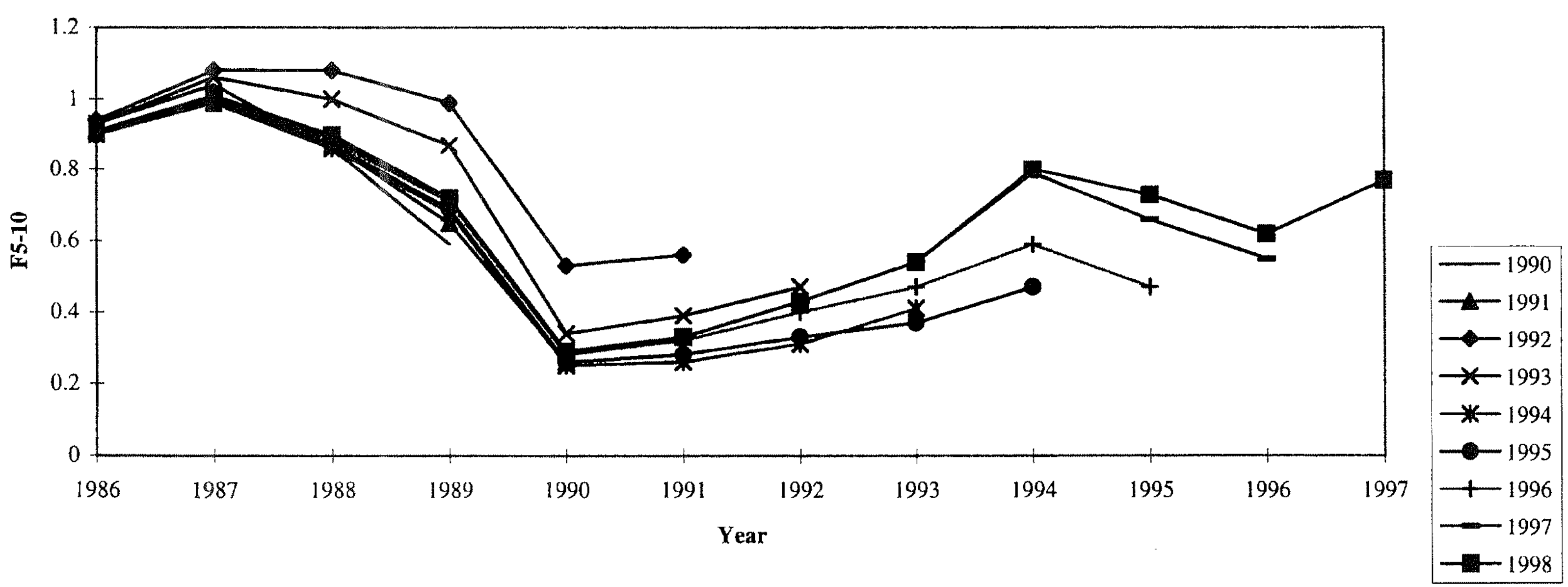


Figure 3.2F (FLT61) Northeast Arctic cod abundance index from the Norwegian Barents Sea and Lofoten acoustic survey plotted against the VPA results by age.

Figure 3.3 NEA cod retrospective analysis, no cannibalism



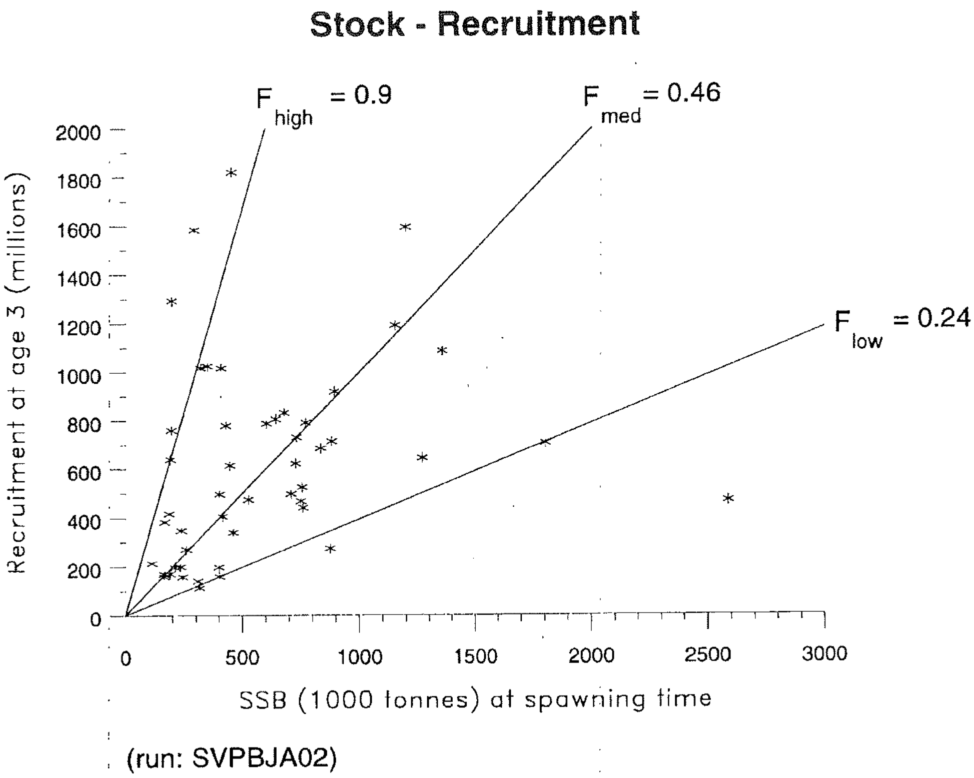
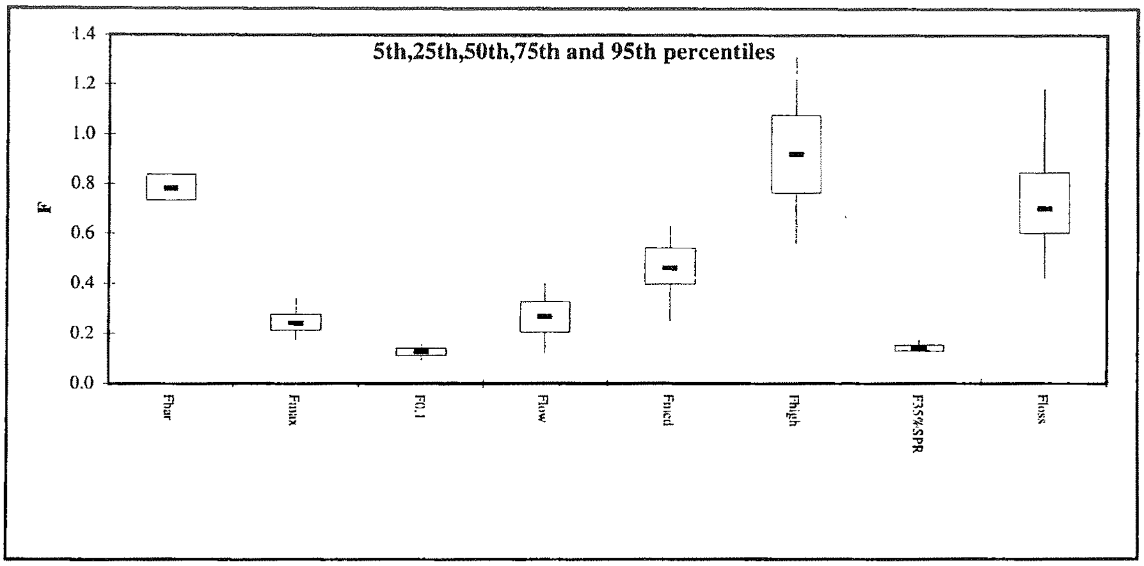


Figure 3.4

Fig. 3.4



Reference point	Deterministic	Median	95th percentile	80th percentile
MedianRecruits	511025	496722	664531	623041
MBAL	500000			
Bloss	112217			
SSB90%R90%Sur	345365	371425	558093	437460
SPR%ofVirgin	3.68	3.70	5.71	4.57
VirginSPR	10.88	12.26	21.21	16.78
SPRloss	0.47	0.50	0.80	0.63
	Deterministic	**Median**	**5th percentile**	**20th percentile**
FBar	0.79	0.78	0.66	0.71
Fmax	0.24	0.24	0.17	0.21
F0.1	0.12	0.13	0.09	0.11
Flow	0.24	0.27	0.12	0.19
Fmed	0.45	0.46	0.25	0.37
Fhigh	0.90	0.91	0.56	0.71
F35%SPR	0.14	0.14	0.11	0.13
Floss	0.72	0.70	0.42	0.56

Figure 3.5 Northeast Arctic cod. Reference points estimated by the PASoft program package

Fig 3.6A. NEA cod. Percentiles of catch distribution, F=0.33

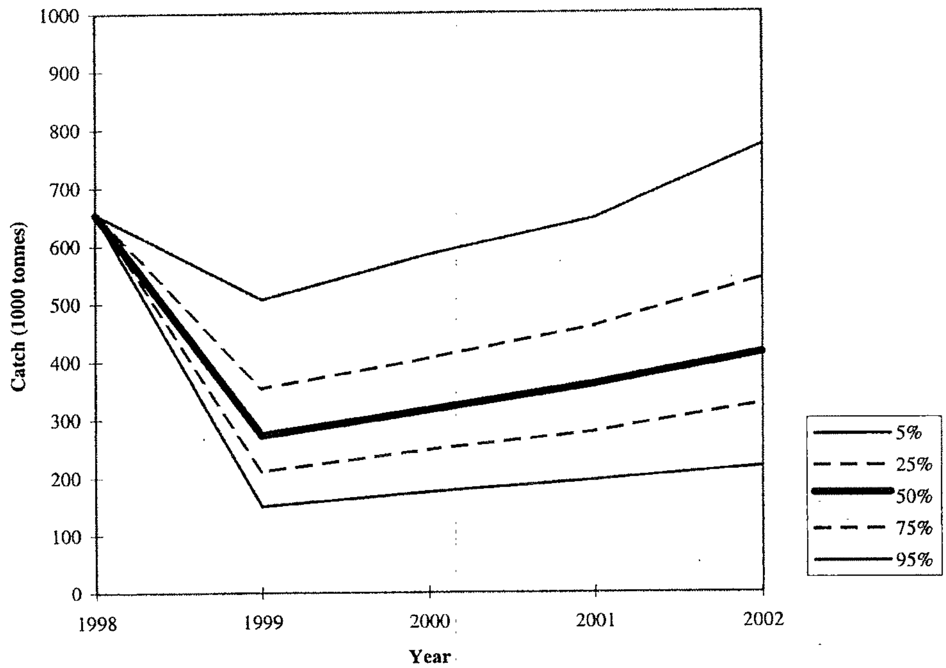


Fig 3.6A NEA cod. Percentiles of the SSB distribution. F=0.33

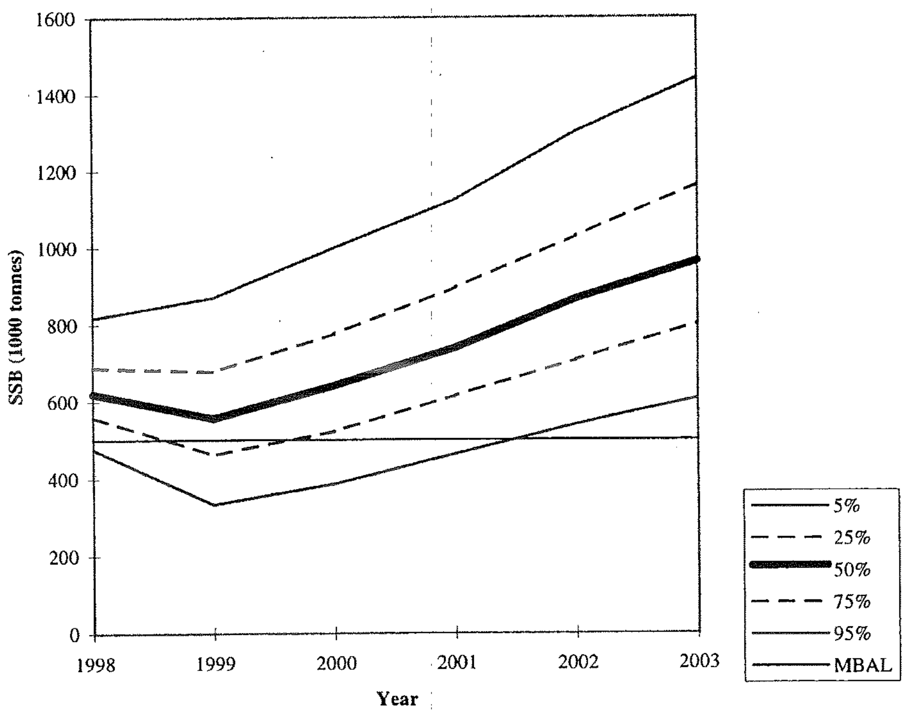


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Fig 3.6B. Percentiles of the catch distribution. F=0.42

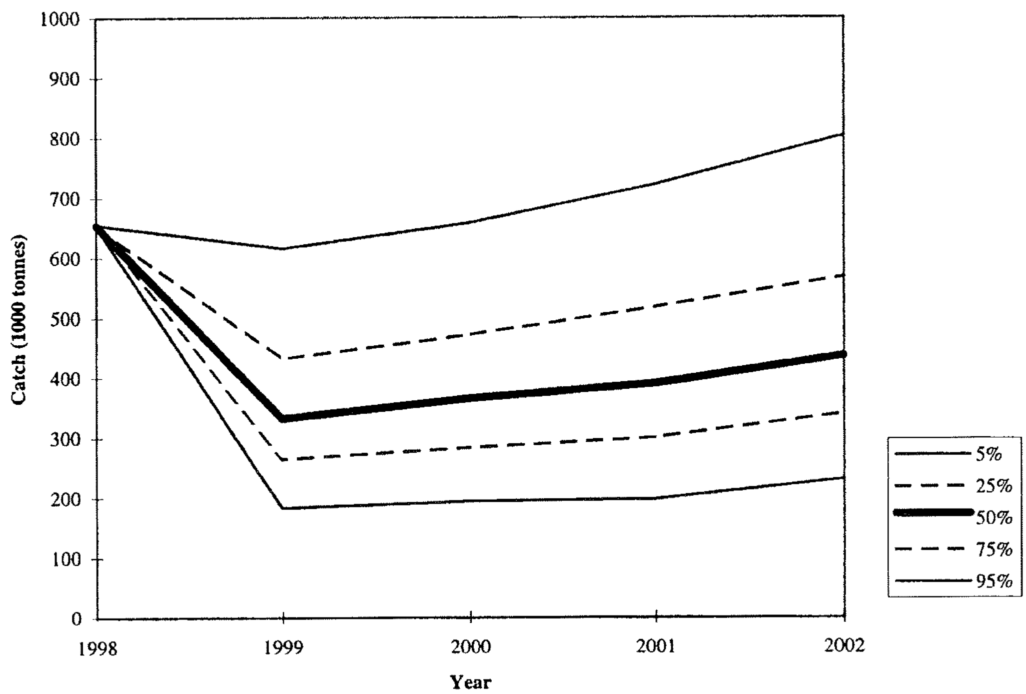
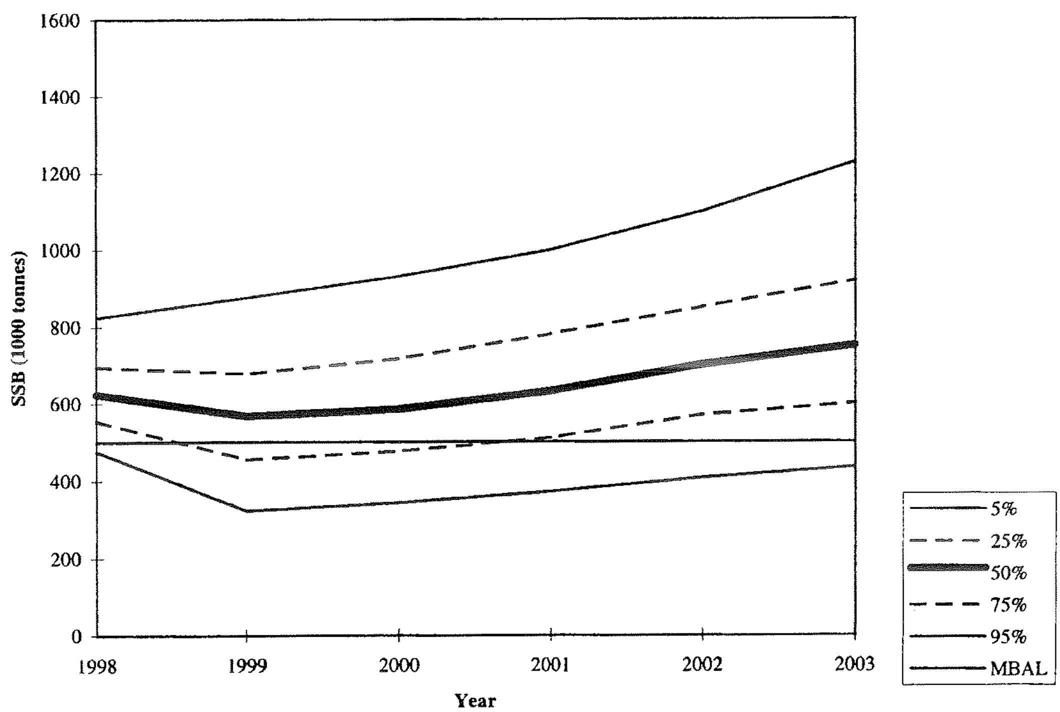
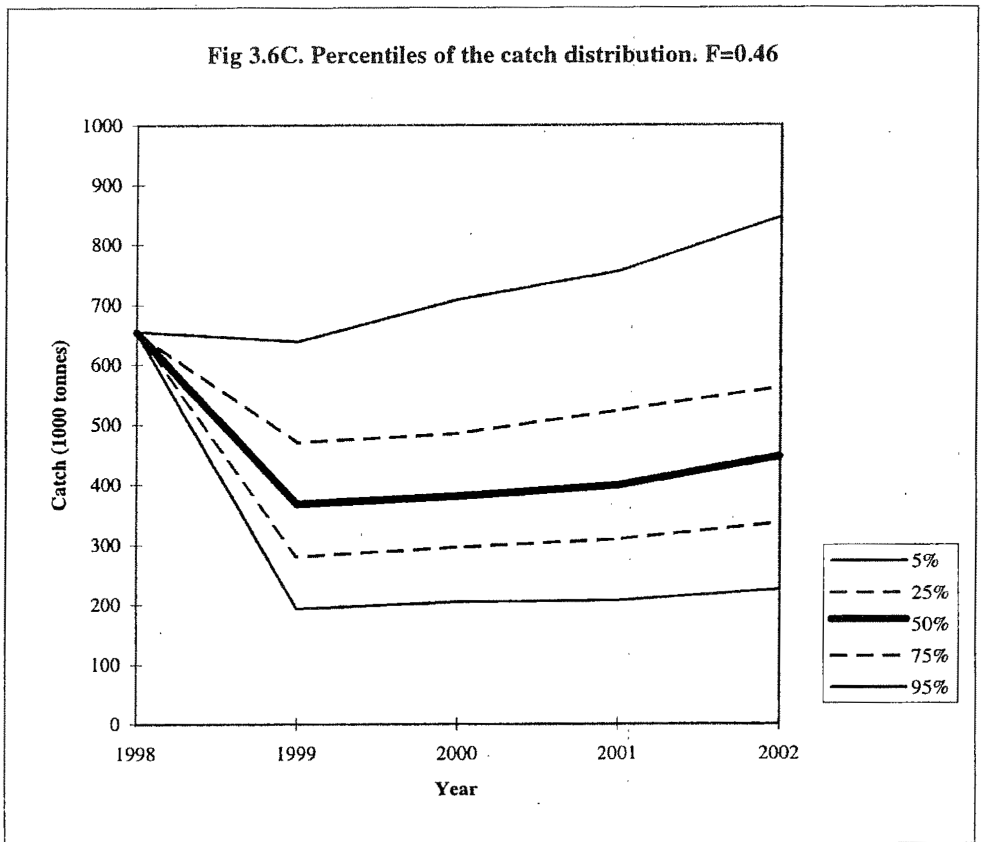


Fig 3.6 B. NEA cod. Percentiles of the SSB distribution. F=0.42





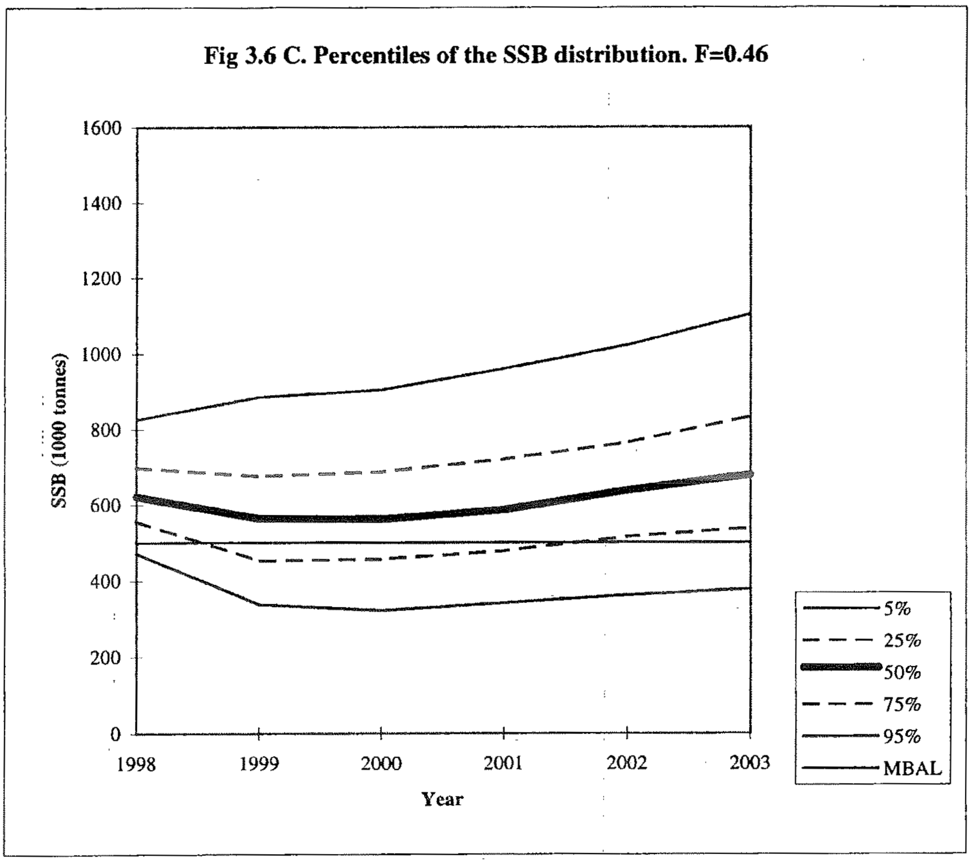


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Fig. 3.6D NEA cod. Percentiles of catch distribution. F=0.79

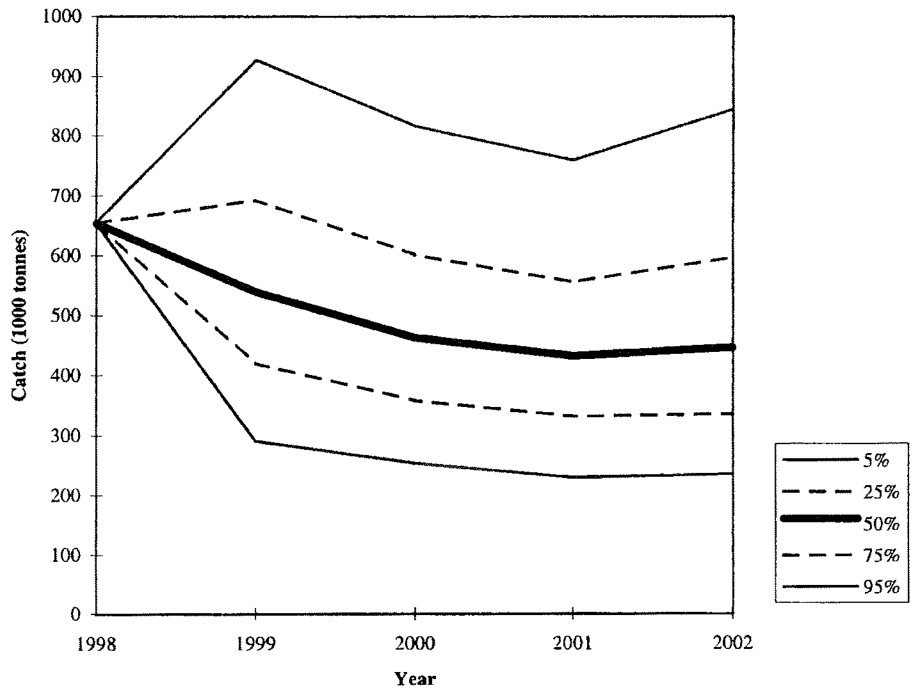

Fig 3.6D. NEA cod. Percentiles of the SSB distribution. F=0.79

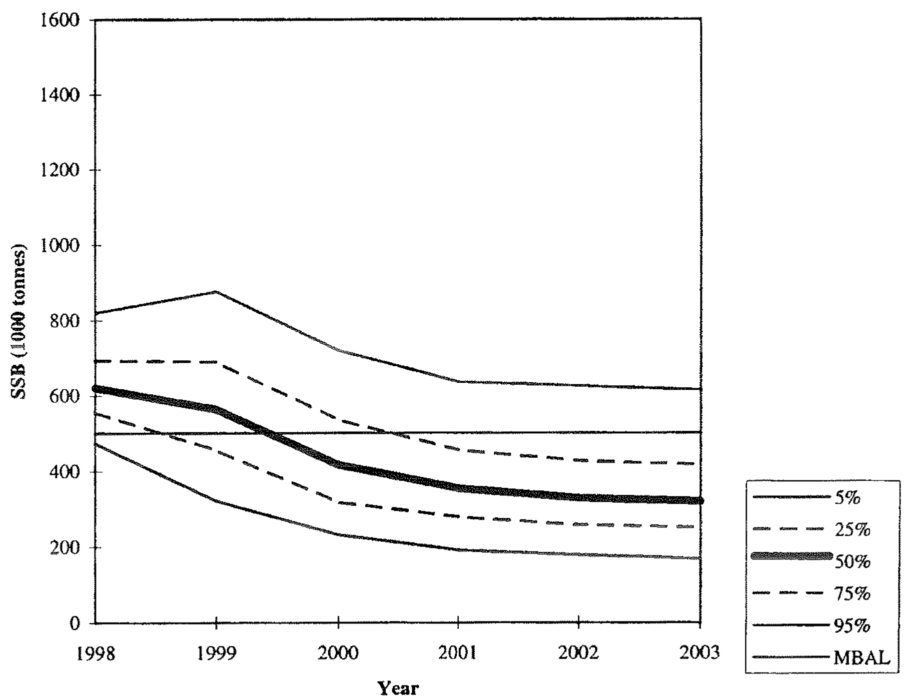

Fig. 3.6E. NEA cod. Percentiles of the catch distribution, TAC = 300 000 t, F< 1.5

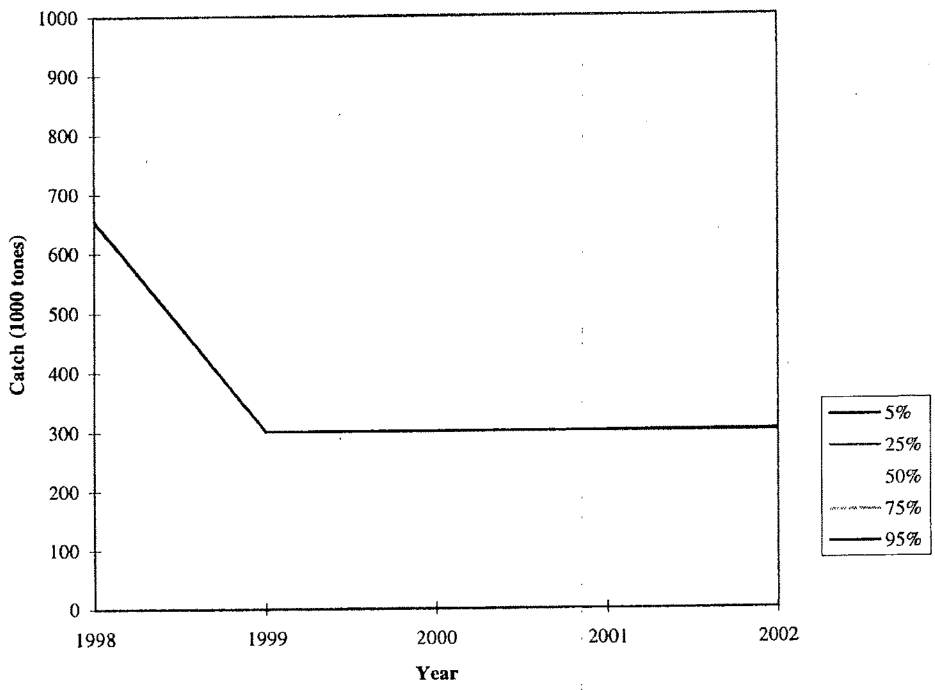

Fig. 3.6E. NEA cod. Percentiles of the SSB distribution, TAC = 300 000 t, F< 1.5

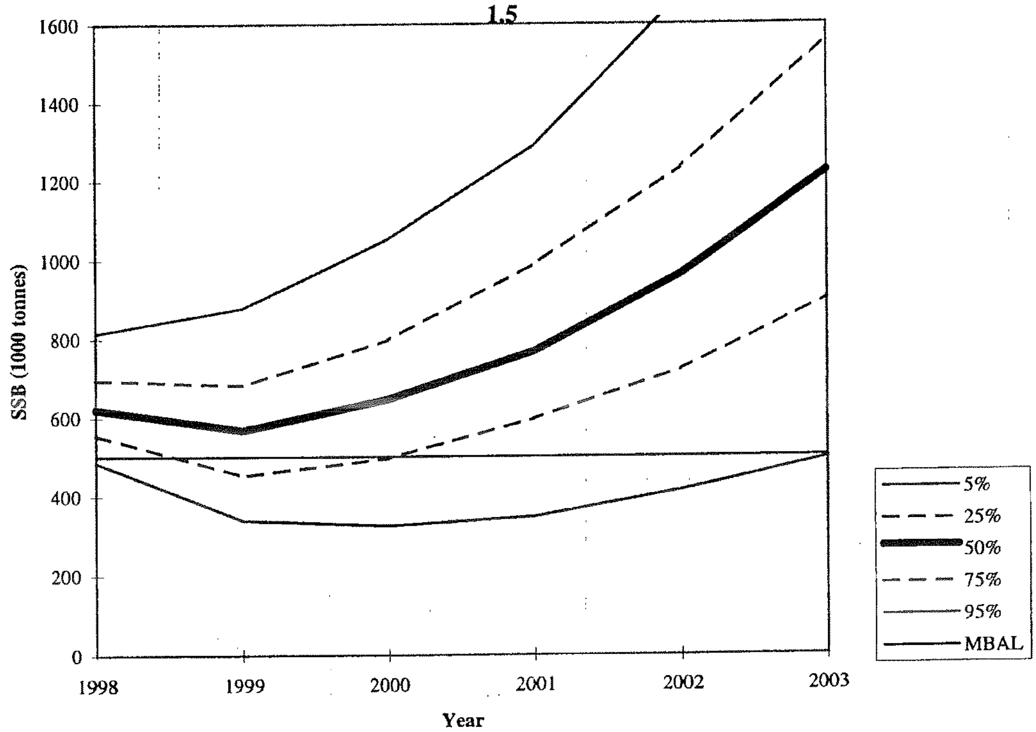

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Fig. 3.6 F. NEA cod. Percentiles of the catch distribution. TAC = 400 000 t, F < 1.5

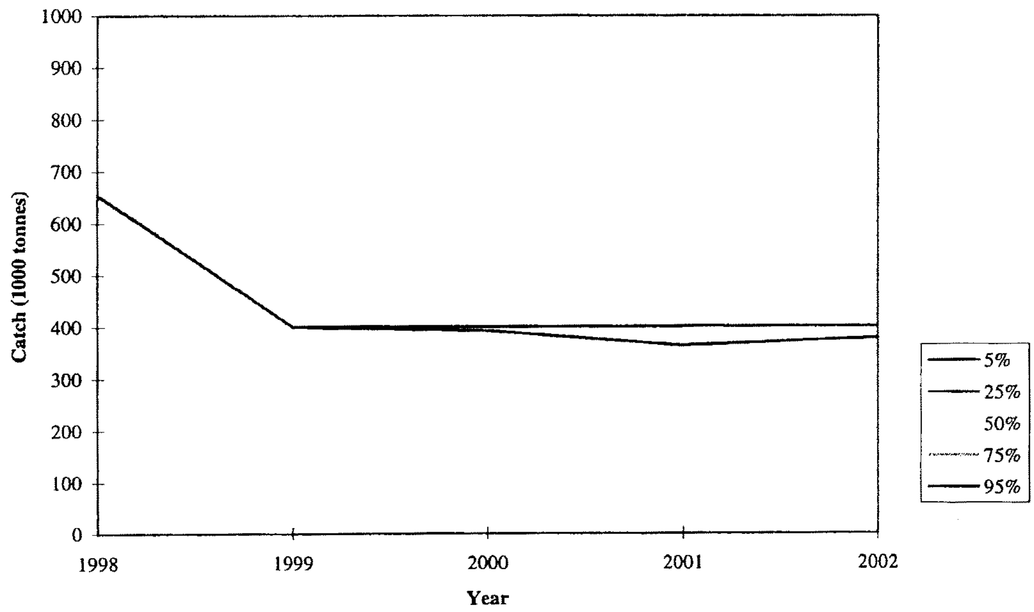

Fig. 3.6F. NEA cod. Percentiles of the SSB distribution. TAC = 400 000 t, F< 1.5.

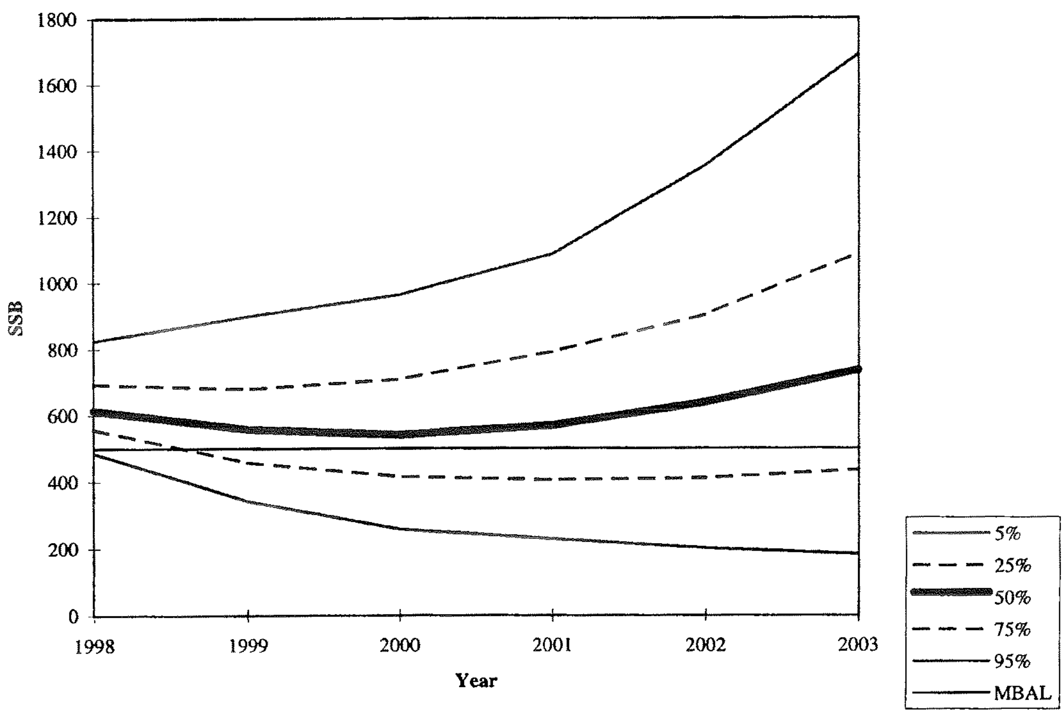

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Fig. 3.6G. NEA cod. Percentiles of the SSB distribution, TAC = 500 000 tonnes, F< 1.5

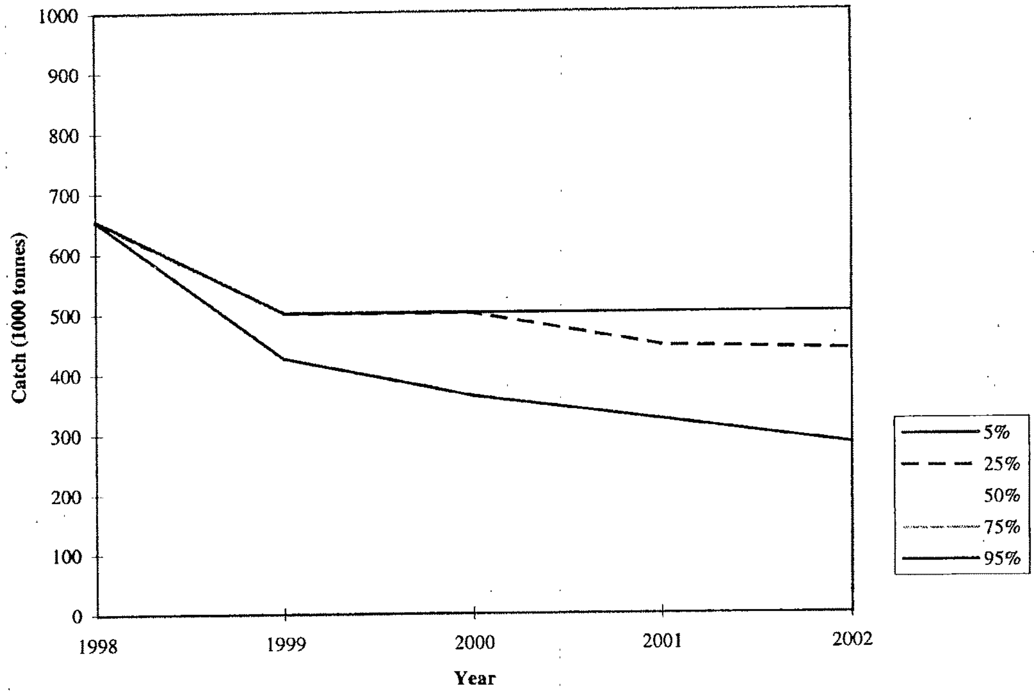

Fig 3.6 G NEA cod. Percentiles of the SSB distribution. TAC = 500 000 t, F< 1.5

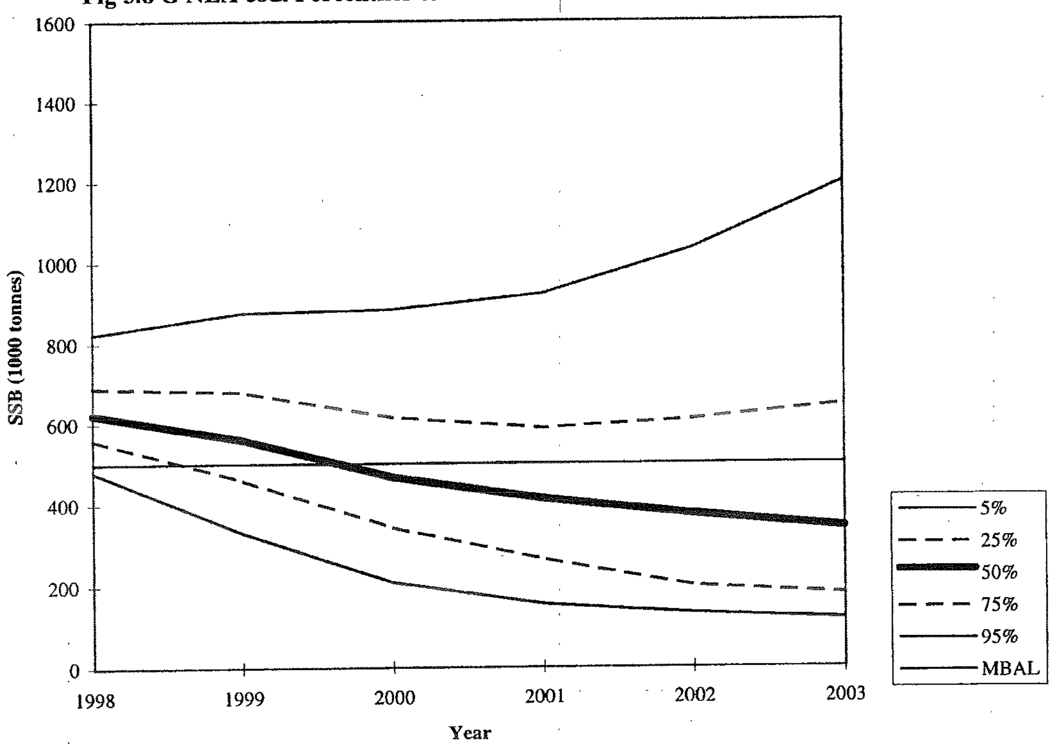

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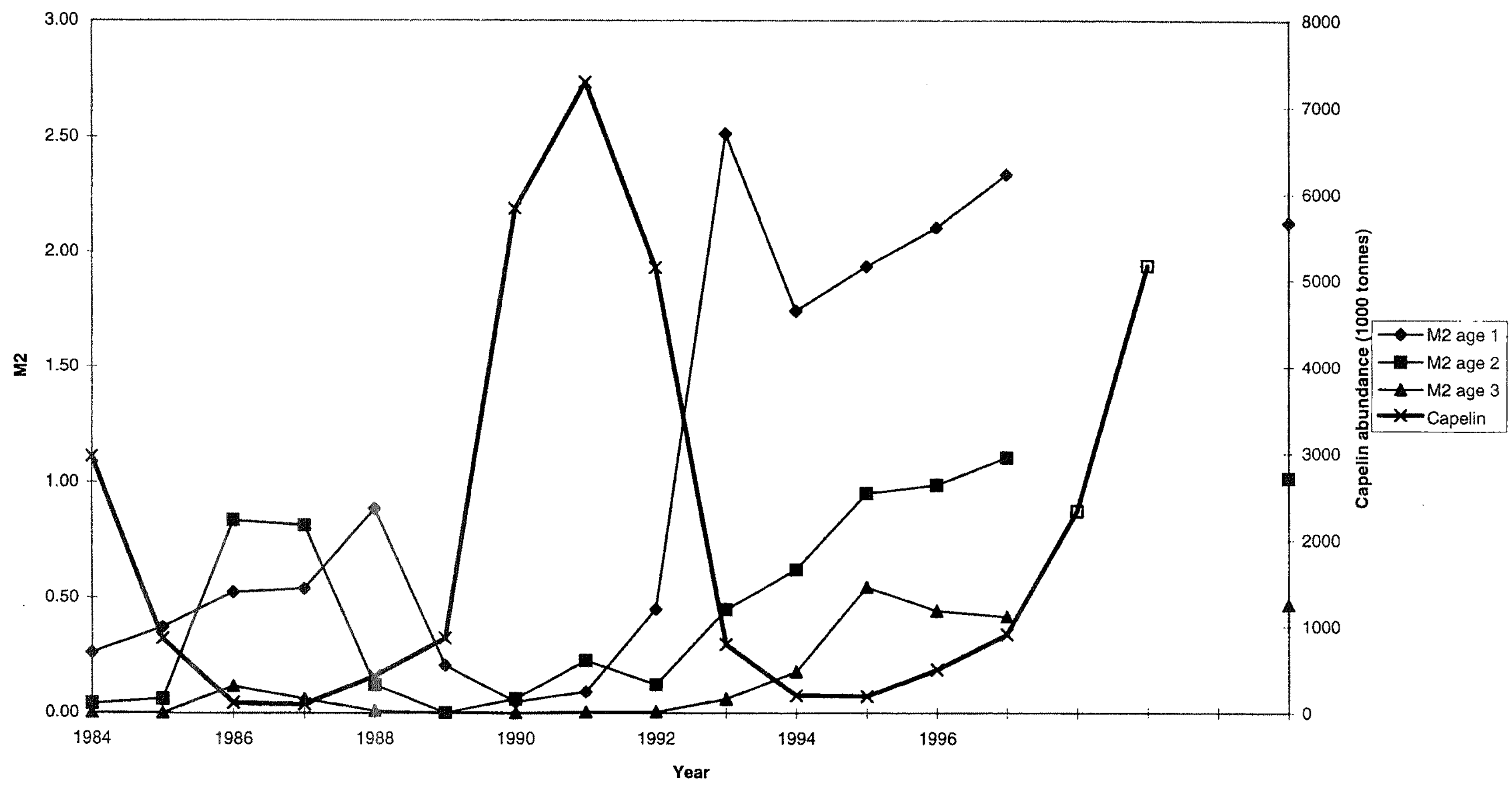
Figure 3.7 Northeast Arctic cod. Natural mortality due to cannibalism (M2) vs. capelin abundance



F-3-7.XLS

Table A.1 North-East Arctic COD. Catch per unit effort.

	Sub-area I			Division IIa			Division IIb		
Year	Norway[2]	UK[3]	Russia[4]	Norway[2]	UK[3]	Norway[5]	Norway[2]	UK[3]	Russia[4]
1960	-	0.075	0.42	-	0.067	3.0	-	0.105	0.31
1961	-	0.079	0.38	-	0.058	3.7	-	0.129	0.44
1962	-	0.092	0.59	-	0.066	4.0	-	0.133	0.74
1963	-	0.085	0.60	-	0.066	3.1	-	0.098	0.55
1964	-	0.056	0.37	-	0.070	4.8	-	0.092	0.39
1965	-	0.066	0.39	-	0.066	2.9	-	0.109	0.49
1966	-	0.074	0.42	-	0.067	4.0	-	0.078	0.19
1967	-	0.081	0.53	-	0.052	3.5	-	0.106	0.87
1968	-	0.110	1.09	-	0.056	5.1	-	0.173	1.21
1969	-	0.113	1.00	-	0.094	5.9	-	0.135	1.17
1970	-	0.100	0.80	-	0.066	6.4	-	0.100	0.80
1971	-	0.056	0.43	-	0.062	10.6	-	0.071	0.16
1972	0.90	0.047	0.34	1.08	0.055	11.5	0.59	0.051	0.18
1973	1.05	0.057	0.56	0.71	0.043	6.8	0.43	0.054	0.57
1974	1.75	0.079	0.86	0.19	0.028	3.4	1.94	0.106	0.77
1975	1.82	0.077	0.94	1.36	0.033	3.4	1.67	0.100	0.43
1976	1.69	0.060	0.84	1.69	0.035	3.8	1.20	0.081	0.30
1977	1.54	0.052	0.63	1.16	0.044	5.0	0.91	0.056	0.25
1978	1.37	0.062	0.52	1.12	0.037	7.1	0.56	0.044	0.08
1979	0.85	0.046	0.43	1.06	0.042	6.4	0.62	-	0.06
1980	1.47	-	0.49	1.27	-	5.0	0.41	-	0.16
					Russia[4]			**Spain[6]**	
1981	1.42	-	0.41	1.02	0.35	6.2	(0.96)	-	0.07
1982	1.30	-	0.35	1.01	0.34	6.4	-	0.86	0.26
1983	1.58	-	0.31	1.05	0.38	7.6	(1.31)	0.92	0.36
1984	1.40	-	0.45	0.73	0.27	7.0	1.20	0.78	0.35
1985	1.86	-	1.04	0.90	0.39	5.1	1.51	1.37	0.50
1986	1.97	-	1.00	1.36	1.14	4.1	2.39	1.73	0.84
1987	1.77	-	0.97	1.73	0.67	3.3	2.00	1.82	1.05
1988	1.58	-	0.66	0.97	0.55	2.2	1.61	(1.36)	0.54
1989	1.49	-	0.71	0.78	0.43	3.6	0.41	2.70	0.45
1990	1.35	-	0.70	0.38	0.60	4.8	0.39	2.69	0.80
1991	1.38	-	0.67	0.50	0.90	-	0.29	4.96	0.76
1992	2.19	-	0.79	0.98	0.65	-	3.06	2.47	0.23
1993	2.33	-	0.85	1.74	1.03	-	2.98	3.38	1.00
1994	2.50	-	1.01	1.27	0.86	-	2.82	1.44	1.14
1995	1.57	-	0.59	1.00	1.01	-	2.73	1.65	1.10
1996			0.74		0.99			1.11	0.85
1997			0.61		0.74				0.57

[1] Preliminary figures.
[2] Norwegian data - t per 1,000 tonnage*hrs fishing.
[3] United Kingdom data - t per 100 tonnage*hrs fishing.
[4] Russia data - t per hr fishing.
[5] Norwegian data - t per gillnet boat week in Lofoten.
[6] Spanish data - t per hr fishing.

Period	Sub-area I	Divisions IIa and IIb
1960–1973	RT	RT
1974–1980	PST	RT
1981–	PST	PST

Vessel type:
RT = side trawlers, 800–1000 HP.
PST = stern trawlers, up to 2000 HP.

Table A2 North-East Arctic COD. Abundance indices (millions) from the Norwegian acoustic survey in the Barents Sea in January–March. New TS and rock-hopper gear (1981–1988 back-calculated from bobbins gear). Corrected for length-dependent effective spread of trawl.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	8	82	40	63	106	103	16	3	1	1	423
1982	4	5	49	43	40	26	28	2	+	0	197
1983	0	19	13	23	27	14	7	4	1	+	108
1984	1807	150	31	11	7	5	2	+	+	0	2013
1985	108	768	179	127	21	9	6	+	+	+	1218
1986	1302	590	595	124	56	7	2	+	+	0	2676
1987	3	72	96	256	46	12	1	1	+	0	487
1988	2	29	64	42	75	9	2	+	+	0	224
1989	9	9	20	43	27	57	8	1	+	0	174
1990	350	45	16	24	27	22	40	3	1	0	526
1991	187	234	55	31	27	25	14	16	1	0	591
1992	348	579	182	48	18	11	8	4	2	0	1201
1993	1686	432	300	163	80	14	7	3	1	3	2688
1994	1083	686	358	343	159	43	9	2	1	1	2685
1995	2644	280	181	161	214	69	18	2	1	1	3570
1996	2404	335	96	70	86	75	21	3	+	+	3090
1997[1]	1520	470	182	54	51	37	22	4	1	+	2341
1998[1]	3082	554	379	187	45	33	25	14	2	0	4321

[1)] Adjusted indices

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

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	4.6	34.3	16.4	23.3	40.0	38.4	4.8	1.0	0.3	0.0	163.1
1982	0.8	2.9	28.3	27.7	23.6	15.5	16.0	1.4	0.2	0.0	116.5
1983	341.9	19.0	22.3	37.1	33.3	13.5	4.6	3.0	0.6	0.2	474.4
1984	2864.4	393.2	115.9	26.2	18.9	10.6	3.2	0.5	0.2	0.1	3433.1
1985	51.5	727.6	144.4	99.5	15.7	6.4	2.5	0.2	0.1	0.1	1047.8
1986	741.8	461.5	657.1	137.1	75.0	23.3	5.5	0.6	0.2	0.1	2102.2
1987	33.4	457.4	233.4	365.5	46.1	11.3	1.4	0.4	+	0.0	1148.9
1988	5.0	72.9	185.2	95.3	189.5	19.1	3.6	0.6	0.1	0.0	571.3
1989	9.4	13.6	36.5	64.9	35.2	77.9	8.7	0.8	0.2	0.2	247.4
1990	161.0	50.8	23.3	30.1	33.6	19.7	23.9	1.3	0.4	0.1	344.1
1991	470.8	224.7	32.3	19.1	17.5	16.1	9.3	9.7	0.5	0.1	800.1
1992	131.6	528.9	149.6	49.5	18.4	11.8	7.5	4.0	2.7	0.2	904.3
1993[1]	534.1	331.0	311.8	152.6	69.0	14.2	6.9	4.2	2.2	2.1	1430.2
1994[1]	861.8	496.8	276.3	297.6	145.9	46.9	8.8	2.3	1.2	1.2	2138.8
1995[1]	4892.4	503.8	288.2	231.2	249.2	70.4	18.0	2.2	0.7	1.0	6256.8
1996[1]	5778.8	715.5	177.6	116.0	136.9	107.5	24.5	2.9	0.4	0.5	7060.5
1997[1,2]	5244.5	1096.4	258.6	68.6	79.4	57.0	30.2	6.7	1.2	0.3	6842.9
1998[1,2]	2814.5	686.3	424.1	194.1	44.3	30.4	20.0	11.1	1.3	0.3	4226.2

[1)] Survey covered a larger area

[2)] Adjusted indices

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

Year	5	6	7	8	9	10	11	12+	Sum
1985	0.68	7.45	12.36	3.11	1.15	1.01	0.45		26.21
1986	2.49	3.30	5.54	2.71	0.16		0.40	0.08	14.66
1987	8.77	7.04	0.23	2.83	0.04		0.03	0.03	18.97
1988	1.57	4.43	2.56	0.05	0.01	0.05			8.66
1989	0.04	13.19	9.73	2.20	0.38	0.12		0.06	25.73
1990	0.13	2.60	27.02	4.85	0.49	0.32			35.41
1991	0.00	5.00	19.83	32.67	2.75	0.19	0.17		60.61
1992	2.74	5.23	20.80	20.87	79.60	4.17	1.61	0.22	135.25
1993	4.87	14.58	17.35	20.22	25.44	41.95	4.74	0.71	129.86
1994	23.78	25.85	10.36	8.21	7.68	3.49	17.53	2.61	99.51
1995	6.49	35.24	12.34	2.27	3.62	2.56	2.15	7.96	72.63
1996	1.41	14.43	24.00	3.65	0.79	0.25	0.80	1.30	46.63
1997	0.40	4.95	27.56	16.50	1.50	0.42		0.75	52.09
1998	0.05	0.30	7.06	11.05	3.24	0.51	0.18	0.02	22.41

Table A5. North-east Arctic COD. Abundance indices (millions) from the Norwegian Bottom Trawl survey in the Svalbard area in September-October. Rock-hopper gear (1981-1988 back-calculated from bobbins gear). Corrected for length-dependent effective spread of trawl.

	Age									
Year	1	2	3	4	5	6	7	8	9+	Total
1983	173.7	25.4	9.3	7.4	1.7	1.4	0.7	0.9	0.2	220.8
1984	598.4	106.8	6.3	3.3	3.4	1.3	0.3	0.3	0.3	720.3
1985	280.6	447.7	81.1	21.5	9.8	3.9	0.7	0.3	0.2	845.8
1986	49.8	182.3	260.6	32.5	11.0	1.9	0.7	0.2	0.1	539.1
1987	48.7	112.3	128.0	103.5	12.5	3.9	0.4	0.1	0.1	409.3
1988	3.6	16.8	31.0	27.5	29.2	6.8	0.4	0.4	0.6	116.5
1989	4.5	2.6	13.5	10.7	9.3	13.9	2.3	0.3	0.1	57.2
1990	80.9	8.9	7.3	11.5	17.4	11.8	14.3	1.4	0.2	153.8
1991	134.2	92.1	20.6	6.3	9.9	11.5	9.7	13.6	1.1	299.0
1992	112.9	125.1	85.9	42.6	11.5	5.2	4.1	2.4	6.4	396.0
1993	178.1	135.6	126.5	48.8	21.0	2.4	2.8	1.6	3.9	520.7
1994	88.4	174.5	90.7	43.8	38.9	18.6	4.2	1.6	3.3	464.2
1995	448.1	67.1	108.6	83.0	69.3	33.7	11.5	2.8	1.3	825.2
1996	548.2	192.5	60.0	38.1	35.1	31.9	17.7	2.3	0.8	926.5
1997	245.9	206.4	55.0	18.2	10.3	10.2	6.9	2.0	0.4	555.3

Table A6 North-East Arctic COD. Length at age (cm) from Norwegian surveys in January–March.

Year	Age 1	2	3	4	5	6	7	8
1978	14.2	23.1	32.1	45.9	54.2	64.6	67.6	76.9
1979	12.8	22.9	33.1	40.0	52.3	64.4	74.7	83.0
1980	17.6	24.8	34.2	40.5	52.5	63,5	73.6	83.6
1981	17.0	26.1	35.5	44.7	52.0	61.3	69.6	77.9
1982	14.8	25.8	37.6	46.3	54.7	63.1	70.8	82.9
1983	-	26.1	34.8	46.8	56.0	64.5	73.3	80.4
1984	13.8	26.2	35.8	49.2	57.9	67.4	79.6	82.2
1985	14.5	23.5	40.3	50.8	62.2	71.1	81.8	88.7
1986	13.3	22.6	34.4	50.4	60.0	70.2	82.3	95.2
1987	14.5	21.0	31.8	41.1	55.7	67.2	81.8	94.5
1988	14.7	22.5	29.7	37.0	46.4	58.0	70.1	81.1
1989	12.7	25.7	34.7	40.6	47.5	57.1	68.5	84.0
1990	14.3	29.0	39.4	47.4	53.9	60.9	70.9	87.5
1991	13.8	27.6	41.6	52.6	60.2	68.2	73.8	79.0
1992	13.4	24.7	41.3	50.7	59.9	69.2	77.0	82.7
1993	11.4	20.7	35.9	50.9	59.2	68.8	76.2	84.5
1994	12.0	18.5	30.5	44.8	55.0	64.6	73.5	84.0
1995	12.7	18.8	29.9	42.5	54.2	63.9	76.0	82.0
1996	12.6	19.6	28.1	40.9	49.3	61.4	72.3	85.3
1997[1]	11.4	18.9	28.0	40.1	49.6	59.2	69.1	80.5
1998[1]	10.9	17.5	28.7	39.6	49.7	58.6	67.3	76.5

[1]Adjusted lengths

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

Year	Age 1	2	3	4	5	6	7	8
1985	-	-	670	1070	2230	3650	4920	5060
1986	-	-	390	1090	1850	3110	4320	5509
1987	21	65	230	490	1380	2300	3970	-
1988	20	80	203	410	793	1473	2706	4613
1989	10	150	380	590	930	1570	2640	4940
1990	28	229	570	1030	1460	1930	2890	4370
1991	20	190	720	1370	2040	2850	3660	4630
1992	20	130	640	1120	1850	2830	3980	4990
1993	11	76	430	1196	1766	2779	3894	5519
1994	12	59	261	797	1452	2273	3369	5062
1995	16	56	250	675	1347	2192	3606	4974
1996	15	61	206	633	1059	1995	3352	5512
1997[1]	13	54	197	593	1090	1788	2856	4650
1998[1]	12	49	214	562	1096	1721	2581	3969

[1)] Adjusted weights

a8

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

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

a9

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

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

Table A10 North-East Arctic COD. Results from the Russian acoustic trawl survey in the Barents Sea and adjacent waters in the autumn. *Stock numbers in millions.*

Year	Age										Older	Total
	0	1	2	3	4	5	6	7	8	9		
1985[1]	45	105	895	422	255	83	44	50	21	2	16	1,939
1986[1]	60	53	141	980	444	183	56	62	19	-	2	2,000
1987[2]	8	15	170	170	738	99	67	42	20	9	5	1,344
1988[2]	+	+	43	161	106	245	34	10	2	+	+	602
1989[1]	2	1	4	17	44	56	99	82	20	6	4	335
1990[1]	29	22	57	29	35	52	46	89	14	2	1	376
1991[1]	33	44	75	89	51	53	61	45	43	+	+	494
1992[1]	228	61	333	317	110	45	37	38	29	22	3	1,223
1993[1]	9	10	45	215	243	136	43	14	14	8	11	783
1994[1]	215	58	110	208	282	277	120	44	8	4	3	1,332
1995[1]	255	59	47	86	160	203	100	28	8	2	3	951
1996[1,3,5]	210	297	188	130	201	290	276	123	23	1	3	1,742
1997[4,5]	342	98	263	216	99	68	49	27	9	1	1	1,172
New method												
1995[1]	2,950	331	75	112	150	180	81	20	6	1	1	3,907
1996[1,3]	13,765	5,869	365	127	63	75	58	23	5	1	+	20,352
1997[4]	1,326	76	303	231	80	38	21	11	3	1	+	2,091

[1]October-December.
[2]September-October.
[3] Area IIb not covered
[4] Areas IIa and IIb covered in October-December, part of Area I covered in February-March 1998.
[5] Adjusted for incomplete area coverage

Table A11 North-East Arctic COD. Results from the Russian bottom trawl survey in the Barents Sea and adjacent waters in November–December (numbers per hour trawling).

Year	Age										Older	Total
	0	1	2	3	4	5	6	7	8	9		
					Sub-area I							
1982	1.4	0.2	6.9	13.2	7.4	1.9	2.8	0.4	-	-	-	34.2
1983	4.3	8.0	5.1	4.6	5.4	5.9	2.7	0.7	1.2	0.1	-	38.0
1984	0.7	12.3	11.6	25.5	13.7	6.5	4.0	1.6	0.6	0.3	-	76.8
1985	3.3	2.9	51.3	35.2	53.1	25.2	4.4	1.8	0.8	0.1	0.1	178.2
1986	0.3	2.2	7.0	60.4	15.8	8.2	1.8	0.6	0.1	0.1	-	96.5
1987	+	0.1	3.6	4.0	35.9	6.3	3.6	0.6	0.1	0.1	+	54.4
1988	0.2	0.1	1.7	5.7	5.2	17.2	2.6	0.6	0.2	0.1	+	33.4
1989	0.4	0.1	1.0	3.5	11.2	15.4	20.8	16.1	3.7	0.7	0.3	73.4
1990	6.8	4.8	12.7	5.3	6.0	9.4	8.2	14.6	2.2	0.2	+	70.2
1991	3.1	5.9	10.9	14.0	7.5	7.7	8.1	5.5	4.2	0.3	0.1	67.3
1992	10.3	2.9	26.4	42.3	22.4	8.5	4.6	5.6	3.3	2.7	0.6	129.6
1993	1.7	1.1	7.8	67.9	89.5	47.2	16.0	4.6	4.2	2.0	3.2	245.3
1994	15.8	2.8	10.9	28.4	45.0	52.4	17.9	6.3	1.4	0.7	1.1	182.6
1995	24.8	7.3	3.8	13.1	30.4	40.5	13.8	3.1	1.1	0.3	0.3	138.5
1996	10.4	12.8	10.4	7.0	11.7	16.9	12.1	5.1	1.1	0.1	0.1	87.7
1997	-	-	-	-	-	-	-	-	-	-	-	-
					Division IIa							
1982	0.1	+	11.7	10.6	4.7	1.1	4.1	2.0	0.2	0.3	0.2	35.0
1983	0.7	0.4	0.3	1.5	6.4	5.0	2.1	1.3	1.2	0.1	0.2	19.2
1984	0.4	0.7	0.6	3.7	4.0	6.7	4.7	1.1	0.3	0.1	0.2	22.5
1985	0.2	0.2	1.4	3.7	9.5	12.6	6.4	2.5	0.6	0.1	0.1	37.6
1986	-	+	0.1	2.5	2.9	3.2	1.5	0.5	0.4	-	0.2	11.3
1987	-	-	-	-	3.0	1.7	2.3	0.9	0.1	-	0.1	8.1
1988	0.2	+	0.1	0.2	1.2	10.0	2.4	0.7	0.2	0.1	+	15.1
1989	-	+	0.1	0.3	0.9	1.3	3.9	3.9	1.2	0.5	0.2	12.3
1990	-	+	0.3	1.1	1.6	2.2	1.9	4.4	0.9	0.1	+	12.5
1991	1.0	0.1	0.5	1.3	1.9	2.2	2.5	1.9	1.7	0.2	0.1	13.3
1992	0.4	0.3	0.3	2.7	3.8	3.0	2.2	2.1	1.8	1.3	0.1	18.0
1993	0.2	0.1	0.1	3.5	9.9	13.1	4.5	1.3	1.2	0.7	0.8	35.4
1994	0.2	0.1	0.3	4.0	28.3	46.2	22.4	6.3	1.4	0.8	1.6	116.6
1995	4.8	1.3	1.0	1.6	6.1	19.6	8.8	2.7	0.7	0.1	0.2	46.9
1996	4.3	15.6	7.1	5.7	9.2	12.4	6.9	1.7	0.4	+	+	63.5
1997	8.1	0.6	1.5	2.9	2.5	2.3	2.8	2.0	0.7	+	+	23.5
					Division IIb							
1982	9.9	1.7	42.5	17.8	1.1	0.2	1.5	0.5	-	-	-	75.2
1983	9.7	14.9	5.0	9.4	11.0	2.6	0.7	0.8	0.7	0.1	0.1	55.0
1984	1.4	7.7	22.7	7.4	2.7	2.4	1.3	0.4	0.2	0.2	-	46.4
1985	9.1	9.4	45.2	32.3	32.8	11.5	5.3	1.8	0.3	-	0.1	147.8
1986	1.6	2.9	14.8	67.2	19.9	16.4	5.4	1.3	0.6	0.1	-	127.1
1987	-	0.2	5.6	11.0	64.4	4.0	2.2	0.5	0.1	-	-	88.0
1988	0.1	0.4	4.8	13.7	15.1	25.0	2.5	0.6	0.1	0.2	-	62.8
1989	0.6	0.1	0.3	3.8	6.4	6.1	9.2	5.4	0.2	0.4	0.2	33.7
1990	0.1	0.7	1.3	2.3	2.9	3.7	3.9	8.6	1.6	0.3	+	25.4
1991	6.4	7.1	10.1	8.4	5.2	6.3	8.2	6.5	5.9	0.5	0.1	64.7
1992	60.5	15.1	60.5	60.8	13.8	5.2	6.5	5.0	5.1	3.4	0.5	236.4
1993	4.7	5.9	23.8	60.3	44.6	24.7	5.6	3.2	3.4	2.5	3.6	182.3
1994	3.0	6.0	19.5	44.3	61.4	45.3	16.3	5.6	1.5	1.0	1.9	205.6
1995	36.0	8.6	7.7	18.3	35.5	21.7	13.6	2.3	0.5	0.1	0.3	144.6
1996	-	-	-	-	-	-	-	-	-	-	-	-
1997	15.9	7.3	25.7	20.1	7.0	4.2	2.3	0.8	0.3	+	+	83.6

Table A11 (Cont'd)

Total (Sub-area I and Divisions IIa and IIb)

1982	3.7	0.6	18.1	14.1	5.1	1.3	2.6	0.7	-	0.1	-	46.3
1983	5.4	8.9	4.3	5.6	7.3	4.7	2.0	0.8	1.1	0.1	-	40.2
1984	0.9	9.2	14.2	16.2	8.6	5.0	3.1	1.1	0.4	0.3	0.1	59.1
1985	5.0	4.9	43.0	30.3	40.5	18.8	4.9	1.9	0.6	-	-	150.0
1986	0.7	2.2	9.1	56.5	16.1	10.6	3.0	0.8	0.3	0.1	-	99.4
1987	-	0.2	4.0	5.9	42.6	5.4	3.1	0.6	0.1	+	-	61.9
1988	0.1	0.2	2.5	7.7	7.8	19.0	2.5	0.6	0.1	0.2	-	40.8
1989	0.4	0.1	0.6	3.4	8.8	11.8	15.5	11.4	2.6	0.5	0.3	54.8
1990	4.0	3.1	7.8	3.8	4.4	6.6	6.0	11.3	1.8	0.2	+	49.0
1991	4.2	5.9	9.8	11.0	6.2	5.8	7.7	5.6	4.6	0.4	0.1	62.3
1992	30.6	7.8	39.5	48.5	18.2	6.9	5.3	5.2	4.0	2.9	0.5	169.4
1993	2.8	2.8	13.1	64.7	59.7	33.4	9.1	3.4	3.3	2.1	2.9	197.4
1994	11.2	3.3	12.0	30.0	47.5	50.0	18.0	6.1	1.4	0.8	1.3	181.5
1995	24.9	6.4	4.6	12.4	26.7	28.7	12.6	2.7	0.8	0.2	0.3	120.3
1996[1]	9.3	13.4	9.9	6.8	11.3	16.4	11.4	4.4	1.0	0.1	0.1	84.2
1997[1]	11.7	4.8	18.4	17.4	7.6	5.9	3.3	1.4	0.5	0.1	+	71.0

[1]Adjusted assuming area distribution as 1984-1995 average.

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

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

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

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

Table A14 Abundance indices of 0-group fish in the Barents Sea and adjacent waters in 1965–1997.

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

Table A15 Estimated logarithmic indices with 90% confidence limits of year class abundance for 0-group herring, cod and haddock in the Barents Sea and adjacent waters 1965–1997.

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

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

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

Year	Other	Amphipods	Krill	Shrimp	Capelin	Herring	Polar cod	Cod	Haddock	Redfish	G. halibut	Total
1984	511	27	111	439	735	77	15	23	51	370	0	2359
1985	1153	168	57	154	1619	180	3	33	47	226	0	3639
1986	659	1214	106	140	828	132	140	83	109	312	0	3725
1987	669	1060	65	188	224	32	200	24	4	316	0	2782
1988	407	1233	308	128	331	8	90	9	2	220	0	2736
1989	726	823	238	129	578	3	32	8	10	228	0	2775
1990	1554	136	85	191	1593	7	6	20	16	238	0	3846
1991	1101	70	80	191	2884	8	12	26	20	314	7	4713
1992	1041	104	165	388	2529	323	100	53	105	191	22	5022
1993	823	268	732	331	3155	169	285	288	75	101	2	6229
1994	733	619	779	569	1176	161	662	234	52	83	0	5069
1995	926	1064	568	396	686	127	276	428	126	211	2	4811
1996	1044	621	1026	426	649	46	58	522	101	119	0	4612
1997	720	748	503	439	1104	13	34	362	67	66	1	4057

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

Year	Age									Total
	1	2	3	4	5	6	7	8	9+	
1990	197.9	27.4	32.1	25.3	38.1	31.3	58.1	5.5	0.9	416.6
1991	391.4	213.6	105.6	31.0	20.2	22.3	20.7	31.3	3.8	839.9
1992	450.1	449.5	240.2	169.7	33.0	17.8	10.0	6.7	12.2	1389.2
1993	453.7	542.1	448.9	123.2	64.6	13.2	7.2	2.4	9.8	1665.1
1994										
1995	1028.7	244.7	234.9	290.7	186.2	69.1	22.6	4.8	2.6	2084.3
1996	2067.5	725.5	164.7	158.3	144.3	82.1	39.0	6.3	1.9	3389.6
1997[1]	1115.7	938.0	276.3	77.0	55.4	50.8	30.8	11.0	2.9	2557.9

[1] Adjusted value, only Norwegian zone covered

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

4.1 Status of the Fisheries

4.1.1 Historical development of the fisheries

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

Historical landings of the fishery show a cyclical pattern (Figure 4.1A, Table 4.1). The historical high catch level of 320,000 t in 1973 divides the time series into two periods. Formerly, highs were close to 200,000 t around 1956, 1961 and 1968, and lows were between 75,000 and 100,000 t in 1959, 1964 and 1971. The second period showed a steady decline from the peak in 1973 down to the historically low level of 17,300 t in 1984. Afterwards, landings increased to 151,000 t before declining to 26,000 t in 1990. A new increase reached the peak in 1996 with 174,000 t.

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

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

4.1.2 Landings prior to 1998 (Tables 4.1–4.3, Figure 4.1A)

Final reported landings in 1996 are 173,525 t (Table 4.1) which is very close to the figure used in last year's assessment. The provisional landings for 1997 are 145,574 t which is below the agreed TAC of 210,000 t. Catches decreased substantially in Sub-area I, but increased in Division IIa.

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

4.1.3 Expected landings in 1998

Haddock landings in recent years have been close to the agreed TAC. However, in 1997 only 69% of the TAC was taken. The agreed TAC in 1998 is 130,000 t. The Norwegian quota of 66,000 t is expected to be taken, but Russian landings are expected to be only 30,000 t, compared to a quota of 58,000 t. Even after transfers to Norway and Faroe Islands, 23,400 t of the Russian quota is not accounted for. There could be more transfers, but they will probably not be very large. On this basis the landings in 1998 are estimated to be 110,000 t.

4.2 Status of Research

4.2.1 Fishing effort and CPUE

After a period of very little trawl fishery for haddock, it has increased in recent years (Table 4.2). The CPUE series of Norwegian trawl fisheries has been updated for tuning of the older ages in the VPA, with revised effort data. The basis is now the trawl effort in Norwegian statistical areas 03, 04 and 05, covering the Norwegian coastal banks north of Lofoten. These areas account for approximately 70% of the Norwegian trawl landings. However, because of the large proportion taken as by-catch it is difficult to estimate the directed trawl effort on haddock. A more thorough analysis of the data might provide a basis for future revisions.

4.2.2 Survey results (Tables B1-B6)

Norway provided indices from the 1998 Barents Sea bottom trawl and acoustic survey in January-March. The results of this survey are given by Mehl (1998). As described in Section 3.2.2 the survey was once more restricted to the Norwegian economic zone and the adjustments made to the abundance indices followed the same procedure as for cod. The table below shows the proportions of haddock found in the bottom trawl survey in the Norwegian zone in 1993–1996.

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

The table indicates that the potential error caused by this raising procedure is biggest (20–30%) for age groups 2–4, but estimating the proportions in earlier years might reveal that the error could be larger.

Tables B1 and B3 show the time series of abundance estimates (acoustic and bottom trawl, respectively) from this survey. High indices caused by the good period of recruitment around 1990 can be traced from year to year in both series and the 1990 year class appears as the strongest for age groups 3–8. Although recruitment has been lower in more recent years, the indices are still well above the historical low levels.

Russia provided indices from the 1997 Barents Sea trawl and acoustic survey (Divisions IIa and IIb in October-December, Sub-area I in February-March) (Tables B2 and B4). The Russian survey has in 1997 and 1998 not been carried out in a way that is consistent with earlier surveys, neither with regard to area coverage or time period. However, the effect on the haddock indices is probably not very large and the Russian survey shows the same main trends as the Norwegian survey. From 1995 onwards there has been a substantial change in the method for calculating acoustic indices (Table B4) The acoustic survey will therefore be excluded from the VPA tuning until a longer time series with the new method is established.

Estimates of the abundance of 0-group haddock from the International 0-group survey are presented in Tables A14 and A15. The indices show good recruitment for haddock from 1990 to 1994, but average from 1995 to 1997.

4.2.3 Weight at age (Table B6)

Length and weight at age from the surveys are given in Tables B5 and B6, respectively. The most recent weights at age show an increase from the previous year for most of the dominant age groups.

4.3 Data Used in the Assessment

4.3.1 Catch at age (Table 4.7)

A revised age composition for the Norwegian landings, with final total landings from all countries, were used to revise the number at age in the 1996 landings.

Age compositions of the landings for 1997 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 and 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.

The SOP check gave a deviation of 0.6% and 1.0% from the nominal catch for 1996 and for 1997, respectively. The numbers at age were adjusted to make the SOP fit to the nominal catch for these years.

4.3.2 Weight at age (Tables 4.8–4.9)

The mean weights at age in the catch (Table 4.8) were calculated as weighted averages of the weights in the catch of Norway, Russia, Germany and UK (England & Wales). The weights at age in the catch in 1997 in general continue to be at relatively low levels and are lower than those used for prediction in last year's report for most age groups.

Stock weights (Table 4.9) used from 1985 to 1997 for ages 3–7 are averages of values derived from Russian surveys in autumn (mostly October-December) and Norwegian surveys in January-March the following year (Table B6). These averages are assumed to give representative values for the beginning of the year. For the oldest age groups, the time series' fixed weights have been used when survey data are missing or inadequate. The stock weights at age in 1997 indicate an improvement in growth that is not yet reflected in the catch at age data.

4.3.3 Natural mortality (Table 4.13)

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

4.3.4 Maturity at age (Table 4.4)

A maturity ogive was available from Russia for 1998. The ogive shows a marked change to earlier maturation in 1998.

4.3.5 Data for tuning (Table 4.10)

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

Name	Place	Season	Age	Year
Russian bottom trawl	Total area	Autumn	1–7	1983–1997
Norwegian bottom trawl	Barents Sea	Winter	1–7	1980–1997
Norwegian acoustic	Barents Sea	Winter	1–7	1980–1997
Norwegian trawl fleet	Total area	All year	8–13	1985–1997

4.3.6 Recruitment indices (Table 4.5).

Four time series of recruitment indices were updated with data from 1997. These are from the Russian bottom trawl survey in autumn (age 0), the International 0-group survey (age 0), and the Norwegian bottom trawl and acoustic survey in winter (age 1 for both indices).

4.3.7 Prediction data (Table 4.20)

The data used for 1998–2000 in the short-term prediction were also used for these years in the medium-term prediction (1998–2002), and the 2000 data were extended forward to 2001 and 2002.

The stock numbers at age are taken from the VPA (Tables 4.12 and 4.15) and the recruitment of the 1997 year class from the RCT3 analysis (Table 4.6). The recruitment at age 3 of the 1998 and later year classes is set as the long-term geometric mean.

The fishing pattern is the average of the last 3 years from the final VPA, scaled to the 1997 F_{4-7} level.

The Russian maturity ogive for 1998 (Table 4.4) was used for all the years in the prediction because maturity in 1994–1997 has been unusually low.

The most recent surveys show evidence of improved growth for most age groups, but this is not yet reflected in the catch data which on average are collected at least half a year before the surveys are carried out. Recent averages seem inappropriate for prediction of both catch and stock weights. For the stock weights the 1998 values are therefore used directly in the prediction. However, due to lack of survey data on the oldest fish, the values of weight at age in the stock for ages 12 and older were set equal to the fixed historical values. To account for the improved growth seen in the surveys, the 1995–1997 average catch weights were multiplied by the corresponding factors of increase observed from 1997 to 1998 in the stock weights, with smoothed values for ages > 9.

The natural mortality on ages 3–6 was set equal to the mean 1995–1997 estimate from the VPA based on cod predation.

4.4 Methods Used in the Assessment

4.4.1 VPA and tuning

The Extended Survivors Analysis (XSA) was used to tune the VPA to the available index series (Table 4.10) and the settings were the same as used last year, i.e., with stock size dependent catchability for ages < 6 years. The XSA was initially run on the updated 1996 data in the same way as last year. The main results were close to those obtained last year, but showed slightly lower fishing mortalities. The change was probably caused mainly by the exclusion of the Russian acoustic survey in the VPA tuning.

The estimated consumption of haddock by cod was incorporated into the XSA analysis by constructing a new catch number at age matrix, adding the numbers of haddock eaten by cod to the catches for the years where such data were available (1984–1996) (Table A16). The consumption of haddock by cod for the period 1984–1997 is given below:

Consumption by cod at age (million individuals)

	Age						
Year	0	1	2	3	4	5	6
1984	1,907	1,011	16	+	0	0	0
1985	1,678	1.198	5	0	0	0	0
1986	91	554	241	165	0	0	0
1987	0	753	0	0	0	0	0
1988	0	16	+	9	0	+	0
1989	22	235	0	0	0	0	0
1990	50	142	39	4	0	0	0
1991	0	445	14	0	0	0	0
1992	160	2,085	148	1	0	0	0
1993	875	1,520	165	36	4	3	0
1994	1,502	1,615	80	25	8	1	+
1995	201	3,195	182	13	32	35	+
1996	2,159	1,659	164	45	3	4	4
1997	0	1,364	57	23	1	4	1

In order to create a matrix of natural mortality which includes predation, the fishing mortality estimated in the final XSA was split into the mortality caused by the fishing fleet (F) and the mortality caused by predation by cod (M2) by using the proportion of fleet catch and predation catch, respectively, to the total catch. The new natural mortality data set was then prepared by adding 0.2 to the predation mortality. This new M matrix (Table 4.13) was used to run the final VPA.

The retrospective analysis showed that levels of fishing mortality tend to be progressively lower in consecutive year's assessment (Figure 4.2), but there has been little change in the last year.

4.4.2 Recruitment (Tables 4.6, 4.12)

The XSA estimate of the strength of the 1995 year class at age 3 was accepted. The strength of the 1996 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 1997 year class at age 3. The age 0 and 1 survey indices for this year class were used in the estimation, together with estimates of year class strength at age 3 from the XSA.

4.5 Results of the Assessment

4.5.1 Fishing mortality and VPA (Tables 4.11–4.18 and Figures 4.1A and 4.1B)

The tuning diagnostics of the final XSA (predation included) are given in Table 4.11 and the population numbers of this analysis in Table 4.12.

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

Natural mortalities, fishing mortalities and stock numbers of the final VPA are given in Tables 4.13, 4.14 and 4.15, respectively, while the stock biomass at age and the spawning biomass at age are given in Tables 4.16 and 4.17. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1950 is given in Table 4.18 and Figures 4.1A and 4.1B.

The fishing mortality rate (F_{4-7}) increased to 0.41 in 1997 compared to an average level of 0.30 in the previous 8 years. The 1997 level is above F_{med} (0.35).

The spawning stock biomass has been rapidly increasing since 1994 to 215 000 t in 1997, a level exceeded only in two earlier years in the time series. However, the total stock biomass shows a marked decline in the same period to 433 000 t in 1997, reflecting less abundant recruiting year classes in recent years.

4.5.2 Recruitment (Tables 4.5–4.6, 4.12, 4.20)

The estimates of the 1994–1996 year classes at age 3, derived from the XSA (Table 4.12), are 93, 36 and 62 million, respectively. The RCT3 estimate of the 1997 year class is 48 million at age 3 (Table 4.6). The long term geometric mean is 97 million individuals.

4.5.3 Yield per Recruit (Table 4.19, Figure 4.1C)

The yield per recruit analysis using the fishing pattern and stock parameters for 1996 and 1997 from the management option table gave estimates of $F_{0.1} = 0.15$ while F_{max} was not defined. The present exploitation level is $F_{97} = 0.41$ (*status quo*).

4.5.4 Catch options for 1999 (Table 4.21)

The expected catch of 110,000 t in 1998 gives F = 0.37 and the spawning stock biomass will be close to the 1997 level. A *status quo* F in 1998 of F = 0.41, corresponds to a catch of 84,000 t, and there will be a considerable reduction of the spawning stock. However, considering the dominance of the 1990 year class in the stock, some reduction sooner or later is inevitable. Even with no fishing in 1999 the spawning stock biomass will be reduced.

4.6 Biological reference points.

4.6.1 Biomass reference points (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 and this has been suggested as an MBAL level. This could also be a possible Bpa level However, because of the wide natural fluctuation in recruitment for the stock, even under responsible management there might be periods where SSB levels under 140,000 t are impossible to avoid. However, the Working Group could not find valid arguments for proposing alternative levels.

4.6.2 Fishing mortality reference points

Because of the large variation in recruitment, meaningful biological reference points are difficult to estimate and the Working Group's attempts at estimating F_{loss} gave no reasonable results (Motos, WD 1998). The F_{med} estimate of Jakobsen (1992) is 0.35 and the stock has sustained fishing mortalities at higher levels than this for most of the period after 1950 without collapsing, although very low levels of SSB has been experienced. An F_{pa} of 0.35 does not seem unreasonable in view of the stock history and is recommended by the Working Group.

4.7 Medium-term forecasts and management scenarios

4.7.1 Input data (Table 4.20)

The input data were the same as used for the short term predictions. The recruitment at age 3 of the 1997 and later year classes was set equal to the long-term geometric average of 97 million.

4.7.2 Methods

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

4.7.3 Results (Tables 4.22–4.23 and Figure 4.1D)

In Figure 4.1D the catch level in 1999 and spawning stock biomass level in 2000 are plotted against the fishing mortality, F, in 1999.

In Table 4.22, the results of the medium-term prediction are given, for 0.4, 0.6, 0.8 and 1.0* F_{sq}. Detailed output of the prediction for F_{sq} is also given (Table 4.23). In the medium term, the spawning stock will decrease to a level of approximately 75,000 t when fishing at F_{sq} and the catches will decrease to 34,000 t. Only a very low fishing mortality (< 0.10) will prevent the spawning stock from declining, but this means that the catch level would be 15,000–20,000 t.

4.8 Comments to the assessment and forecasts

As discussed in last year's report the assessment is presently extremely vulnerable to assumptions about catchability in the surveys. In spite of the large uncertainty about the stock level, the Working Group concludes that the stock is presently at a high level. However, the stock will decline as the influence of the 1990 year class is reduced. Improved growth and earlier maturation, as indicated by the most recent survey data, might reduce the decline.

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

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

Year	Sub-area I	Division IIa	Division IIb	Total
1960	125,675	27,925	1,854	155,454
1961	165,165	25,642	2,427	193,234
1962	160,972	25,189	1,727	187,888
1963	124,774	21,031	939	146,744
1964	79,056	18,735	1,109	98,900
1965	98,505	18,640	939	118,079
1966	124,115	34,892	1,614	160,621
1967	108,066	27,980	440	136,486
1968	140,970	40,031	725	181,726
1969	89,736	40,211	565	130,512
1970	59,493	26,611	497	86,601
1971	56,991	21,454	463	78,908
1972	221,183	41,979	2,155	265,317
1973	283,728	23,348	12,989	320,065
1974	159,037	47,033	15,068	221,138
1975	121,692	44,337	9,729	175,758
1976	94,065	37,566	5,649	137,280
1977	72,159	28,452	9,547	110,158
1978	63,965	30,478	979	95,422
1979	63,841	39,167	615	103,623
1980	54,205	33,616	68	87,889
1981	36,834	39,864	455	77,153
1982	17,948	29,005	2	46,955
1983	7,550	13,872	185	21,607
1984	4,000	13,247	71	17,318
1985	30,385	10,774	111	41,270
1986	69,865	26,006	714	96,585
1987	109,429	38,182	3,048	150,659
1988	43,990	47,086	668	91,744
1989	31,265	23,502	355	55,122
1990	15,138	10,375	304	25,817
1991	18,772	14,417	416	33,605
1992	30,746	22,177	964	53,887
1993	47,573	27,010	3,037	77,619
1994	70,773	43,707	6,885	121,365
1995	70,252	54,073	14,098	138,423
1996	112,932	57,319	3,274	173,525
1997 [1]	74,380	68,480	2,714	145,574

[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	37.9	9.7	18.0	9.0	3.0
1994	57.8	13.0	29.5	14.2	6.9
1995	58.0	12.3	33.2	20.9	14.1
1996	98.5	14.5	34.8	22.5	3.3
1997 [1]	47.6	26.7	43.1	25.3	2.7

[1] Provisional

T-4-2.XLS

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.Re.	Fed. Re. Germ.	Norway	Poland	United Kingdom	Russia[2]	Others	Total
1960	172	-	-	5,597	46,263	-	45,469	57,025	125	155,651
1961	285	220	-	6,304	60,862	-	39,650	85,345	558	193,234
1962	83	409	-	2,895	54,567	-	37,486	91,910	58	187,438
1963	17	363	-	2,554	59,955	-	19,809	63,526	-	146,224
1964	-	208	-	1,482	38,695	-	14,653	43,870	250	99,158
1965	-	226	-	1,568	60,447	-	14,345	41,750	242	118,578
1966	-	1,072	11	2,098	82,090	-	27,723	48,710	74	161,778
1967	-	1,208	3	1,705	51,954	-	24,158	57,346	23	136,397
1968	-	-	-	1,867	64,076	-	40,129	75,654	-	181,726
1969	2	-	309	1,490	67,549	-	37,234	24,211	25	130,820
1970	541	-	656	2,119	37,716	-	20,423	26,802	-	87,257
1971	81	-	16	896	45,715	43	16,373	15,778	3	78,905
1972	137	-	829	1,433	46,700	1,433	17,166	196,224	2,231	266,153
1973	1,212	3,214	22	9,534	86,767	34	32,408	186,534	2,501	322,626
1974	925	3,601	454	23,409	66,164	3,045	37,663	78,548	7,348	221,157
1975	299	5,191	437	15,930	55,966	1,080	28,677	65,015	3,163	175,758
1976	536	4,459	348	16,660	49,492	986	16,940	42,485	5,358	137,265
1977	213	1,510	144	4,798	40,118	-	10,878	52,210	287	110,158
1978	466	1,411	369	1,521	39,955	1	5,766	45,895	38	95,422
1979	343	1,198	10	1,948	66,849	2	6,454	26,365	454	103,623
1980	497	226	15	1,365	61,886	-	2,948	20,706	246	87,889
1981	381	414	22	2,398	58,856	**Spain**	1,682	13,400	-	77,153
1982	496	53	-	1,258	41,421	-	827	2,900	-	46,955
1983	428	-	1	729	19,371	139	259	680	-	21,607
1984	297	15	4	400	15,186	37	276	1,103	-	17,318
1985	424	21	20	395	17,490	77	153	22,690	-	41,270
1986	893	33	75	1,079	48,314	22	431	45,738	-	96,585
1987	464	26	83	3,106	69,333	99	563	76,980	-	150,654
1988	1,113	116	78	1,324	57,273	72	435	31,293	41	91,745
1989	1,218	125	26	171	31,825	1	590	20,903	-	54,859
1990	875	-	5	128	17,634	-	494	6,605	-	25,741
1991	1,117	60	**Greenld**	219	19,285	-	514	12,388	22	33,605
1992	1,093	151	1,719	387	30,203	38	596	19,699	1	53,887
1993	546	1,215	880	1,165	36,590	76	1,802	34,700	646	77,619
1994	2,761	678	770	2,412	64,688	22	4,673	44,484	877	121,365
1995	2,833	598	1,097	2,675	72,864	14	3,108	54,516	718	138,423
1996	3,743	538	1,510	942	89,500	669	2,275	74,131	217	173,525
1997 [1]	416	547	1,790	971	97,585	364	2,340	41,286	275	145,574

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

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

	Age									
Year	3	4	5	6	7	8	9	10	11	12
1981	1	12	64	73	96	100	100	-	-	-
1982	9	55	73	93	96	100	93	-	-	-
1983	17	70	100	99	99	100	-	-	-	-
1984	7	14	35	47	74	82	89	-	-	-
1985	2	8	80	93	96	91	96	-	-	-
1986	+	22	53	86	86	100	83	100	-	-
1987	-	1	21	53	100	100	-	100	-	-
1988	-	3	33	51	-	-	-	-	-	-
1989	-	4	30	63	82	100	-	-	-	-
1990	-	2	30	54	77	87	80	100	-	-
1991	-	7	30	50	80	92	100	100	-	-
1992	2	13	50	62	77	80	94	100	-	-
1993	2	22	49	76	79	88	88	87	100	100
1994	-	2	13	41	90	88	100	100	97	100
1995	-	2	12	42	81	88	100	87	100	94
1996	-	-	10	36	78	86	90	93	90	100
1997	-	3	10	29	60	82	100	83	100	100
1998	-	5	30	53	69	81	91	100	-	100

Table 4.5 Input RCT3

NORTHEAST ARCTIC HADDOCK : recruits as 3 year-olds (inc. data for ages 0 & 1)
4,40,2 (No. of surveys, No. of years, VPA Column No.)

58	109	2	-11	-11	-11
59	241	7	-11	-11	-11
60	275	30	-11	-11	-11
61	320	32	-11	-11	-11
62	100	5	-11	-11	-11
63	240	16	-11	-11	-11
64	291	11	-11	-11	-11
65	20	0.3	-11	-11	-11
66	17	0.3	1	-11	-11
67	164	3	8	-11	-11
68	95	0.3	0.3	-11	-11
69	1018	31	29	-11	-11
70	270	10	64	-11	-11
71	54	3	26	-11	-11
72	49	2	16	-11	-11
73	56	13	26	-11	-11
74	114	15	51	-11	-11
75	170	163	60	-11	-11
76	134	6	38	-11	-11
77	19	1	33	-11	-11
78	6	0.3	12	-11	-11
79	8	0.3	20	-11	-11
80	5	0.3	15	3.1	7
81	10	0.3	3	3.9	9
82	257	23	38	2776.8	0.3
83	541	40	62	5382	1685
84	87	9.7	78	1421.2	1809
85	45	3.9	27	649	680
86	18	0.2	39	134.3	111
87	25	0.4	10	44.6	20
88	86	1.9	13	80.8	58
89	238	3.3	14	555.4	493
90	757	72	61	1526	1938
91	324	16	117	1282.2	859
92	87	20	87	717.5	1424
93	97	5.5	64	587.5	848
94	92	14	64	1271.8	1380
95	36	9.9	25	312.7	249
96	-11	5	39	1140.6	779
97	-11	2.7	21	190.9	246

R-T-1 Russian Bottom Trawl Survey, age 0+,,,,
INT0GP 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 4.6 Output RCT3

Analysis by RCT3 ver3.1 of data from file :

W:/ACFM/AFWG/98/HAD_ARCT/RCT1.INP

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

Data for 4 surveys over 40 years : 58 - 97

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 = 95

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	1.16	2.23	.84	.725	37	2.39	4.99	.959	.393
INTOGP	.08	.74	2.41	.243	29	25.00	2.67	2.798	.046
N-BST1	.89	-.80	.97	.646	15	5.75	4.31	1.112	.293
N-BSA1	1.19	-2.22	2.26	.252	15	5.52	4.34	2.586	.054
					VPA Mean =		4.55	1.300	.214

Yearclass = 96

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	1.23	1.96	.98	.634	38	1.79	4.17	1.117	.321
INTOGP	.07	.97	2.25	.247	30	39.00	3.82	2.567	.061
N-BST1	.98	-1.40	1.02	.604	16	7.04	5.47	1.177	.289
N-BSA1	1.25	-2.72	2.18	.249	16	6.66	5.61	2.511	.064
					VPA Mean =		4.53	1.227	.266

Table 4.6 (ContÆd)

Yearclass = 97

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	1.24	1.94	1.02	.600	38	1.31	3.56	1.195	.296
INTOGP	.07	.99	2.27	.231	30	21.00	2.50	2.702	.058
N-BST1	1.04	-1.83	1.06	.574	16	5.26	3.66	1.244	.273
N-BSA1	1.27	-2.92	2.10	.254	16	5.51	4.07	2.435	.071
					VPA Mean =		4.58	1.181	.303

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
95	95	4.55	.60	.25	.18	36	3.61
96	111	4.71	.63	.30	.23		
97	48	3.87	.65	.28	.18		

Table 4.7

Run title : Arctic Haddock (run: SVPTJA01/V01)

At 26-Aug-98 11:47:12

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	657,	1520,	23004,	1978,	230217,	70205,	9684,	10037,	13989,	55967,
4,	67632,	1963,	2408,	24359,	22245,	258773,	41702,	14088,	13449,	22043,
5,	41267,	44526,	1870,	1257,	42846,	24018,	88112,	33871,	6808,	7368,
6,	7748,	18956,	21996,	918,	3196,	6873,	5828,	49711,	20789,	2586,
7,	15599,	3611,	7948,	9279,	1606,	419,	4138,	2135,	40044,	7781,
8,	5292,	4925,	1974,	3056,	6737,	423,	382,	1236,	1247,	11043,
9,	655,	1624,	1978,	826,	2630,	1681,	618,	92,	1350,	311,
10,	182,	315,	726,	1043,	897,	525,	2043,	131,	193,	388,
11,	101,	43,	166,	369,	989,	147,	935,	500,	280,	96,
12,	115,	43,	26,	130,	538,	339,	276,	147,	652,	101,
13,	18,	14,	52,	27,	53,	68,	457,	53,	332,	84,
+gp,	52,	9,	44,	8,	67,	27,	202,	234,	340,	98,
TOTALNUM,	139318,	77549,	62192,	43250,	312021,	363498,	154377,	112235,	99473,	107866,
TONSLAND,	181726,	130502,	86601,	78908,	265317,	320065,	221138,	175758,	137218,	110158,
SOPCOF %,	79,	80,	75,	101,	86,	83,	86,	81,	62,	77,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	47311,	17540,	627,	486,	883,	704,	456,	29548,	25596,	3928,
4,	18812,	35290,	22878,	2561,	900,	1930,	841,	1153,	61470,	88297,
5,	4076,	10645,	21794,	22124,	3372,	884,	836,	546,	1013,	52611,
6,	1389,	1429,	2971,	10685,	12203,	1374,	307,	715,	376,	586,
7,	1626,	812,	250,	1034,	2625,	3282,	765,	316,	346,	207,
8,	2596,	546,	504,	162,	344,	906,	2250,	634,	144,	123,
9,	6215,	1466,	230,	162,	75,	52,	499,	1312,	295,	74,
10,	162,	2310,	842,	72,	80,	37,	70,	416,	484,	119,
11,	258,	181,	1299,	330,	91,	29,	25,	50,	112,	175,
12,	3,	87,	111,	564,	320,	21,	36,	5,	35,	87,
13,	74,	2,	35,	27,	204,	21,	44,	1,	3,	4,
+gp,	65,	53,	15,	42,	34,	91,	185,	57,	7,	19,
TOTALNUM,	82587,	70361,	51556,	38249,	21131,	9331,	6314,	34753,	89881,	146230,
TONSLAND,	95422,	103623,	87889,	77153,	46955,	21607,	17661,	41270,	96585,	150659,
SOPCOF %,	95,	112,	103,	98,	93,	91,	91,	97,	90,	98,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	794,	1050,	518,	3968,	12342,	13398,	3202,	1347,	1704,	2193,
4,	9031,	3951,	1174,	1967,	12652,	25902,	45943,	13565,	5790,	6172,
5,	50868,	12305,	1871,	1886,	2411,	13154,	34257,	74583,	36543,	11779,
6,	19465,	23032,	4138,	2876,	1740,	2784,	8750,	21227,	74463,	33185,
7,	382,	3423,	6754,	4442,	2070,	973,	1709,	3530,	10834,	48992,
8,	65,	247,	851,	4422,	2619,	1297,	693,	385,	1980,	4807,
9,	35,	11,	389,	398,	2737,	2131,	1200,	310,	438,	552,
10,	44,	36,	50,	21,	241,	2011,	1844,	469,	295,	192,
11,	142,	12,	3,	1,	12,	314,	1655,	344,	251,	166,
12,	135,	22,	3,	7,	4,	55,	281,	627,	228,	127,
13,	22,	17,	9,	2,	1,	9,	46,	39,	790,	126,
+gp,	11,	15,	15,	7,	1,	6,	2,	2,	23,	149,
TOTALNUM,	80994,	44121,	15775,	19997,	36830,	62034,	99582,	116428,	133339,	108440,
TONSLAND,	91744,	55122,	25816,	33605,	53886,	77619,	121365,	138423,	173525,	145574,
SOPCOF %,	99,	96,	96,	96,	101,	100,	100,	100,	100,	100,

Table 4.8

Run title : Arctic Haddock (run: SVPTJA01/V01)

At 26-Aug-98 11:47:12

Table 2 Catch weights at age (kg)

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,
SOPCOFAC,	.7910,	.8023,	.7531,	1.0074,	.8566,	.8267,	.8597,	.8093,	.6228,	.7678,

Table 2 Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	1.5200,	1.5700,	.9200,	.8600,	.6400,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.8600,	1.9900,	1.6600,	1.2500,	.8600,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	2.1000,	2.4200,	2.3900,	1.8800,	1.3300,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.6800,	2.7100,	2.4100,	2.4500,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.9300,	2.8900,	2.6600,	2.9800,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3700,	3.2200,	3.0400,	2.9800,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,
SOPCOFAC,	.9477,	1.1247,	1.0321,	.9828,	.9337,	.9107,	.9105,	.9654,	.9013,	.9825,

Table 2 Catch weights at age (kg)

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	.5800,	.8000,	.8900,	.7700,	.8400,	.5900,	.5400,	.6300,	.6400,	.6600,
4,	.8400,	.8900,	1.2200,	1.3100,	1.3600,	1.0600,	.8800,	.6600,	.7900,	.9900,
5,	1.0500,	1.1700,	1.4000,	1.6100,	1.7000,	1.5200,	1.3300,	1.0600,	1.0400,	1.0900,
6,	1.4300,	1.3700,	1.6000,	1.8600,	1.9600,	1.8400,	1.7400,	1.6800,	1.3400,	1.2200,
7,	1.9700,	1.7100,	1.7700,	2.1100,	2.2900,	2.1800,	2.0600,	2.1100,	1.8100,	1.4700,
8,	2.5200,	2.0100,	2.1600,	2.3400,	2.3900,	2.3000,	2.2000,	2.3400,	2.2900,	1.9800,
9,	3.7000,	3.7000,	3.7000,	2.9300,	2.3200,	2.5200,	2.5000,	2.6700,	2.3100,	2.2600,
10,	4.4100,	4.4100,	4.4100,	2.3400,	2.8800,	2.6400,	2.5800,	2.9100,	3.1800,	2.2500,
11,	5.4000,	5.4000,	5.4000,	5.4000,	3.1400,	3.1100,	2.8900,	3.0200,	2.6200,	2.9700,
12,	6.7000,	6.7000,	6.7000,	6.7000,	2.9200,	3.8000,	2.8200,	3.0700,	3.3700,	2.7900,
13,	7.4000,	7.4000,	7.4000,	7.4000,	2.2800,	2.8600,	3.2400,	2.7400,	3.2700,	2.8400,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	3.2900,	4.4100,	3.1500,	3.1500,	3.1500,	3.1500,
SOPCOFAC,	.9923,	.9617,	.9630,	.9581,	1.0132,	1.0016,	.9991,	1.0021,	.9994,	.9986,

Table 4.9

Run title : Arctic Haddock (run: SVPTJA01/V01)

At 26-Aug-98 11:47:12

Table 3 Stock weights at age (kg)

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,

Table 3 Stock weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.6600,	.4400,	.2800,	.2400,
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	1.0300,	.8200,	.8200,	.4800,
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7900,	1.7800,	1.5300,	.9300,
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.4000,	2.2600,	2.2200,
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.6900,	2.2600,	2.8600,
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,
9,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,	3.7000,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,	4.4100,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,

Table 3 Stock weights at age (kg)

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	.2730,	.2840,	.2760,	.3890,	.3710,	.3040,	.2340,	.2060,	.2100,	.2050,
4,	.3900,	.4440,	.7170,	.7540,	.8150,	.8190,	.5450,	.3560,	.4510,	.4080,
5,	.6140,	.7040,	.9460,	1.4840,	1.5400,	1.4370,	1.0520,	.7960,	.6870,	.6970,
6,	1.0980,	1.0190,	1.2670,	1.6220,	2.0720,	2.1150,	1.5360,	1.4400,	1.1260,	1.1140,
7,	1.5600,	1.4360,	1.5060,	1.6890,	2.3580,	2.3440,	1.9540,	1.9530,	1.8460,	1.4890,
8,	3.3300,	3.3300,	2.0040,	2.0470,	2.2450,	3.0450,	2.5090,	2.9130,	2.4300,	2.4420,
9,	3.7000,	3.7000,	3.7000,	2.6060,	2.7740,	3.3910,	2.3740,	2.9340,	2.8150,	3.2180,
10,	4.4100,	4.4100,	4.4100,	4.4100,	4.1980,	3.4000,	2.6210,	3.0330,	3.3230,	3.3330,
11,	5.4000,	5.4000,	5.4000,	5.4000,	5.4000,	4.2000,	3.1600,	3.1630,	3.4790,	4.6840,
12,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,	6.7000,
13,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,	7.4000,
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,	8.0000,

Table 4.10

Haddock in the North-East Arctic (Areas I and II) (run name: XSATJA01)
104
FLT23: Russian bottom trawl, total area, Nov-Dec, age 1-7, calendar (Catch: Unknown) (Effort: Unknown)
1983 1997
1 1 0.90 1.00
1 7

1	592	95	5	4	0	0	0
1	586	584	15	2	1	0	0
1	144	1343	900	4	1	1	0
1	14	107	363	164	1	0	0
1	9	17	83	225	57	0	0
1	3	7	17	40	76	8	0
1	18	24	4	14	41	81	11
1	143	106	73	42	73	74	57
1	429	176	62	9	3	6	18
1	282	1286	346	50	4	6	9
1	48	357	1985	356	48	8	4
1	49	58	442	1014	116	15	1
1	72	42	31	123	370	40	5
1	23	57	28	49	362	334	29
1	46	19	32	32	10	27	10

FLT29: Norwegian trawl, catch and effort, ages 8 -13 (Catch: Thousands) (Effort: Unknown)
1985 1997
1 1 0.00 1.00
8 13

0.49	166.0	365.0	26.0	7.0	3.0	1.0
0.48	57.0	142.0	236.0	27.0	23.0	2.0
0.47	28.0	41.0	41.0	69.0	43.0	1.0
0.95	16.0	1.0	8.0	79.0	54.0	8.0
0.85	127.0	1.0	9.0	3.0	8.0	1.0
0.48	149.0	3.0	0.1	0.1	1.0	0.5
0.56	703.0	58.0	7.0	0.1	0.5	0.5
0.49	394.0	599.0	96.0	2.0	2.0	0.1
0.49	200.0	279.0	282.0	36.0	9.0	1.0
0.77	209.4	213.6	496.9	223.7	64.1	16.3
0.81	53.0	72.0	120.0	77.0	197.0	0.0
0.61	1197.0	257.0	118.0	106.0	50.0	315.0
0.79	2326.0	237.0	14.0	43.0	46.0	33.0

FLT30: Norway bottom trawl survey, Jan-Mar, age 1-7, shifted, reviced94 (Catch: Thousands) (Effort: Unknown)
1980 1997
1 1 0.99 1.00
1 7

1	73	23	78	18	53	5	2
1	15	17	18	19	48	24	2
1	66	27	27	13	13	28	13
1	6834	149	16	7	2	3	3
1	13622	3848	63	4	2	3	3
1	3602	3398	1268	45	5	1	1
1	952	1741	2723	506	1	20	0
1	161	288	674	1107	157	2	0
1	7	9	154	269	274	29	0
1	514	41	34	52	94	121	17
1	4209	724	126	31	24	30	56
1	11912	2835	599	41	9	13	51
1	5851	4678	1056	103	5	5	22
1	2003	2960	4482	508	32	2	11
1	1820	426	1534	3416	313	20	5
1	2659	532	489	1494	2559	116	10
1	720	1246	364	187	474	494	39
1	1495	304	386	127	36	72	85

FLT31: Norway acoustic surv, Barents sea, Jan-Mar, age 1-7, shift, rev94 (Catch: Number) (Effort: Unknown)
1980 1997
1 1 0.99 1.00
1 7

1	140	50	210	600	180	10	3
1	20	30	40	40	100	60	3
1	50	20	30	10	10	40	20
1	1730	60	20	10	3	3	3
1	8390	2740	60	3	3	3	10
1	3120	4880	1620	3	3	3	3
1	260	710	1900	470	3	3	3
1	50	80	200	380	60	3	3
1	60	80	100	170	190	20	3
1	440	40	30	40	70	110	10
1	2650	490	70	20	20	20	40
1	6850	1100	190	20	3	3	10
1	6900	5650	990	100	3	3	10
1	2280	2400	5060	770	80	3	3
1	2850	360	1130	3910	400	20	3
1	2290	440	310	760	1500	80	10
1	320	600	200	140	490	460	30
1	1560	230	330	140	60	120	160

Table 4.11

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Arctic Haddock (run: XSATJA01/X01)

CPUE data from file /users/fish/ifad/ifapwork/afwg/had_arct/FLEET.X01

Catch data for 48 years. 1950 to 1997. Ages 1 to 14.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT23: Russian botto,	1983,	1997,	1,	7,	.900,	1.000
FLT29: Norwegian tra,	1985,	1997,	8,	13,	.000,	1.000
FLT30: Norway bottom,	1980,	1997,	1,	7,	.990,	1.000
FLT31: Norway acoust,	1980,	1997,	1,	7,	.990,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 6

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

Catchability independent of age for ages >= 11

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 2 years or the 5 oldest ages.

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

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

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00557

Final year F values

Age ,	1,	2,	3,	4,	5,	6,	7,	8,	9,	10
Iteration 29,	.0001,	.0043,	.0308,	.1804,	.4282,	.5113,	.5240,	.2919,	.3496,	.7507
Iteration 30,	.0001,	.0043,	.0308,	.1803,	.4281,	.5109,	.5232,	.2914,	.3489,	.7500

Age ,	11,	12,	13
Iteration 29,	.5212,	.2966,	.2789
Iteration 30,	.5205,	.2960,	.2781

Table 4.11 (Cont'd)

Regression weights

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

Fishing mortalities

Age,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
1,	.000,	.000,	.000,	.000,	.001,	.000,	.000,	.000,	.000,	.000
2,	.002,	.006,	.003,	.001,	.003,	.001,	.003,	.001,	.003,	.004
3,	.022,	.065,	.025,	.052,	.059,	.020,	.011,	.019,	.026,	.031
4,	.158,	.169,	.096,	.136,	.231,	.171,	.093,	.070,	.122,	.180
5,	.494,	.336,	.112,	.219,	.245,	.424,	.366,	.229,	.303,	.428
6,	1.123,	.436,	.179,	.252,	.323,	.501,	.598,	.411,	.406,	.511
7,	.222,	.590,	.218,	.297,	.291,	.302,	.671,	.517,	.383,	.523
8,	.330,	.219,	.280,	.217,	.286,	.299,	.367,	.305,	.623,	.291
9,	.399,	.084,	.635,	.204,	.202,	.400,	.500,	.277,	.686,	.349
10,	.707,	.957,	.668,	.060,	.183,	.224,	.733,	.370,	.464,	.750
11,	1.121,	.419,	.178,	.023,	.044,	.385,	.291,	.283,	.347,	.520
12,	1.289,	.496,	.173,	.811,	.123,	.293,	.721,	.170,	.307,	.296
13,	.442,	.518,	.387,	.167,	.246,	.448,	.427,	.197,	.336,	.278

XSA population numbers (Thousands)

		AGE								
YEAR ,	1,	2,	3,	4,	5,	6,	7,	8,		
1988 ,	5.57E+04,	2.32E+04,	4.49E+04,	6.82E+04,	1.44E+05,	3.19E+04,	2.12E+03,	2.56E+02,	1.18E+02,	9.59E+01,
1989 ,	4.41E+05,	3.15E+04,	1.85E+04,	2.82E+04,	4.77E+04,	7.20E+04,	8.49E+03,	1.39E+03,	1.51E+02,	6.46E+01,
1990 ,	5.37E+05,	1.50E+05,	2.56E+04,	1.42E+04,	1.95E+04,	2.79E+04,	3.81E+04,	3.85E+03,	9.14E+02,	1.13E+02,
1991 ,	1.87E+06,	3.09E+05,	8.73E+04,	1.71E+04,	1.06E+04,	1.43E+04,	1.91E+04,	2.51E+04,	2.38E+03,	3.97E+02,
1992 ,	3.10E+06,	1.11E+06,	2.40E+05,	6.79E+04,	1.22E+04,	6.96E+03,	9.07E+03,	1.16E+04,	1.65E+04,	1.59E+03,
1993 ,	1.88E+06,	5.88E+05,	7.64E+05,	1.84E+05,	4.42E+04,	7.84E+03,	4.12E+03,	5.55E+03,	7.15E+03,	1.11E+04,
1994 ,	1.95E+06,	1.95E+05,	3.27E+05,	5.79E+05,	1.24E+05,	2.15E+04,	3.86E+03,	2.49E+03,	3.37E+03,	3.92E+03,
1995 ,	3.61E+06,	2.98E+05,	8.81E+04,	2.42E+05,	4.25E+05,	6.99E+04,	9.66E+03,	1.62E+03,	1.42E+03,	1.67E+03,
1996 ,	1.45E+06,	2.82E+05,	9.80E+04,	5.92E+04,	1.56E+05,	2.49E+05,	3.76E+04,	4.72E+03,	9.75E+02,	8.78E+02,
1997 ,	1.85E+06,	9.08E+04,	9.28E+04,	4.23E+04,	3.80E+04,	9.22E+04,	1.33E+05,	2.10E+04,	2.07E+03,	4.02E+02,

Estimated population abundance at 1st Jan 1998

, .00E+00, 1.76E+05, 3.64E+04, 5.47E+04, 2.76E+04, 1.96E+04, 4.48E+04, 6.46E+04, 1.29E+04, 1.20E+03,

Taper weighted geometric mean of the VPA populations:

, 1.00E+06, 1.67E+05, 9.33E+04, 5.90E+04, 3.66E+04, 1.88E+04, 7.73E+03, 2.97E+03, 1.30E+03, 6.45E+02,

Standard error of the weighted Log(VPA populations) :

, 1.3532, 1.3300, 1.3355, 1.4383, 1.5271, 1.5745, 1.5632, 1.4429, 1.4390, 1.5082,

		AGE	
YEAR ,	11,	12,	13,
1988 ,	2.33E+02,	2.06E+02,	6.80E+01,
1989 ,	3.87E+01,	6.22E+01,	4.65E+01,
1990 ,	2.03E+01,	2.08E+01,	3.10E+01,
1991 ,	4.76E+01,	1.39E+01,	1.43E+01,
1992 ,	3.06E+02,	3.81E+01,	5.06E+00,
1993 ,	1.09E+03,	2.39E+02,	2.75E+01,
1994 ,	7.24E+03,	6.05E+02,	1.46E+02,
1995 ,	1.54E+03,	4.43E+03,	2.41E+02,
1996 ,	9.47E+02,	9.52E+02,	3.06E+03,
1997 ,	4.52E+02,	5.48E+02,	5.74E+02,

Estimated population abundance at 1st Jan 1998

, 1.56E+02, 2.20E+02, 3.34E+02,

Taper weighted geometric mean of the VPA populations:

, 3.22E+02, 1.66E+02, 6.43E+01,

Standard error of the weighted Log(VPA populations) :

, 1.6786, 1.7347, 1.8728,

Table 4.11 (Cont'd)

Log catchability residuals.

Fleet : FLT23: Russian botto

Age	1980	1981	1982	1983	1984	1985	1986	1987
1	99.99	99.99	99.99	1.77	.88	.20	-.03	.24
2	99.99	99.99	99.99	2.49	.80	.81	.20	-.56
3	99.99	99.99	99.99	.79	.88	.95	-.25	.05
4	99.99	99.99	99.99	.23	.05	-.27	.11	.00
5	99.99	99.99	99.99	99.99	.02	.46	-.60	.08
6	99.99	99.99	99.99	99.99	99.99	-.04	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	No data for this fleet at this age							
9	No data for this fleet at this age							
10	No data for this fleet at this age							
11	No data for this fleet at this age							
12	No data for this fleet at this age							
13	No data for this fleet at this age							

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-.35	-.52	.59	.24	.28	-.22	-.54	-.30	-.17	-.17
2	-.47	.30	.34	-.18	.41	.09	-.24	-.69	-.36	-.37
3	-.40	-.84	1.30	-.18	.21	.47	.13	-.64	-.49	-.56
4	-.42	-.48	1.14	-.41	-.15	.60	.33	-.60	-.02	-.08
5	-.40	.11	1.29	-.51	-.41	.45	-.01	-.37	.61	-.67
6	-.45	.40	1.01	-.76	.02	.37	.07	-.30	.56	-.87
7	99.99	.93	.72	.33	.38	.37	-.60	-.06	.21	-1.98
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									

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

Age	6	7
Mean Log q	-6.5819	-6.8284
S.E(Log q)	.5856	.8822

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.83	1.138	9.20	.83	15	.51	-8.26
2	.89	.715	7.67	.80	15	.63	-7.10
3	.81	1.189	7.67	.80	15	.67	-6.76
4	.91	.847	7.06	.89	15	.51	-6.65
5	.78	1.772	7.60	.87	14	.61	-6.74

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.99	.089	6.63	.84	11	.61	-6.58
7	1.54	-1.363	5.32	.49	9	1.29	-6.83

Table 4.11 (Cont'd)

Fleet : FLT29: Norwegian tra

Age	1980	1981	1982	1983	1984	1985	1986	1987
1	No data for this fleet at this age							
2	No data for this fleet at this age							
3	No data for this fleet at this age							
4	No data for this fleet at this age							
5	No data for this fleet at this age							
6	No data for this fleet at this age							
7	No data for this fleet at this age							
8	99.99	99.99	99.99	99.99	99.99	.69	1.09	.83
9	99.99	99.99	99.99	99.99	99.99	1.51	1.68	1.91
10	99.99	99.99	99.99	99.99	99.99	-.11	1.89	.98
11	99.99	99.99	99.99	99.99	99.99	.76	1.07	1.82
12	99.99	99.99	99.99	99.99	99.99	1.53	2.97	2.34
13	99.99	99.99	99.99	99.99	99.99	2.08	1.64	.84

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
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	-.49	-.05	-.31	-.82	-.46	-.40	.03	-.99	1.48	.24
9	-2.04	-2.32	-2.20	-.55	-.02	.15	.22	-.15	1.96	.72
10	.25	.98	-3.63	-1.07	.35	-.49	.89	.11	1.06	-.42
11	2.12	.46	-1.83	-2.91	-1.63	.15	-.41	.01	1.13	.79
12	1.93	1.01	.44	.28	.49	.23	1.01	-.16	.36	.56
13	.78	-.77	-.55	-.03	-.43	.27	.93	99.99	1.04	.18

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	-1.9736	-2.3924	-2.2624	-2.5658	-2.5658	-2.5658
S.E(Log q)	.7645	1.4733	1.3634	1.4848	1.2455	.9142

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	-.701	1.17	.76	13	.89	-1.97
9	.78	.874	3.46	.64	13	1.16	-2.39
10	.82	.781	3.05	.67	13	1.14	-2.26
11	.77	1.115	3.33	.72	13	1.13	-2.57
12	1.14	-.766	1.25	.78	13	1.00	-1.71
13	.94	.453	2.28	.87	12	.80	-2.17

Table 4.11 (Cont'd)

Fleet : FLT30: Norway bottom

Age	1980	1981	1982	1983	1984	1985	[illegible]	1987
1	1.47	.92	1.20	1.01	.49	.02	.73	.04
2	.53	-.03	.83	1.37	.45	-.37	.64	.32
3	-.08	-.13	-.08	.01	.43	-.10	.16	.35
4	-2.28	-.47	.53	-.14	-.14	.92	-.06	.19
5	.01	-.32	.44	.46	.28	1.36	-.83	.22
6	.12	.56	.22	-.72	.54	-.41	2.87	-.79
7	.54	-.05	.50	-1.64	-.41	-.06	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	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-1.40	-.22	.65	.08	-.14	.04	-.32	-.23	-.05	-.08
2	-1.34	-.55	.24	.31	-.51	-.06	-.22	-.25	.43	.38
3	-.12	-.77	.21	.24	-.25	-.09	-.19	.18	.21	.04
4	.17	-.30	-.11	-.03	-.56	-.26	.11	.40	.08	.08
5	-.07	.17	-.04	-.05	-.59	-.38	.09	.30	.11	-.19
6	.49	.42	-.28	-.37	-.54	-1.39	-.01	.39	.58	-.26
7	99.99	.51	-.17	.51	.41	.51	.16	-.22	-.35	-.69
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									

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

Age	6	7
Mean Log q	-6.1765	-5.9411
S.E(Log q)	.8947	.5225

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	.68	2.543	7.83	.86	18	.57	-4.95
2	.73	1.974	6.93	.85	18	.60	-5.09
3	.90	1.480	5.65	.95	18	.31	-5.00
4	.83	2.101	6.36	.94	18	.38	-5.42
5	.70	3.327	7.39	.92	18	.46	-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
6	.99	.068	6.22	.76	18	.93	-6.18
7	1.20	-1.364	5.24	.85	15	.60	-5.94

Table 4.11 (Cont'd)

Fleet : FLT31: Norway acoust

Age	1980	1981	1982	1983	1984	1985	1986	1987
1	1.63	.62	.62	.06	.41	.12	-.12	-.79
2	1.04	.28	.46	.65	.48	.22	.24	-.64
3	1.13	.91	.34	.54	.71	.41	.13	-.43
4	.76	.50	.77	.61	.18	-.76	.01	-.54
5	.95	.27	.28	.74	.56	1.00	-.06	-.38
6	1.00	1.66	.75	-.54	.72	.87	1.16	-.21
7	1.08	.49	1.06	-1.51	.92	1.17	1.53	1.62
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	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	-.28	-.39	.40	-.13	.26	.37	.20	-.06	-.52	.15
2	.24	-.65	.11	-.19	-.03	.08	-.20	-.20	.11	.30
3	-.19	-.55	.00	-.47	.00	.30	-.16	.08	-.02	.20
4	.03	-.16	-.05	-.21	-.31	.20	.21	-.05	.09	.42
5	-.25	.03	-.14	-.82	-.95	.33	.36	.05	.24	.23
6	.30	.51	-.51	-1.66	-.87	-.81	.17	.20	.69	.43
7	-.07	.11	-.37	-.99	-.25	-.65	-.22	-.09	-.48	.07
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									

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

Age	6	7
Mean Log q	-6.3565	-6.0724
S.E(Log q)	.7994	.7888

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	.78	2.405	7.00	.92	18	.40	-5.10
2	.82	2.265	6.52	.94	18	.36	-5.30
3	.89	1.346	6.01	.94	18	.36	-5.34
4	.75	3.482	7.05	.95	18	.34	-5.73
5	.72	2.675	7.35	.90	18	.53	-6.13

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.93	.454	6.59	.82	18	.77	-6.36
7	1.44	-2.440	4.79	.75	18	.95	-6.07

Table 4.11 (Cont'd)

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1996

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	148844.,	.529,	.000,	.00,	1,	.265,	.000
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	162259.,	.595,	.000,	.00,	1,	.209,	.000
FLT31: Norway acoust,	204656.,	.425,	.000,	.00,	1,	.410,	.000
P shrinkage mean ,	167259.,	1.33,,,,				.042,	.000
F shrinkage mean ,	175080.,	1.00,,,,				.074,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
175619.,	.27,	.07,	5,	.248,	.000

Age 2 Catchability dependent on age and year class strength

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	28487.,	.416,	.095,	.23,	2,	.224,	.006
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	42548.,	.428,	.215,	.50,	2,	.212,	.004
FLT31: Norway acoust,	34305.,	.278,	.405,	1.46,	2,	.503,	.005
P shrinkage mean ,	93315.,	1.34,,,,				.022,	.002
F shrinkage mean ,	80794.,	1.00,,,,				.039,	.002

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
36398.,	.20,	.15,	8,	.771,	.004

Age 3 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,	37114.,	.359,	.075,	.21,	3,	.177,	.045
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	57726.,	.257,	.137,	.53,	3,	.345,	.029
FLT31: Norway acoust,	60215.,	.227,	.074,	.33,	3,	.444,	.028
P shrinkage mean ,	59028.,	1.44,,,,				.011,	.029
F shrinkage mean ,	74154.,	1.00,,,,				.024,	.023

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
54742.,	.15,	.07,	11,	.486,	.031

Table 4.11 (Cont'd)

Age 4 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,	18185.,	.296,	.135,	.46,	4,	.184,	.262
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	28920.,	.216,	.116,	.54,	4,	.346,	.173
FLT31: Norway acoust,	30576.,	.191,	.139,	.73,	4,	.442,	.164
P shrinkage mean ,	36642.,	1.53,,,,				.008,	.139
F shrinkage mean ,	53968.,	1.00,,,,				.020,	.096

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
27613.,	.13,	.09,	14,	.678,	.180

Age 5 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,	14251.,	.270,	.127,	.47,	5,	.191,	.551
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	20317.,	.197,	.078,	.40,	5,	.357,	.416
FLT31: Norway acoust,	21398.,	.181,	.093,	.51,	5,	.419,	.399
P shrinkage mean ,	18790.,	1.57,,,,				.010,	.443
F shrinkage mean ,	34145.,	1.00,,,,				.024,	.268

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
19632.,	.12,	.06,	17,	.540,	.428

Age 6 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,	38157.,	.258,	.242,	.94,	6,	.221,	.578
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	44869.,	.201,	.105,	.53,	6,	.341,	.510
FLT31: Norway acoust,	47905.,	.184,	.081,	.44,	6,	.405,	.485
F shrinkage mean ,	58643.,	1.00,,,,				.032,	.412

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
44837.,	.12,	.08,	19,	.640,	.511

Age 7 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,	62926.,	.264,	.335,	1.27,	7,	.216,	.533
FLT29: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT30: Norway bottom,	56702.,	.205,	.156,	.76,	7,	.369,	.578
FLT31: Norway acoust,	73084.,	.192,	.085,	.44,	7,	.373,	.474
F shrinkage mean ,	77313.,	1.00,,,,				.043,	.453

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
64599.,	.13,	.10,	22,	.829,	.523

Age 8 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,	14858.,	.264,	.141,	.54,	7,	.202,	.257
FLT29: Norwegian tra,	16408.,	.798,	.000,	.00,	1,	.060,	.235
FLT30: Norway bottom,	11682.,	.204,	.124,	.61,	7,	.347,	.317
FLT31: Norway acoust,	13643.,	.189,	.112,	.59,	7,	.341,	.277
F shrinkage mean ,	7291.,	1.00,,,,				.051,	.468

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
12881.,	.13,	.07,	23,	.549,	.291

Age 9 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,	1198.,	.281,	.113,	.40,	7,	.173,	.348
FLT29: Norwegian tra,	4078.,	.740,	.357,	.48,	2,	.111,	.116
FLT30: Norway bottom,	1028.,	.220,	.116,	.53,	7,	.305,	.396
FLT31: Norway acoust,	1048.,	.201,	.112,	.56,	7,	.286,	.390
F shrinkage mean ,	800.,	1.00,,,,				.124,	.485

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1199.,	.18,	.11,	24,	.609,	.349

Age 10 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,	153.,	.282,	.237,	.84,	7,	.142,	.759
FLT29: Norwegian tra,	117.,	.702,	.731,	1.04,	3,	.137,	.910
FLT30: Norway bottom,	133.,	.215,	.201,	.93,	7,	.255,	.835
FLT31: Norway acoust,	107.,	.206,	.129,	.63,	7,	.240,	.964
F shrinkage mean ,	333.,	1.00,,,,				.226,	.420

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
156.,	.26,	.15,	25,	.562,	.750

Age 11 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,	253.,	.276,	.249,	.90,	7,	.170,	.467
FLT29: Norwegian tra,	344.,	.650,	.275,	.42,	4,	.121,	.363
FLT30: Norway bottom,	184.,	.217,	.214,	.99,	7,	.282,	.597
FLT31: Norway acoust,	149.,	.205,	.166,	.81,	7,	.285,	.697
F shrinkage mean ,	403.,	1.00,,,,				.142,	.317

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
220.,	.19,	.12,	26,	.634,	.520

Table 4.11 (Cont'd)

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

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	310.,	.279,	.289,	1.04,	7,	.154,	.315
FLT29: Norwegian tra,	483.,	.639,	.254,	.40,	5,	.168,	.214
FLT30: Norway bottom,	345.,	.211,	.129,	.61,	7,	.271,	.287
FLT31: Norway acoust,	236.,	.206,	.162,	.79,	7,	.265,	.396
F shrinkage mean ,	424.,	1.00,,,,				.142,	.240

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
334.,	.20,	.10,	27,	.496,	.296

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

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT23: Russian botto,	473.,	.295,	.196,	.67,	7,	.113,	.216
FLT29: Norwegian tra,	424.,	.588,	.125,	.21,	6,	.318,	.238
FLT30: Norway bottom,	471.,	.224,	.090,	.40,	7,	.191,	.217
FLT31: Norway acoust,	301.,	.217,	.155,	.71,	7,	.184,	.321
F shrinkage mean ,	204.,	1.00,,,,				.195,	.445

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
357.,	.28,	.09,	28,	.313,	.278

Table 4.12

Run title : Arctic Haddock (run: XSATJA01/X01)

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	248990,	144609,	1538797,	418745,	89018,	78241,	90662,	183859,	285263,	204845,
2,	21292,	203855,	118396,	1259426,	342826,	72762,	64058,	73974,	149336,	230409,
3,	20067,	17402,	165945,	96684,	1027932,	272205,	54219,	49087,	56624,	115483,
4,	225729,	15835,	12873,	115050,	77369,	633291,	159338,	35629,	31107,	33702,
5,	105685,	123615,	11188,	8360,	72154,	43216,	284347,	92722,	16423,	13299,
6,	23058,	49188,	60919,	7468,	5707,	20306,	13650,	153077,	45266,	7286,
7,	36400,	11868,	23119,	29973,	5284,	1781,	10406,	5902,	80348,	18250,
8,	12321,	15687,	6449,	11737,	16144,	2873,	1079,	4776,	2901,	29550,
9,	1968,	5299,	8387,	3494,	6844,	7122,	1969,	538,	2791,	1246,
10,	479,	1019,	2869,	5077,	2113,	3224,	4310,	1053,	357,	1064,
11,	470,	227,	549,	1692,	3213,	919,	2164,	1680,	744,	118,
12,	193,	294,	147,	299,	1051,	1736,	619,	926,	923,	356,
13,	44,	54,	202,	97,	127,	374,	1114,	257,	625,	166,
+gp,	125,	35,	169,	28,	159,	148,	487,	1128,	630,	190,
TOTAL,	696821,	588987,	1950010,	1958131,	1649942,	1138196,	688424,	604607,	673338,	655965,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	28508,	8500,	12042,	7164,	14733,	409941,	1945756,	1773203,	672583,	835150,
2,	167547,	23298,	6959,	9859,	5865,	12061,	335631,	675130,	373434,	54989,
3,	171943,	135336,	19032,	5698,	8010,	4775,	9728,	260463,	546010,	87674,
4,	43909,	97967,	94933,	15014,	4225,	5759,	3273,	7470,	186513,	273673,
5,	7648,	18928,	48277,	57024,	9976,	2645,	2969,	1918,	5073,	97083,
6,	4222,	2573,	5865,	19805,	26668,	5116,	1366,	1674,	1077,	3237,
7,	3625,	2199,	814,	2113,	6547,	10792,	2946,	840,	724,	541,
8,	7901,	1497,	1066,	440,	795,	2985,	5866,	1719,	402,	280,
9,	14202,	4120,	731,	417,	214,	339,	1624,	2767,	834,	199,
10,	739,	6004,	2047,	391,	195,	107,	231,	878,	1078,	416,
11,	520,	459,	2825,	914,	255,	87,	54,	126,	343,	445,
12,	10,	192,	212,	1138,	450,	126,	45,	22,	58,	179,
13,	200,	5,	79,	73,	421,	79,	84,	4,	13,	15,
+gp,	174,	133,	33,	112,	69,	338,	349,	240,	31,	73,
TOTAL,	451145,	301211,	194914,	120162,	78422,	455151,	2309922,	2726455,	1788173,	1353954,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST
AGE												
1,	55726,	441198,	537314,	1874373,	3102334,	1879562,	1950053,	3613748,	1450127,	1848925,	0,	2338
2,	23212,	31458,	149515,	309411,	1109002,	588443,	194864,	298419,	281566,	90787,	175619,	1335
3,	44882,	18533,	25593,	87332,	240054,	764420,	327190,	88071,	97983,	92778,	36398,	982
4,	68227,	28157,	14223,	17125,	67911,	184362,	579045,	242055,	59234,	42340,	54742,	698
5,	144170,	47688,	19478,	10583,	12241,	44153,	124220,	425050,	156197,	38006,	27613,	394
6,	31881,	72009,	27910,	14254,	6958,	7841,	21485,	69857,	249280,	92158,	19632,	181
7,	2120,	8489,	38116,	19106,	9068,	4122,	3863,	9664,	37645,	132913,	44837,	82
8,	256,	1390,	3853,	25095,	11624,	5551,	2495,	1617,	4718,	21019,	64599,	38
9,	118,	151,	914,	2385,	16545,	7147,	3371,	1415,	975,	2071,	12881,	18
10,	96,	65,	113,	397,	1592,	11070,	3923,	1674,	878,	402,	1199,	9
11,	233,	39,	20,	48,	306,	1086,	7243,	1544,	947,	452,	156,	4
12,	206,	62,	21,	14,	38,	239,	605,	4433,	952,	548,	220,	2
13,	68,	46,	31,	14,	5,	28,	146,	241,	3062,	574,	334,	
+gp,	34,	41,	51,	50,	5,	18,	6,	12,	89,	674,	774,	
TOTAL,	371227,	649325,	817153,	2360187,	4577682,	3498041,	3218511,	4757799,	2343652,	2363645,	439004,	

Table 4.13

Run title : Arctic Haddock (run: XSATJA01/X01)

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Table 4 Natural Mortality (M) at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
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,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	1.0585,	1.5578,	2.5035,	3.5829,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2527,	.2085,	1.4453,	.2000,
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2106,	.2000,	.6245,	.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,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
1,	.5718,	1.0821,	.5519,	.5248,	1.6615,	2.2663,	1.8771,	2.5521,	2.7707,	2.3542,
2,	.2229,	.2000,	.5351,	.2526,	.3692,	.5859,	.7912,	1.1125,	1.1076,	.9099,
3,	.4439,	.2000,	.3770,	.2000,	.2053,	.2576,	.2900,	.3780,	.8126,	.4971,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2239,	.2166,	.3683,	.3218,	.2475,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2964,	.2099,	.3050,	.2242,	.2330,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2072,	.2007,	.2072,	.2226,	.2105,
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 4.14

Run title : Arctic Haddock (run: SVPTJA01/V01)

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Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	.0370,	.1024,	.1677,	.0231,	.2855,	.3364,	.2211,	.2579,	.3225,	.7671,
4,	.4029,	.1478,	.2334,	.2689,	.3846,	.6004,	.3427,	.5745,	.6509,	1.2782,
5,	.5645,	.5080,	.2047,	.1836,	1.0625,	.9489,	.4204,	.5180,	.6124,	.9440,
6,	.4640,	.5546,	.5097,	.1466,	.9623,	.4693,	.6377,	.4461,	.7076,	.4987,
7,	.6399,	.4101,	.4782,	.4202,	.4093,	.3036,	.5791,	.5108,	.7986,	.6368,
8,	.6422,	.4260,	.4132,	.3405,	.6192,	.1783,	.5003,	.3387,	.6435,	.5336,
9,	.4589,	.4137,	.3025,	.3037,	.5533,	.3047,	.4261,	.2131,	.7636,	.3237,
10,	.5437,	.4190,	.3288,	.2584,	.6316,	.1999,	.7445,	.1487,	.9200,	.5174,
11,	.2710,	.2351,	.4080,	.2769,	.4164,	.1954,	.6499,	.4038,	.5376,	2.2920,
12,	1.0635,	.1769,	.2179,	.6539,	.8280,	.2444,	.6755,	.1949,	1.5089,	.3776,
13,	.6031,	.3359,	.3355,	.3683,	.6161,	.2243,	.6036,	.2586,	.8842,	.8211,
+gp,	.6031,	.3359,	.3355,	.3683,	.6161,	.2243,	.6036,	.2586,	.8842,	.8211,
FBAR 4- 7,	.5178,	.4051,	.3565,	.2548,	.7047,	.5805,	.4949,	.5124,	.6924,	.8394,

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	.3639,	.1555,	.0373,	.0995,	.1307,	.1785,	.0537,	.1352,	.0655,	.0510,
4,	.6434,	.5091,	.3110,	.2097,	.2691,	.4633,	.3346,	.1874,	.4556,	.4406,
5,	.8880,	.9696,	.6915,	.5606,	.4677,	.4610,	.3743,	.3782,	.2498,	.9134,
6,	.4533,	.9466,	.8196,	.9035,	.7036,	.3529,	.2865,	.6391,	.4877,	.2238,
7,	.6832,	.5259,	.4153,	.7766,	.5849,	.4110,	.3395,	.5369,	.7506,	.5486,
8,	.4525,	.5161,	.7398,	.5221,	.6501,	.4095,	.5528,	.5242,	.5038,	.6659,
9,	.6610,	.5015,	.4277,	.5644,	.4908,	.1868,	.4161,	.7425,	.4972,	.5292,
10,	.2789,	.5551,	.6088,	.2291,	.6108,	.4811,	.4101,	.7396,	.6865,	.3827,
11,	.7938,	.5742,	.7101,	.5140,	.5037,	.4679,	.7092,	.5817,	.4492,	.5737,
12,	.4293,	.6930,	.8636,	.7935,	1.5295,	.2052,	2.1380,	.2929,	1.1059,	.7661,
13,	.5268,	.5720,	.6760,	.5272,	.7664,	.3499,	.8594,	.3025,	.2869,	.3365,
+gp,	.5268,	.5720,	.6760,	.5272,	.7664,	.3499,	.8594,	.3025,	.2869,	.3365,
FBAR 4- 7,	.6670,	.7378,	.5593,	.6126,	.5063,	.4221,	.3338,	.4354,	.4859,	.5316,

Table 8 Fishing mortality (F) at age

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
3,	.0223,	.0649,	.0248,	.0519,	.0589,	.0203,	.0114,	.0187,	.0259,	.0308,	.0251,
4,	.1586,	.1689,	.0960,	.1366,	.2318,	.1714,	.0931,	.0699,	.1223,	.1803,	.1242,
5,	.4931,	.3358,	.1126,	.2198,	.2467,	.4227,	.3655,	.2287,	.3042,	.4281,	.3203,
6,	1.1160,	.4351,	.1795,	.2527,	.3238,	.5013,	.5975,	.4104,	.4065,	.5109,	.4426,
7,	.2228,	.5881,	.2181,	.2975,	.2911,	.3028,	.6707,	.5167,	.3824,	.5232,	.4741,
8,	.3303,	.2195,	.2801,	.2168,	.2871,	.2991,	.3672,	.3072,	.6212,	.2914,	.4066,
9,	.4009,	.0847,	.6331,	.2045,	.2022,	.4004,	.4988,	.2781,	.6864,	.3489,	.4378,
10,	.7036,	.9522,	.6660,	.0606,	.1837,	.2244,	.7290,	.3701,	.4643,	.7500,	.5282,
11,	1.1134,	.4181,	.1792,	.0236,	.0446,	.3856,	.2911,	.2828,	.3466,	.5205,	.3833,
12,	1.2799,	.4955,	.1733,	.8064,	.1241,	.2934,	.7163,	.1704,	.3071,	.2960,	.2578,
13,	.4424,	.5178,	.3872,	.1674,	.2463,	.4480,	.4270,	.1972,	.3357,	.2781,	.2703,
+gp,	.4424,	.5178,	.3872,	.1674,	.2463,	.4480,	.4270,	.1972,	.3357,	.2781,	
FBAR 4- 7,	.4976,	.3820,	.1516,	.2266,	.2734,	.3495,	.4317,	.3064,	.3039,	.4106,	

Table 4.15

Run title : Arctic Haddock (run: SVPTJA01/V01)

At 26-Aug-98 11:47:13

Traditional vpa using file input for terminal F

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	19933,	17204,	163912,	95484,	1017756,	269632,	53676,	48504,	55687,	113842,
4,	223524,	15727,	12715,	113477,	76390,	626290,	157691,	35231,	30684,	33023,
5,	104569,	122318,	11107,	8243,	71001,	42576,	281310,	91649,	16238,	13102,
6,	22851,	48682,	60260,	7410,	5617,	20090,	13496,	151275,	44700,	7207,
7,	36030,	11763,	22890,	29634,	5240,	1757,	10288,	5840,	79279,	18036,
8,	12192,	15556,	6391,	11618,	15939,	2849,	1062,	4720,	2869,	29206,
9,	1949,	5252,	8318,	3462,	6767,	7026,	1952,	527,	2754,	1234,
10,	474,	1008,	2843,	5033,	2092,	3186,	4241,	1044,	349,	1051,
11,	467,	226,	543,	1675,	3182,	911,	2136,	1649,	736,	114,
12,	190,	292,	146,	296,	1040,	1718,	613,	913,	902,	352,
13,	43,	54,	200,	96,	126,	372,	1102,	256,	615,	163,
+gp,	125,	35,	169,	28,	159,	148,	487,	1128,	630,	190,
TOTAL,	422348,	238116,	289495,	276456,	1205308,	976554,	528052,	342736,	235443,	217521,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	170092,	134055,	18873,	5652,	7933,	4737,	9664,	257207,	541063,	87078,
4,	43282,	96779,	93951,	14886,	4189,	5699,	3245,	7419,	183952,	271387,
5,	7531,	18622,	47625,	56361,	9882,	2621,	2936,	1901,	5036,	95497,
6,	4174,	2537,	5782,	19528,	26343,	5068,	1353,	1653,	1066,	3212,
7,	3584,	2172,	806,	2086,	6477,	10672,	2916,	832,	714,	536,
8,	7811,	1482,	1051,	436,	786,	2955,	5793,	1700,	398,	276,
9,	14024,	4068,	724,	411,	212,	336,	1606,	2729,	824,	197,
10,	731,	5928,	2017,	386,	191,	106,	228,	867,	1063,	410,
11,	513,	453,	2786,	898,	252,	85,	54,	124,	339,	438,
12,	9,	190,	209,	1121,	440,	124,	44,	22,	57,	177,
13,	198,	5,	78,	72,	415,	78,	83,	4,	13,	15,
+gp,	174,	133,	33,	112,	69,	338,	349,	240,	31,	73,
TOTAL,	252122,	266423,	173934,	101949,	57189,	32819,	28269,	274698,	734557,	459297,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST
AGE												
3,	44593,	18409,	25354,	86456,	238342,	757340,	324025,	87177,	97311,	91641,	0,	973
4,	67749,	27977,	14124,	16965,	67203,	182999,	573610,	239697,	58629,	42075,	54054,	691
5,	143011,	47331,	19347,	10505,	12117,	43636,	123252,	420823,	154652,	37604,	27430,	390
6,	31366,	71511,	27698,	14153,	6903,	7751,	21259,	69324,	246780,	91176,	19415,	179
7,	2102,	8412,	37892,	18950,	9000,	4089,	3816,	9570,	37381,	131545,	44318,	81
8,	254,	1378,	3825,	24944,	11522,	5508,	2473,	1598,	4673,	20880,	63825,	37
9,	116,	149,	906,	2367,	16442,	7079,	3344,	1403,	962,	2056,	12774,	18
10,	95,	64,	112,	394,	1579,	10998,	3884,	1662,	870,	397,	1187,	9
11,	229,	38,	20,	47,	303,	1076,	7194,	1534,	940,	447,	153,	4
12,	202,	62,	21,	14,	38,	238,	599,	4402,	946,	544,	218,	2
13,	67,	46,	31,	14,	5,	27,	145,	240,	3040,	570,	331,	
+gp,	34,	41,	51,	50,	5,	18,	6,	12,	88,	674,	771,	
TOTAL,	289817,	175417,	129380,	174859,	363461,	1020759,	1063607,	837441,	606272,	419609,	224476,	

Table 4.16

Run title : Arctic Haddock (run: SVPTJA01/V01)

At 26-Aug-98 11:47:13

Traditional vpa using file input for terminal F

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	10407,	9110,	81471,	63486,	575374,	147122,	30455,	25909,	22889,	57688,
4,	182121,	12996,	9863,	117747,	67396,	533303,	139630,	29368,	19683,	26115,
5,	148066,	175659,	14973,	14865,	108863,	63005,	432884,	132772,	18102,	18007,
6,	43021,	92954,	108009,	17767,	11451,	39529,	27612,	291386,	66256,	13169,
7,	81513,	26991,	49302,	85382,	12836,	4154,	25294,	13517,	141207,	39604,
8,	32117,	41558,	16028,	38973,	45463,	7843,	3040,	12722,	5949,	74672,
9,	5704,	15591,	23178,	12903,	21445,	21490,	6208,	1578,	6347,	3506,
10,	1655,	3568,	9442,	22358,	7902,	11615,	16079,	3724,	958,	3558,
11,	1996,	977,	2208,	9115,	14719,	4066,	9915,	7208,	2476,	472,
12,	1009,	1569,	736,	1995,	5968,	9517,	3532,	4951,	3762,	1812,
13,	254,	320,	1116,	716,	798,	2276,	7008,	1530,	2835,	928,
+gp,	794,	222,	1020,	229,	1090,	977,	3349,	7304,	3138,	1170,
TOTALBIO,	508658,	381515,	317347,	385537,	873305,	844897,	705005,	531970,	293603,	240700,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	106388,	99512,	12856,	3666,	4888,	2847,	5808,	109250,	136544,	20532,
4,	42249,	112116,	99876,	15069,	4029,	5346,	3043,	5873,	135952,	127981,
5,	12775,	37492,	87985,	99153,	16516,	4272,	4785,	3266,	6945,	87254,
6,	9413,	6791,	14203,	45678,	58540,	10985,	2932,	3830,	2172,	7006,
7,	9713,	6986,	2379,	5863,	17297,	27795,	7593,	2160,	1455,	1506,
8,	24650,	5549,	3612,	1426,	2442,	8961,	17564,	5464,	1195,	903,
9,	49174,	16927,	2765,	1493,	731,	1131,	5412,	9746,	2748,	716,
10,	3055,	29406,	9180,	1675,	787,	426,	916,	3693,	4226,	1778,
11,	2624,	2750,	15528,	4767,	1269,	418,	264,	646,	1650,	2324,
12,	60,	1431,	1444,	7384,	2752,	760,	266,	140,	342,	1166,
13,	1386,	42,	594,	524,	2869,	526,	559,	30,	88,	112,
+gp,	1316,	1197,	275,	882,	517,	2463,	2543,	1851,	222,	573,
TOTALBIO,	262804,	320197,	250696,	187580,	112637,	65929,	51683,	145949,	293539,	251850,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	12080,	5028,	6739,	32221,	89596,	230589,	75751,	17995,	20423,	18761,
4,	26219,	11947,	9752,	12255,	55496,	150109,	312324,	85507,	26426,	17143,
5,	87134,	32047,	17624,	14936,	18907,	62803,	129539,	335662,	106185,	26175,
6,	34175,	70082,	33793,	21993,	14493,	16419,	32623,	100031,	277714,	101431,
7,	3255,	11618,	54951,	30664,	21504,	9599,	7450,	18728,	68965,	195604,
8,	838,	4412,	7382,	48919,	26210,	16798,	6199,	4664,	11350,	50919,
9,	426,	531,	3226,	5909,	46215,	24043,	7930,	4124,	2707,	6607,
10,	416,	270,	477,	1663,	6718,	37450,	10169,	5053,	2888,	1320,
11,	1228,	200,	105,	244,	1660,	4526,	22713,	4861,	3269,	2093,
12,	1344,	397,	134,	88,	256,	1594,	4010,	29557,	6338,	3641,
13,	495,	327,	219,	101,	38,	202,	1072,	1777,	22480,	4212,
+gp,	268,	312,	395,	383,	41,	146,	50,	99,	708,	5385,
TOTALBIO,	167876,	137171,	134796,	169376,	281134,	554277,	609832,	608058,	549453,	433292,

Table 4.17

Run title : Arctic Haddock (run: SVPTJA01/V01)

At 26-Aug-98 11:47:13

Traditional vpa using file input for terminal F

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	9106,	650,	493,	5887,	3370,	26665,	6981,	1468,	984,	1306,
5,	34055,	40402,	3444,	3419,	25038,	14491,	99563,	30538,	4163,	4142,
6,	22801,	49266,	57245,	9417,	6069,	20950,	14634,	154435,	35116,	6980,
7,	71732,	23752,	43385,	75136,	11296,	3656,	22258,	11895,	124263,	34851,
8,	31474,	40727,	15707,	38194,	44554,	7687,	2979,	12467,	5830,	73178,
9,	5704,	15591,	23178,	12903,	21445,	21490,	6208,	1578,	6347,	3506,
10,	1655,	3568,	9442,	22358,	7902,	11615,	16079,	3724,	958,	3558,
11,	1996,	977,	2208,	9115,	14719,	4066,	9915,	7208,	2476,	472,
12,	1009,	1569,	736,	1995,	5968,	9517,	3532,	4951,	3762,	1812,
13,	254,	320,	1116,	716,	798,	2276,	7008,	1530,	2835,	928,
+gp,	794,	222,	1020,	229,	1090,	977,	3349,	7304,	3138,	1170,
TOTSPBIO,	180581,	177042,	157976,	179369,	142249,	123389,	192507,	237099,	189873,	131902,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
3,	0,	0,	0,	37,	440,	484,	407,	2185,	0,	0,
4,	2112,	5606,	4994,	1808,	2216,	3742,	426,	470,	29909,	1280,
5,	2938,	8623,	20237,	63458,	12057,	4272,	1675,	2613,	3681,	18323,
6,	4989,	3599,	7527,	33345,	54442,	10985,	1378,	3562,	1868,	3713,
7,	8547,	6147,	2094,	5628,	16605,	27795,	5618,	2074,	1251,	1506,
8,	24157,	5438,	3539,	1426,	2442,	8961,	17564,	5464,	1195,	903,
9,	49174,	16927,	2765,	1493,	731,	1131,	5412,	9746,	2748,	716,
10,	3055,	29406,	9180,	1675,	787,	426,	916,	3693,	4226,	1778,
11,	2624,	2750,	15528,	4767,	1269,	418,	264,	646,	1650,	2324,
12,	60,	1431,	1444,	7384,	2752,	760,	266,	140,	342,	1166,
13,	1386,	42,	594,	524,	2869,	526,	559,	30,	88,	112,
+gp,	1316,	1197,	275,	882,	517,	2463,	2543,	1851,	222,	573,
TOTSPBIO,	100360,	81165,	68177,	122427,	97127,	61962,	37027,	32473,	47180,	32394,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
3,	0,	0,	0,	0,	1792,	4612,	0,	0,	0,	0,
4,	787,	478,	195,	858,	7214,	33024,	6246,	1710,	0,	514,
5,	28754,	9614,	5287,	4481,	9453,	30773,	16840,	40279,	10618,	2617,
6,	17429,	44152,	18248,	10996,	8986,	12479,	13375,	42013,	99977,	29415,
7,	3255,	9527,	42313,	24531,	16558,	7583,	6705,	15170,	53793,	117362,
8,	838,	4412,	6422,	45005,	20968,	14782,	5455,	4104,	9761,	41754,
9,	426,	531,	2581,	5909,	43442,	21157,	7930,	4124,	2436,	6607,
10,	416,	270,	477,	1663,	6718,	32582,	10169,	4396,	2686,	1096,
11,	1228,	200,	105,	244,	1660,	4526,	22031,	4861,	2942,	2093,
12,	1344,	397,	134,	88,	256,	1594,	4010,	27784,	6338,	3641,
13,	495,	327,	219,	101,	38,	202,	1072,	1777,	22480,	4212,
+gp,	268,	312,	395,	383,	41,	146,	50,	99,	708,	5385,
TOTSPBIO,	55238,	70219,	76375,	94260,	117126,	163460,	93887,	146316,	211738,	214697,

Table 4.18

Run title : Arctic Haddock (run: SVPTJA01/V01)

At 26-Aug-98 11:47:13

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 4- 7,
1950,	66401,	269854,	140642,	132125,	.9394,	.4483,	.8412,
1951,	552707,	439081,	111584,	120077,	1.0761,	.6468,	.6273,
1952,	62333,	317969,	64151,	127660,	1.9900,	.5115,	.7325,
1953,	1030188,	652916,	81680,	123920,	1.5171,	.5709,	.5328,
1954,	122540,	716191,	124221,	156788,	1.2622,	.5998,	.3865,
1955,	52309,	580934,	176276,	202286,	1.1476,	.4730,	.5158,
1956,	169104,	532421,	237439,	213924,	.9010,	.5526,	.4431,
1957,	53254,	353841,	197612,	123583,	.6254,	.5668,	.4446,
1958,	68972,	292205,	155117,	112672,	.7264,	.6119,	.5333,
1959,	324527,	414699,	133923,	88211,	.6587,	.7979,	.3937,
1960,	242520,	529752,	128196,	155454,	1.2126,	.8371,	.4989,
1961,	109130,	491160,	133522,	193234,	1.4472,	.8017,	.6494,
1962,	240726,	429466,	122878,	187888,	1.5291,	.7438,	.8256,
1963,	274815,	401756,	91083,	146744,	1.6111,	.7422,	.8878,
1964,	320312,	378960,	62714,	98900,	1.5770,	.6155,	.6541,
1965,	100310,	438631,	92977,	118079,	1.2700,	.6922,	.5089,
1966,	240270,	471106,	126356,	160621,	1.2712,	.6598,	.6198,
1967,	290556,	563805,	160798,	136486,	.8488,	.7910,	.4316,
1968,	19933,	508658,	180581,	181726,	1.0063,	.7910,	.5178,
1969,	17204,	381515,	177042,	130502,	.7371,	.8023,	.4051,
1970,	163911,	317347,	157976,	86601,	.5482,	.7531,	.3565,
1971,	95484,	385537,	179369,	78908,	.4399,	1.0074,	.2548,
1972,	1017757,	873305,	142249,	265317,	1.8652,	.8566,	.7047,
1973,	269632,	844897,	123389,	320065,	2.5939,	.8267,	.5805,
1974,	53676,	705005,	192507,	221138,	1.1487,	.8597,	.4949,
1975,	48504,	531970,	237099,	175758,	.7413,	.8093,	.5124,
1976,	55687,	293603,	189873,	137218,	.7227,	.6228,	.6924,
1977,	113842,	240700,	131902,	110158,	.8352,	.7678,	.8394,
1978,	170092,	262804,	100360,	95422,	.9508,	.9477,	.6670,
1979,	134055,	320197,	81165,	103623,	1.2767,	1.1247,	.7378,
1980,	18873,	250697,	68177,	87889,	1.2891,	1.0321,	.5593,
1981,	5652,	187580,	122427,	77153,	.6302,	.9828,	.6126,
1982,	7933,	112637,	97127,	46955,	.4834,	.9337,	.5063,
1983,	4737,	65929,	61962,	21607,	.3487,	.9107,	.4221,
1984,	9664,	51683,	37026,	17661,	.4770,	.9105,	.3338,
1985,	257207,	145949,	32473,	41270,	1.2709,	.9654,	.4354,
1986,	541063,	293539,	47180,	96585,	2.0472,	.9013,	.4859,
1987,	87078,	251850,	32394,	150659,	4.6508,	.9825,	.5316,
1988,	44593,	167876,	55238,	91744,	1.6609,	.9923,	.4976,
1989,	18409,	137171,	70219,	55122,	.7850,	.9617,	.3820,
1990,	25354,	134796,	76375,	25816,	.3380,	.9630,	.1516,
1991,	86456,	169376,	94260,	33605,	.3565,	.9581,	.2266,
1992,	238342,	281133,	117126,	53886,	.4601,	1.0132,	.2734,
1993,	757339,	554277,	163460,	77619,	.4748,	1.0016,	.3495,
1994,	324025,	609831,	93887,	121365,	1.2927,	.9991,	.4317,
1995,	87177,	608058,	146316,	138423,	.9461,	1.0021,	.3064,
1996,	97311,	549453,	211738,	173525,	.8195,	.9994,	.3039,
1997,	91641,	433291,	214697,	145574,	.6780,	.9986,	.4106,
Arith. Mean ,	191325,	394696,	124516,	124199,	1.1143		.5106,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 4.19

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

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	3.751	7743.246	1.628	6548.235	1.628	6548.235
0.0500	0.0205	0.045	86.000	3.531	6530.623	1.425	5361.427	1.425	5361.427
0.1000	0.0411	0.083	153.165	3.350	5579.693	1.260	4434.762	1.260	4434.762
0.1500	0.0616	0.114	206.227	3.198	4825.662	1.124	3703.563	1.124	3703.563
0.2000	0.0821	0.141	248.595	3.071	4221.684	1.011	3121.094	1.011	3121.094
0.2500	0.1027	0.164	282.760	2.962	3733.352	0.917	2653.045	0.917	2653.045
0.3000	0.1232	0.183	310.570	2.868	3335.050	0.836	2273.891	0.836	2273.891
0.3500	0.1437	0.201	333.409	2.786	3007.477	0.767	1964.414	0.767	1964.414
0.4000	0.1642	0.216	352.328	2.715	2735.934	0.708	1709.991	0.708	1709.991
0.4500	0.1848	0.230	368.129	2.652	2509.123	0.657	1499.394	0.657	1499.394
0.5000	0.2053	0.242	381.434	2.595	2318.282	0.612	1323.924	0.612	1323.924
0.5500	0.2258	0.253	392.724	2.545	2156.563	0.572	1176.795	0.572	1176.795
0.6000	0.2464	0.263	402.377	2.500	2018.577	0.537	1052.671	0.537	1052.671
0.6500	0.2669	0.273	410.691	2.459	1900.051	0.506	947.329	0.506	947.329
0.7000	0.2874	0.281	417.905	2.421	1797.580	0.478	857.409	0.478	857.409
0.7500	0.3080	0.289	424.206	2.387	1708.430	0.453	780.220	0.453	780.220
0.8000	0.3285	0.296	429.747	2.355	1630.395	0.431	713.596	0.431	713.596
0.8500	0.3490	0.303	434.651	2.326	1561.687	0.410	655.784	0.410	655.784
0.9000	0.3695	0.309	439.018	2.299	1500.846	0.392	605.358	0.392	605.358
0.9500	0.3901	0.315	442.930	2.274	1446.677	0.375	561.153	0.375	561.153
1.0000	0.4106	0.321	446.454	2.251	1398.195	0.359	522.214	0.359	522.214
1.0500	0.4311	0.326	449.646	2.229	1354.586	0.345	487.751	0.345	487.751
1.1000	0.4517	0.331	452.550	2.208	1315.170	0.332	457.110	0.332	457.110
1.1500	0.4722	0.336	455.207	2.189	1279.383	0.320	429.750	0.320	429.750
1.2000	0.4927	0.340	457.647	2.171	1246.750	0.308	405.215	0.308	405.215
1.2500	0.5133	0.345	459.899	2.153	1216.870	0.298	383.124	0.298	383.124
1.3000	0.5338	0.349	461.984	2.137	1189.405	0.288	363.159	0.288	363.159
1.3500	0.5543	0.353	463.923	2.121	1164.067	0.279	345.046	0.279	345.046
1.4000	0.5748	0.357	465.731	2.107	1140.611	0.270	328.556	0.270	328.556
1.4500	0.5954	0.360	467.424	2.092	1118.826	0.262	313.494	0.262	313.494
1.5000	0.6159	0.364	469.013	2.079	1098.530	0.255	299.691	0.255	299.691
1.5500	0.6364	0.367	470.509	2.066	1079.568	0.248	287.002	0.248	287.002
1.6000	0.6570	0.370	471.921	2.054	1061.803	0.241	275.306	0.241	275.306
1.6500	0.6775	0.373	473.258	2.042	1045.118	0.235	264.493	0.235	264.493
1.7000	0.6980	0.376	474.525	2.031	1029.409	0.229	254.471	0.229	254.471
1.7500	0.7186	0.379	475.731	2.020	1014.586	0.223	245.159	0.223	245.159
1.8000	0.7391	0.382	476.879	2.009	1000.568	0.217	236.486	0.217	236.486
1.8500	0.7596	0.385	477.974	1.999	987.287	0.212	228.390	0.212	228.390
1.9000	0.7801	0.388	479.022	1.989	974.678	0.207	220.816	0.207	220.816
1.9500	0.8007	0.390	480.025	1.980	962.688	0.203	213.717	0.203	213.717
2.0000	0.8212	0.393	480.988	1.971	951.266	0.198	207.050	0.198	207.050
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDSME03
Date and time : 26AUG98:21:01
Computation of ref. F: Simple mean, age 4 - 7
F-0.1 factor : 0.5715
F-max factor : Not found
F-0.1 reference F : 0.2347
F-max reference F : Not found
Recruitment : Single recruit

Table 4.20

The SAS System 19:31 Wednesday, August 26, 1998

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

Prediction with management option table: Input data

Year: 1998								
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	36398.000	0.5626	0.0000	0.0000	0.0000	0.235	0.0303	0.740
4	54054.000	0.3125	0.0500	0.0000	0.0000	0.507	0.1499	1.010
5	27430.000	0.2541	0.3000	0.0000	0.0000	0.860	0.3865	1.310
6	19415.000	0.2134	0.5300	0.0000	0.0000	1.206	0.5340	1.530
7	44318.000	0.2000	0.6900	0.0000	0.0000	1.505	0.5720	1.820
8	63825.000	0.2000	0.8100	0.0000	0.0000	1.966	0.4906	2.000
9	12774.000	0.2000	0.9100	0.0000	0.0000	3.155	0.5282	2.250
10	1187.000	0.2000	1.0000	0.0000	0.0000	2.815	0.6373	2.500
11	153.000	0.2000	1.0000	0.0000	0.0000	5.400	0.4625	2.750
12	218.000	0.2000	1.0000	0.0000	0.0000	6.700	0.3111	3.000
13	331.000	0.2000	1.0000	0.0000	0.0000	7.400	0.3261	3.000
14+	771.000	0.2000	1.0000	0.0000	0.0000	8.000	0.3261	3.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	61867.000	0.5626	0.0000	0.0000	0.0000	0.235	0.0303	0.740
4	.	0.3125	0.0500	0.0000	0.0000	0.507	0.1499	1.010
5	.	0.2541	0.3000	0.0000	0.0000	0.860	0.3865	1.310
6	.	0.2134	0.5300	0.0000	0.0000	1.206	0.5340	1.530
7	.	0.2000	0.6900	0.0000	0.0000	1.505	0.5720	1.820
8	.	0.2000	0.8100	0.0000	0.0000	1.966	0.4906	2.000
9	.	0.2000	0.9100	0.0000	0.0000	3.155	0.5282	2.250
10	.	0.2000	1.0000	0.0000	0.0000	2.815	0.6373	2.500
11	.	0.2000	1.0000	0.0000	0.0000	5.400	0.4625	2.750
12	.	0.2000	1.0000	0.0000	0.0000	6.700	0.3111	3.000
13	.	0.2000	1.0000	0.0000	0.0000	7.400	0.3261	3.000
14+	.	0.2000	1.0000	0.0000	0.0000	8.000	0.3261	3.000
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	48000.000	0.5626	0.0000	0.0000	0.0000	0.235	0.0303	0.740
4	.	0.3125	0.0500	0.0000	0.0000	0.507	0.1499	1.010
5	.	0.2541	0.3000	0.0000	0.0000	0.860	0.3865	1.310
6	.	0.2134	0.5300	0.0000	0.0000	1.206	0.5340	1.530
7	.	0.2000	0.6900	0.0000	0.0000	1.505	0.5720	1.820
8	.	0.2000	0.8100	0.0000	0.0000	1.966	0.4906	2.000
9	.	0.2000	0.9100	0.0000	0.0000	3.155	0.5282	2.250
10	.	0.2000	1.0000	0.0000	0.0000	2.815	0.6373	2.500
11	.	0.2000	1.0000	0.0000	0.0000	5.400	0.4625	2.750
12	.	0.2000	1.0000	0.0000	0.0000	6.700	0.3111	3.000
13	.	0.2000	1.0000	0.0000	0.0000	7.400	0.3261	3.000
14+	.	0.2000	1.0000	0.0000	0.0000	8.000	0.3261	3.000
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANSME01
Date and time: 26AUG98:19:46

Table 4.21

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

Prediction with management option table

Year: 1998					Year: 1999					Year: 2000	
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
0.9040	0.3712	329689	219438	110000	0.0000	0.0000	263605	187935	0	278605	212636
.	.	.	.	.	0.0500	0.0205	.	187935	5209	272516	207283
.	.	.	.	.	0.1000	0.0411	.	187935	10295	266580	202069
.	.	.	.	.	0.1500	0.0616	.	187935	15260	260795	196990
.	.	.	.	.	0.2000	0.0821	.	187935	20107	255155	192043
.	.	.	.	.	0.2500	0.1027	.	187935	24840	249659	187224
.	.	.	.	.	0.3000	0.1232	.	187935	29462	244301	182530
.	.	.	.	.	0.3500	0.1437	.	187935	33974	239078	177957
.	.	.	.	.	0.4000	0.1642	.	187935	38381	233987	173503
.	.	.	.	.	0.4500	0.1848	.	187935	42683	229024	169164
.	.	.	.	.	0.5000	0.2053	.	187935	46885	224186	164937
.	.	.	.	.	0.5500	0.2258	.	187935	50989	219470	160819
.	.	.	.	.	0.6000	0.2464	.	187935	54997	214872	156807
.	.	.	.	.	0.6500	0.2669	.	187935	58911	210389	152899
.	.	.	.	.	0.7000	0.2874	.	187935	62733	206019	149092
.	.	.	.	.	0.7500	0.3080	.	187935	66467	201759	145383
.	.	.	.	.	0.8000	0.3285	.	187935	70115	197605	141769
.	.	.	.	.	0.8500	0.3490	.	187935	73677	193555	138249
.	.	.	.	.	0.9000	0.3695	.	187935	77158	189606	134819
.	.	.	.	.	0.9500	0.3901	.	187935	80557	185756	131477
.	.	.	.	.	1.0000	0.4106	.	187935	83879	182001	128222
.	.	.	.	.	1.0500	0.4311	.	187935	87124	178341	125050
.	.	.	.	.	1.1000	0.4517	.	187935	90294	174771	121959
.	.	.	.	.	1.1500	0.4722	.	187935	93392	171291	118948
.	.	.	.	.	1.2000	0.4927	.	187935	96418	167896	116014
.	.	.	.	.	1.2500	0.5133	.	187935	99376	164586	113155
.	.	.	.	.	1.3000	0.5338	.	187935	102266	161359	110369
.	.	.	.	.	1.3500	0.5543	.	187935	105090	158211	107655
.	.	.	.	.	1.4000	0.5748	.	187935	107850	155141	105010
.	.	.	.	.	1.4500	0.5954	.	187935	110547	152147	102433
.	.	.	.	.	1.5000	0.6159	.	187935	113184	149227	99922
.	.	.	.	.	1.5500	0.6364	.	187935	115760	146379	97475
.	.	.	.	.	1.6000	0.6570	.	187935	118279	143601	95090
.	.	.	.	.	1.6500	0.6775	.	187935	120741	140892	92766
.	.	.	.	.	1.7000	0.6980	.	187935	123148	138249	90502
.	.	.	.	.	1.7500	0.7186	.	187935	125501	135671	88295
.	.	.	.	.	1.8000	0.7391	.	187935	127801	133157	86145
.	.	.	.	.	1.8500	0.7596	.	187935	130050	130704	84049
.	.	.	.	.	1.9000	0.7801	.	187935	132248	128311	82007
.	.	.	.	.	1.9500	0.8007	.	187935	134398	125977	80016
.	.	.	.	.	2.0000	0.8212	.	187935	136500	123700	78076
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSME01
Date and time : 26AUG98:19:46
Computation of ref. F: Simple mean, age 4 - 7
Basis for 1998 : TAC constraints

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
1998	0.9040	0.3712	63095	109999	260874	329689	117784	219438	117784	219438
1999	0.2000	0.0821	11079	20107	204353	263606	81964	187936	81964	187936
2000	0.2000	0.0821	10572	20126	186640	255157	77513	192044	77513	192044
2001	0.2000	0.0821	9582	18105	223501	288754	71870	219440	71870	219440
2002	0.2000	0.0821	9133	16340	243041	314926	68150	234372	68150	234372
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
1998	0.9040	0.3712	63095	109999	260874	329689	117784	219438	117784	219438
1999	0.4000	0.1642	21198	38381	204353	263606	81964	187936	81964	187936
2000	0.4000	0.1642	18599	34986	177678	233988	70537	173504	70537	173504
2001	0.4000	0.1642	15962	29288	209120	244234	60081	178409	60081	178409
2002	0.4000	0.1642	14988	25529	225742	251412	53777	174909	53777	174909
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
1998	0.9040	0.3712	63095	109999	260874	329689	117784	219438	117784	219438
1999	0.6000	0.2464	30445	54997	204353	263606	81964	187936	81964	187936
2000	0.6000	0.2464	24623	45730	169522	214873	64230	156808	64230	156808
2001	0.6000	0.2464	20153	35826	197215	208168	50461	145343	50461	145343
2002	0.6000	0.2464	18824	30480	212444	204420	42996	131254	42996	131254
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
1998	0.9040	0.3712	63095	109999	260874	329689	117784	219438	117784	219438
1999	0.8000	0.3285	38904	70115	204353	263606	81964	187936	81964	187936
2000	0.8000	0.3285	29074	53275	162096	197606	58527	141770	58527	141770
2001	0.8000	0.3285	22864	39303	187324	178907	42596	118675	42596	118675
2002	0.8000	0.3285	21431	32987	202124	169525	34869	99140	34869	99140
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
1998	0.9040	0.3712	63095	109999	260874	329689	117784	219438	117784	219438
1999	1.0000	0.4106	46648	83879	204353	263606	81964	187936	81964	187936
2000	1.0000	0.4106	32298	58347	155330	182002	53368	128222	53368	128222
2001	1.0000	0.4106	24587	40806	179078	155129	36154	97147	36154	97147
2002	1.0000	0.4106	23298	34137	194032	143502	28706	75460	28706	75460
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSME02
Date and time : 26AUG98:21:12
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

Table 4.23

The SAS System 10:31 Thursday, August 27, 1998

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

Single option prediction: Detailed tables

Year: 1998	F-factor: 0.9040		Reference F: 0.3712			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	0.0274	753	557	36398	8554	0	0	0	0
4	0.1355	5904	5963	54054	27405	2703	1370	2703	1370
5	0.3494	7196	9426	27430	23590	8229	7077	8229	7077
6	0.4827	6752	10330	19415	23414	10290	12410	10290	12410
7	0.5171	16357	29769	44318	66699	30579	46022	30579	46022
8	0.4435	20875	41749	63825	125480	51698	101639	51698	101639
9	0.4775	4430	9969	12774	40302	11624	36675	11624	36675
10	0.5761	476	1189	1187	3341	1187	3341	1187	3341
11	0.4181	48	131	153	826	153	826	153	826
12	0.2812	49	146	218	1461	218	1461	218	1461
13	0.2948	77	231	331	2449	331	2449	331	2449
14+	0.2948	179	538	771	6168	771	6168	771	6168
Total		63095	109999	260874	329689	117784	219438	117784	219438
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1999	F-factor: 1.0000		Reference F: 0.4106			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	0.0303	1414	1046	61867	14539	0	0	0	0
4	0.1499	2422	2446	20177	10230	1009	511	1009	511
5	0.3865	9856	12911	34535	29700	10361	8910	10361	8910
6	0.5340	5642	8632	15001	18092	7951	9589	7951	9589
7	0.5720	3857	7021	9679	14566	6678	10051	6678	10051
8	0.4906	7665	15330	21635	42534	17524	34453	17524	34453
9	0.5282	12582	28309	33637	105809	30518	96286	30518	96286
10	0.6373	2800	7001	6488	18263	6488	18263	6488	18263
11	0.4625	185	508	546	2950	546	2950	546	2950
12	0.3111	20	60	82	552	82	552	82	552
13	0.3261	34	102	135	997	135	997	135	997
14+	0.3261	170	511	672	5375	672	5375	672	5375
Total		46648	83879	204353	263606	81964	187936	81964	187936
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000	F-factor: 1.0000		Reference F: 0.4106			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	0.0303	1097	812	48000	11280	0	0	0	0
4	0.1499	4104	4145	34195	17337	1710	867	1710	867
5	0.3865	3626	4751	12707	10928	3812	3278	3812	3278
6	0.5340	6845	10472	18199	21948	9646	11633	9646	11633
7	0.5720	2832	5153	7105	10692	4902	7378	4902	7378
8	0.4906	1585	3169	4472	8793	3623	7122	3623	7122
9	0.5282	4069	9155	10845	34216	9869	31136	9869	31136
10	0.6373	6989	17472	16191	45577	16191	45577	16191	45577
11	0.4625	950	2612	2808	15165	2808	15165	2808	15165
12	0.3111	69	206	282	1887	282	1887	282	1887
13	0.3261	13	38	49	366	49	366	49	366
14+	0.3261	121	363	477	3813	477	3813	477	3813
Total		32298	58347	155330	182002	53368	128222	53368	128222
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

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

Single option prediction: Detailed tables

(cont.)

Year: 2001 F-factor: 1.0000 Reference F: 0.4106

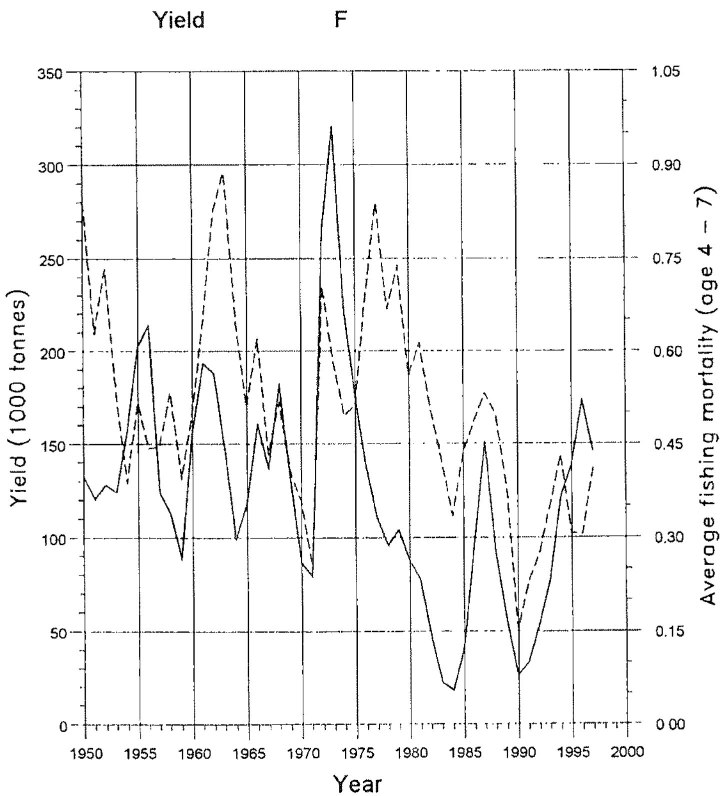
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.0303	2194	1624	96000	22560	0	0	0	0
4	0.1499	3184	3216	26531	13451	1327	673	1327	673
5	0.3865	6146	8051	21535	18520	6461	5556	6461	5556
6	0.5340	2518	3853	6696	8075	3549	4280	3549	4280
7	0.5720	3435	6252	8619	12972	5947	8950	5947	8950
8	0.4906	1163	2326	3283	6454	2659	5228	2659	5228
9	0.5282	841	1892	2242	7073	2040	6437	2040	6437
10	0.6373	2260	5650	5236	14739	5236	14739	5236	14739
11	0.4625	2370	6518	7009	37847	7009	37847	7009	37847
12	0.3111	353	1058	1448	9701	1448	9701	1448	9701
13	0.3261	43	129	169	1250	169	1250	169	1250
14+	0.3261	79	236	311	2487	311	2487	311	2487
Total		24587	40806	179078	155129	36154	97147	36154	97147
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 1.0000 Reference F: 0.4106

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	0.0303	2194	1624	96000	22560	0	0	0	0
4	0.1499	6368	6432	53061	26902	2653	1345	2653	1345
5	0.3865	4768	6247	16708	14369	5012	4311	5012	4311
6	0.5340	4268	6530	11349	13686	6015	7254	6015	7254
7	0.5720	1264	2300	3171	4773	2188	3293	2188	3293
8	0.4906	1411	2822	3983	7830	3226	6342	3226	6342
9	0.5282	617	1389	1646	5192	1498	4725	1498	4725
10	0.6373	467	1168	1082	3047	1082	3047	1082	3047
11	0.4625	766	2108	2266	12239	2266	12239	2266	12239
12	0.3111	880	2640	3613	24210	3613	24210	3613	24210
13	0.3261	220	661	869	6427	869	6427	869	6427
14+	0.3261	72	216	284	2268	284	2268	284	2268
Total		23298	34137	194032	143502	28706	75460	28706	75460
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSME02
Date and time : 27AUG98:10:33
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

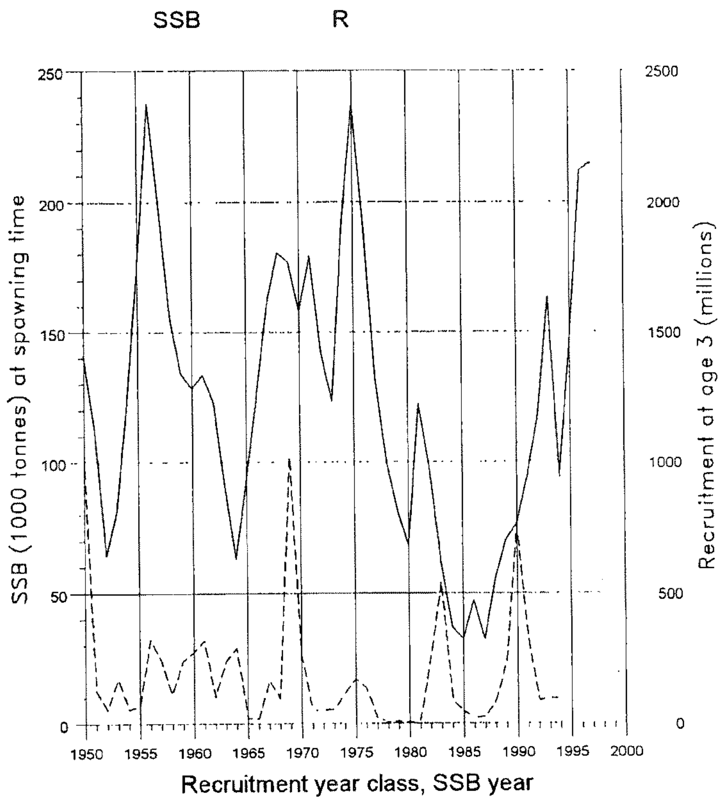
Yield and fishing mortality



(run: SVPTJA01) A

Figure 4.1.a,b

Spawning stock and recruitment

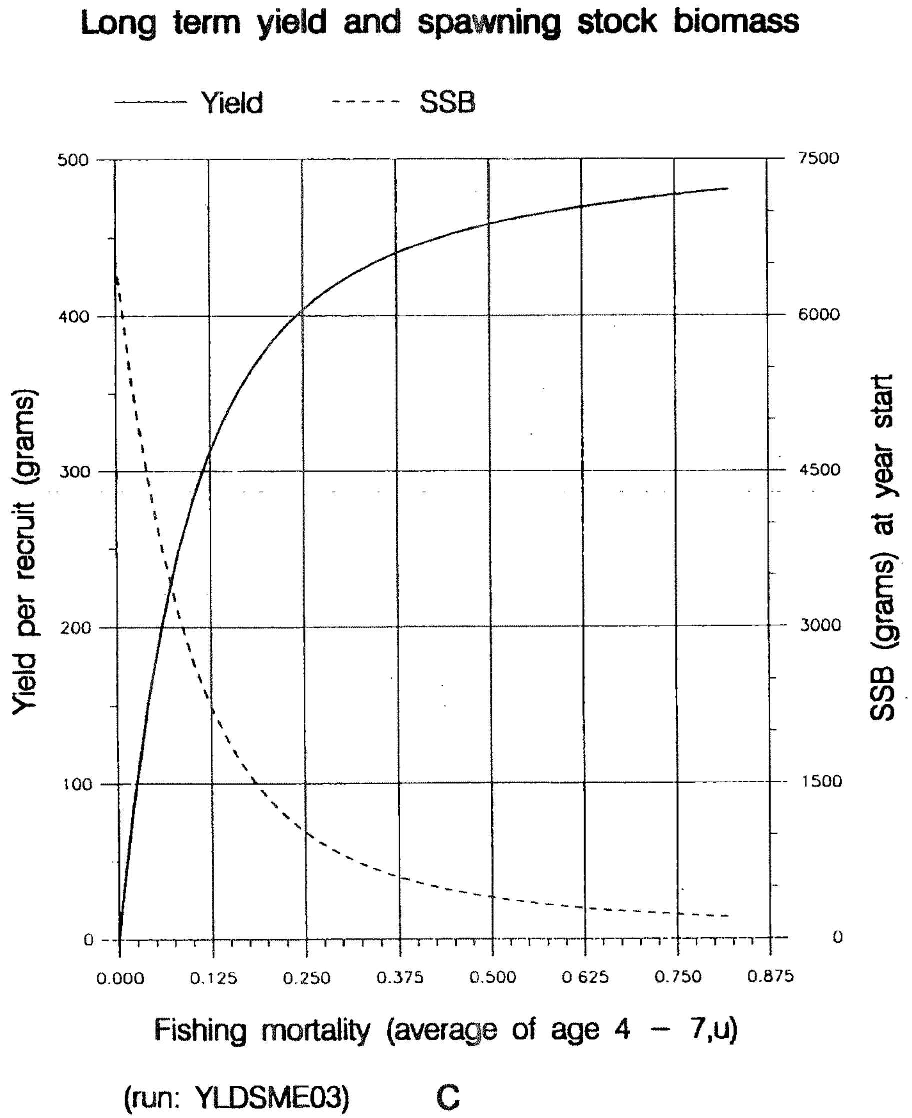


(run: SVPTJA01) B

Fig. 4.1AB

Figure 4.1 C,D

Fish Stock Summary
Haddock in the North–East Arctic (Areas I and II)
26–8–1998



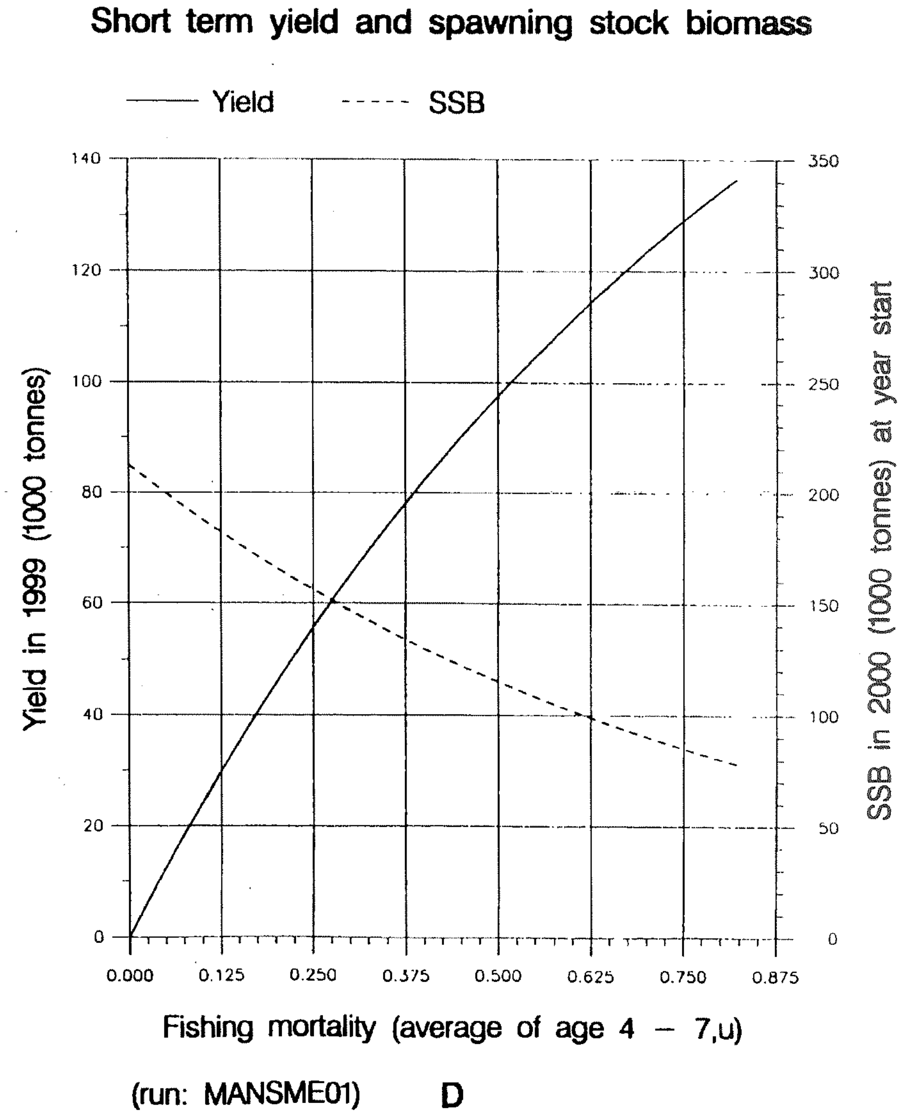
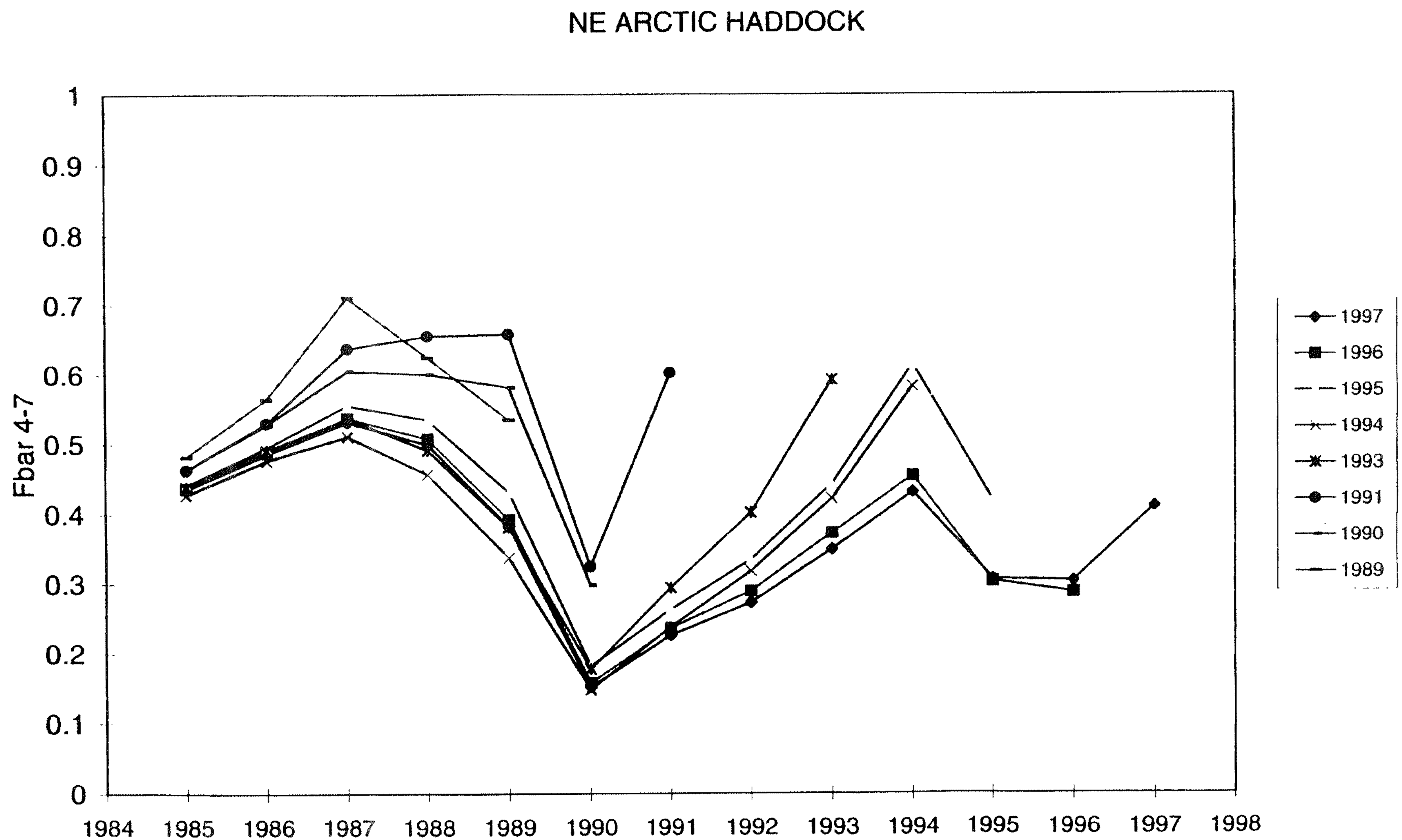


Figure 4.2



G:\ACFM\AFWG\HAD_ARCT\ * q<6 Chart 2

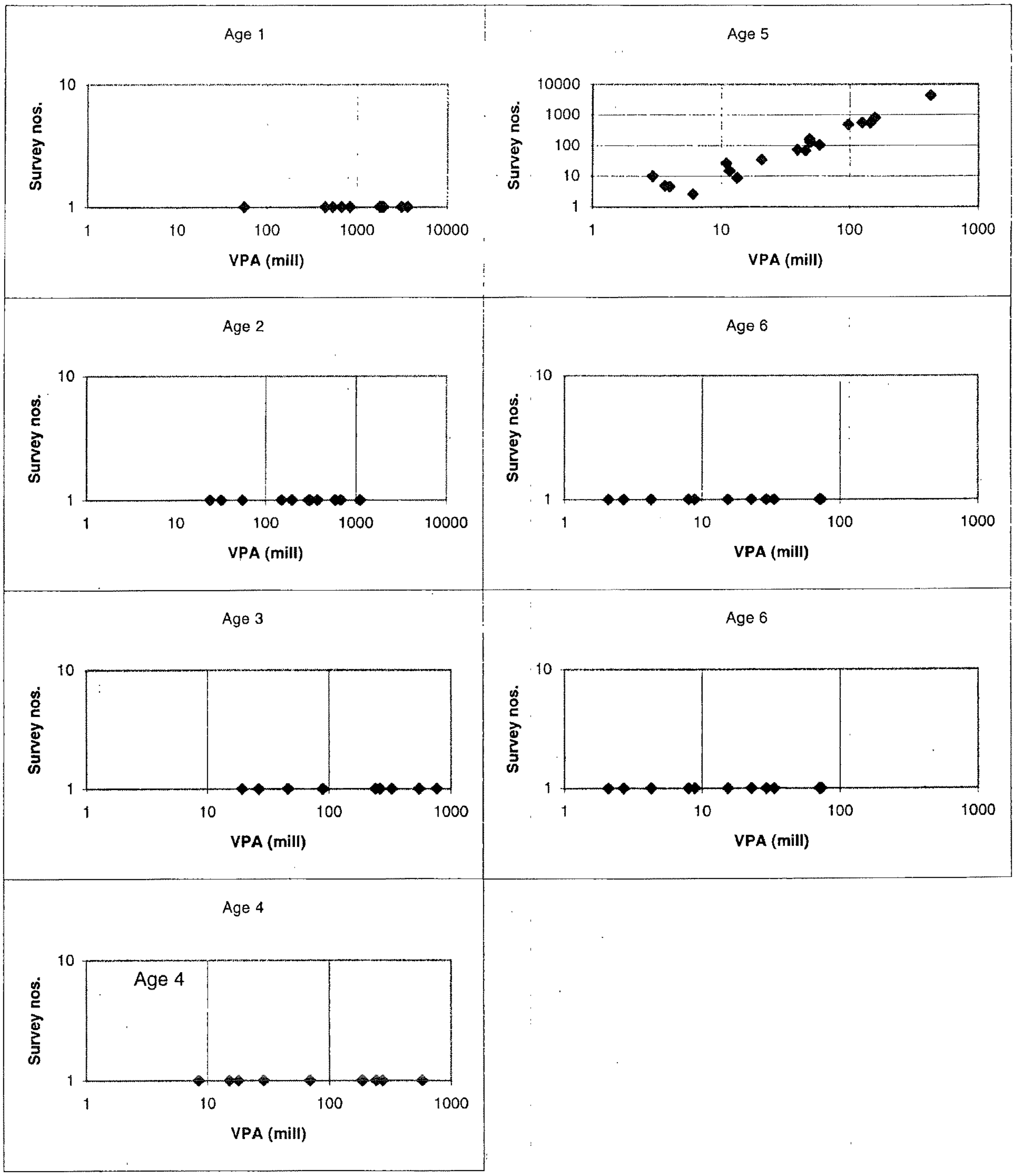
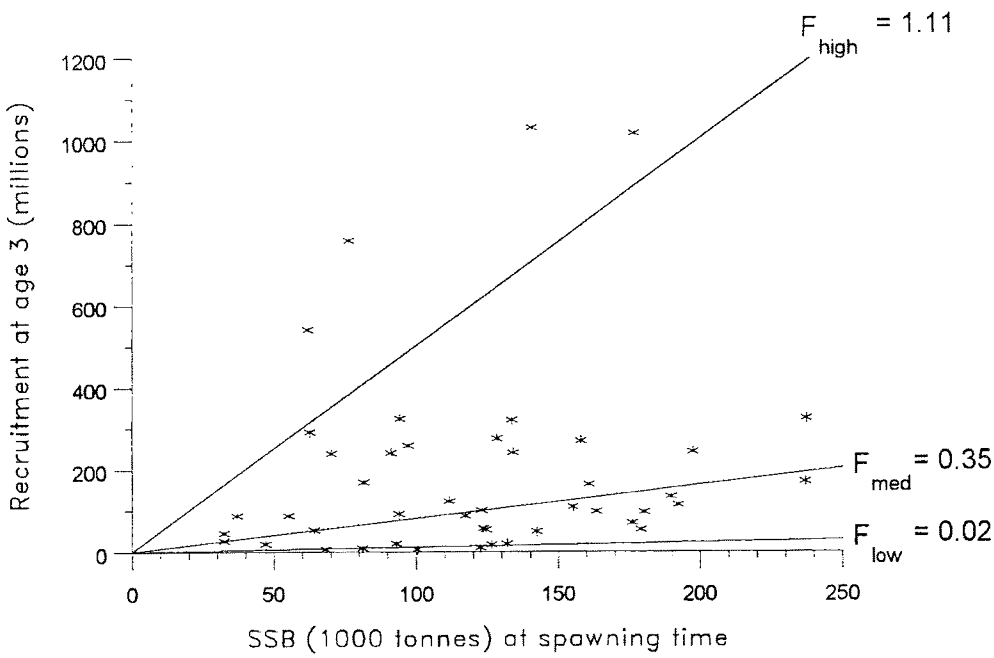


Figure 4.3 NE Arctic Haddock abundance index from the Russian acoustic survey plotted again VPA results on stock number at age

F-4-3.XLS

Stock - Recruitment



(run: SVPTJA01)

Figure 4.4

Table B1 North-East Arctic HADDOCK. Results from the Norwegian bottom trawl survey in the Barents Sea in January-March. Index of number of fish at age. Backcalculated from bobbins gear to rockhopper gear. Corrected for length dependent effective spread of the trawl.

Year	Age								Total
	1	2	3	4	5	6	7	8	
1981	3.1	7.3	2.3	7.8	1.8	5.3	0.5	0.2	28.3
1982	3.9	1.5	1.7	1.8	1.9	4.8	2.4	0.2	18.2
1983	2776.8	6.6	2.7	2.7	1.3	1.3	2.8	1.3	2795.3
1984	5382.0	683.4	14.9	1.6	0.7	0.2	0.3	0.3	6083.3
1985	1421.2	1362.2	384.8	6.3	0.4	0.2	0.3	0.3	3175.5
1986	649.0	360.2	339.8	126.8	4.5	0.5	0.1	0.1	1480.9
1987	134.3	95.2	174.1	272.3	50.6	0.1	2.0	0.0	728.5
1988	44.6	16.1	28.8	67.4	110.7	15.7	0.2	0.0	283.6
1989	80.8	7.0	9.0	15.4	26.9	27.4	2.9	0.0	169.5
1990	555.4	51.4	4.1	3.4	5.2	9.4	12.1	1.7	642.8
1991	1526.0	420.9	72.4	12.6	3.1	2.4	3.0	5.6	2046.0
1992	1282.2	1191.2	283.5	59.9	4.1	0.9	1.3	5.1	2828.3
1993[1]	717.5	585.1	467.8	105.6	10.3	0.5	0.5	2.2	1889.5
1994[1]	587.5	200.3	296.0	448.2	50.8	3.2	0.2	1.1	1587.3
1995[1]	1271.8	182.0	42.6	153.4	341.6	31.3	2.0	0.5	2025.3
1996[1]	312.7	265.9	53.2	48.9	149.4	255.9	11.6	1.0	1098.5
1997[1,2]	1140.6	72.0	124.6	36.4	18.7	47.4	49.4	3.7	1493.2
1998[1,2]	190.9	149.5	30.4	38.6	12.7	3.6	7.2	7.8	441.3

[1] Extended survey area.
[2] Adjusted indices.

Table B2 North-East Arctic HADDOCK. Results from the Russian trawl survey in the Barents Sea and adjacent waters in November-December (numbers per hour trawling).

Year	Age										Older	Total
	0	1	2	3	4	5	6	7	8	9		
					Sub-area I							
1983	39.9	97.3	16.5	0.8	0.7	+					1.1	156.3
1984	9.7	100.2	110.6	2.8	0.4	0.2	+				0.7	224.6
1985	3.9	19.1	213.4	168.8	0.8	0.2	0.1	-			0.3	406.6
1986	0.2	2.3	16.6	58.1	27.6	0.1	+	+	+		-	105.0
1987	0.4	1.4	2.5	12.5	34.2	8.6	+	+	-	+	-	59.8
1988	1.9	0.4	1.1	2.8	6.2	11.6	1.1	+	+	+	-	25.2
1989	3.3	3.0	3.6	0.7	2.5	7.1	13.9	1.8	0.1	+	-	36.0
1990	71.7	22.2	18.6	13.2	7.5	13.2	13.3	10.3	0.6	0.1	-	170.7
1991	15.9	61.5	27.5	10.8	1.6	0.6	1.0	3.3	2.6	0.3	-	125.1
1992	19.6	44.2	180.6	52.1	8.4	0.7	1.0	1.6	1.3	0.2	-	309.7
1993	5.5	8.1	69.2	371.5	78.4	10.2	1.4	0.7	0.8	1.8	-	547.7
1994	13.5	6.7	8.0	65.9	146.0	15.9	1.7	0.1	0.2	0.7	-	258.8
1995	9.9	12.7	6.5	4.0	26.8	77.6	7.3	1.0	0.1	0.5	-	146.3
1996	5.0	3.1	5.6	3.4	7.7	62.3	56.5	4.8	0.4	0.6	-	149.3
1997[1]	2.7	6.9	3.2	5.3	5.5	1.5	4.5	1.7	1.5	-	-	32.7
					Division IIa							
1983	5.4	5.5	0.1	0.2	0.3	0.1					1.0	12.6
1984	4.9	14.4	5.6	0.1	0.1	0.1	-				0.2	25.4
1985	3.8	7.0	11.7	4.1	0.1	-	+	-			0.1	26.8
1986	0.4	0.3	3.5	10.4	2.9	0.1	+	+	-		-	17.6
1987	-	-	-	-	0.3	0.3	-	-	-	-	-	0.6
1988	1.0	0.1	-	+	0.2	0.5	0.2	-	-	-	-	2.1
1989	0.1	0.7	2.7	+	0.1	0.1	0.1	-	-	-	-	3.8
1990	6.1	0.9	0.9	0.1	0.1	0.1	0.1	0.1	-	-	-	8.4
1991	5.7	3.8	0.6	0.1	+	-	-	-	-	-	-	10.2
1992	1.2	2.3	5.6	2.3	3.0	0.3	0.3	0.4	0.4	-	-	15.9
1993	1.8	1.1	1.5	4.5	2.5	0.8	0.2	0.1	0.2	0.2	-	12.8
1994	1.0	0.6	0.5	3.1	15.9	4.4	1.5	+	0.1	0.1	-	27.2
1995	5.0	8.5	6.3	5.3	6.2	23.9	4.1	0.6	+	0.2	-	60.1
1996	29.2	4.1	25.0	8.1	4.9	9.1	13.4	1.3	0.4	0.1	-	95.7
1997	1.2	2.8	0.8	1.3	0.7	0.6	0.9	0.5	0.1	-	-	8.9

Cont'd

Table B2 (Continued)

Year	Age 0	1	2	3	4	5	6	7	8	9	Older	Total
						Division IIb						
1983	22.1	9.9	0.2	0.1	+	+					0.1	32.4
1984	2.2	14.3	1.8	-	-	-	-				+	18.3
1985	1.4	10.2	61.4	5.1	+	+	+	-			+	78.1
1986	+	0.2	3.1	7.2	1.4	-	-	+	+		-	12.0
1987	-	-	0.1	0.7	1.4	0.5	+	-	-	-	-	2.8
1988	0.2	-	-	+	0.3	1.1	0.2	-	+	-	-	1.9
1989	0.7	0.1	0.2	+	0.1	0.3	0.6	0.1	+	-	-	2.1
1990	12.9	5.4	0.8	+	+	0.2	0.1	0.1	+	-	-	19.5
1991	20.0	22.9	6.2	0.4	0.1	0.1	0.1	+	+	-	-	49.8
1992	13.3	9.1	69.8	13.9	0.5	+	+	0	+	+	-	106.6
1993	0.7	0.9	1.9	24.7	1.9	0.2	+	+	+	+	-	30.4
1994	0.4	1.7	1.7	2.3	15.7	2.7	0.8	0.2	+	+	-	25.5
1995	0.1	0.4	0.4	0.8	0.6	1.6	0.4	+	+	+	-	4.4
1996[1]	4.3	0.6	0.5	0.3	0.2	0.4	0.5	0.3	-	-	-	4.1
1997	0.4	1.1	0.1	0.1	0.1	0.1	0.1	0.1	+	+	-	2.1
						Total - Sub-area I and Divisions IIa and IIb						
1983	29.8	59.2	9.5	0.5	0.4	+					0.8	100.2
1984	6.4	58.6	58.4	1.5	0.2	0.1	+				0.3	125.5
1985	3.0	14.4	134.3	90.0	0.4	0.1	0.1	-			0.2	242.7
1986	0.2	1.4	10.7	36.3	16.4	0.1	+	+	+		+	65.1
1987	0.3	0.9	1.7	8.3	22.5	5.7	+	+	-	+	-	39.4
1988	1.3	0.3	0.7	1.7	4.0	7.6	0.8	+	+	+	-	16.4
1989	2.2	1.8	2.4	0.4	1.4	4.1	8.1	1.1	0.1	+	-	21.6
1990	44.8	14.3	10.6	7.3	4.2	7.3	7.4	5.7	0.3	0.1	-	102.0
1991	16.7	42.9	17.6	6.2	0.9	0.3	0.6	1.8	1.5	0.2	-	88.7
1992	16.4	28.2	128.6	34.6	5.0	0.4	0.6	0.9	0.8	0.1	-	215.6
1993	3.5	4.8	35.7	198.5	35.6	4.8	0.8	0.4	0.4	-	-	285.3
1994	9.1	4.9	5.8	44.2	101.4	11.6	1.5	0.1	0.1	0.5	-	179.1
1995	6.4	7.2	4.2	3.1	12.3	37.0	4.0	0.5	0.1	0.3	-	73.9
1996[1]	6.0	2.3	5.7	2.8	4.9	36.2	33.4	2.9	0.3	0.3	-	94.8
1997[1]	1.8	4.6	1.9	3.2	3.2	1.0	2.7	1.0	0.8	-	-	20.2

[1] Adjusted data based on average 1985-1995 distribution.

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Table B3 North-East Arctic HADDOCK. Results from the Norwegian acoustic survey in the Barents Sea in January-March. Stock numbers in millions. New TS and rock-hopper gear (1981-1988 back-calculated from bobbins gear). Corrected for length dependent effective spread of the trawl.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	7	14	5	21	60	18	1	+	+	+	125
1982	9	2	3	4	4	10	6	+	+	+	38
1983	0	5	2	3	1	1	4	2	+	+	18
1984	1685	173	6	2	1	+	+	+	+	+	1866
1985	1809	839	274	6	+	+	+	1	+	+	2928
1986	680	312	488	162	+	+	+	+	+	+	1644
1987	111	26	71	190	47	+	+	+	0	+	446
1988	20	5	8	20	38	6	+	+	0	+	97
1989	58	6	8	10	17	19	2	+	0	+	119
1990	493	44	4	3	4	7	11	1	+	+	568
1991	1938	265	49	7	2	2	2	4	+	0	2269
1992	859	685	110	19	2	+	+	1	2	+	1714
1993	1424	690	565	99	10	+	+	1	+	2	2790
1994	848	228	240	506	77	8	+	+	+	+	1908
1995	1380	285	36	113	391	40	2	+	+	1	2247
1996	249	229	44	31	76	150	8	1	0	+	788
1997[1]	779	32	60	20	14	49	46	3	0	+	1002
1998[1]	246	156	23	33	14	6	12	16	1	+	505

[1]Adjusted indices

Table B4 North-East Arctic HADDOCK. Results from the Russian trawl acoustic survey in the Barents Sea and adjacent waters in the autumn 1985-1996. Index of number of fish at age.

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

[1]October-December.
[2]September-October.

Table B5 North-East Arctic HADDOCK. Length data (cm) from Norwegian surveys in January-March and Russian surveys in November-December.

Year	Age									
	1	2	3	4	5	6	7	8	9	10
1987	13.9	21.6	30.2	39.2	47.0	62.5	-	-	-	-
1988	13.5	24.3	29.3	36.2	42.7	50.1	56.6	-	-	-
1989	16.3	22.5	32.0	36.8	43.0	47.3	53.6	-	-	-
1990	16.3	24.9	33.8	44.2	46.9	50.7	53.0	-	-	-
1991	16.9	25.0	37.0	42.7	54.3	55.2	53.8	56.8	63.7	-
1992	15.6	25.4	36.5	45.9	53.9	61.6	62.9	59.8	66.9	77.5
1993	14.4	21.8	32.2	42.6	50.6	58.4	57.9	-	-	-
1994	14.8	21.5	29.7	38.7	47.4	54.2	57.4	-	-	-
1995	15.4	19.9	27.9	34.0	42.6	51.3	55.9	-	-	-
1996	15.4	21.6	28.6	38.0	42.1	46.8	55.3	-	-	-
1997[1]	16.1	21.4	27.6	36.6	40.4	47.7	50.4	-	-	-
1998[1]	14.4	23.5	29.1	38.2	42.8	48.7	51.4	-	-	-
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+
1984	-	24.1	35.8	44.4	56.4	62.8	64.8	-	-	-
1985	16.5	22.4	30.9	44.1	53.8	61.3	64.7	-	-	-
1986	17.0	20.7	28.1	35.4	46.7	62.0	-	68.0	-	-
1987	12.1	21.5	27.8	32.3	37.3	48.6	-	-	-	-
1988	13.7	23.2	29.7	33.7	39.3	46.2	51.2	-	-	-
1989	14.9	22.2	26.5	38.5	44.5	49.3	53.0	57.7	64.1	-
1990	17.0	24.5	30.9	40.4	50.6	53.2	55.7	59.7	63.8	67.7
1991	17.2	24.2	30.5	39.7	53.4	55.4	58.3	60.5	62.7	70.2
1992	16.0	22.8	31.1	44.6	53.8	63.8	61.2	66.4	69.0	69.6
1993	15.3	21.7	28.7	38.3	48.3	54.3	60.9	64.2	63.2	65.0
1994	15.7	22.5	28.1	33.0	44.1	54.9	61.5	67.5	67.7	67.8
1995	15.5	22.5	28.5	33.3	39.7	49.9	58.2	63.1	66.3	69.5
1996[2]	15.8	22.8	28.4	33.7	42.0	48.7	54.8	63.4	69.3	72.0
1997[2]	13.8	23.5	29.3	36.1	45.3	50.0	54.6	58.9	69.4	66.0

[1] Adjusted lengths to account for limited coverage.
[2] Limited coverage

Table B6 North-East Arctic HADDOCK. Weight data (g) from Norwegian surveys in January-March and Russian surveys in November-December.

Year	Age										
	1	2	3	4	5	6	7	8	9	10	
1987	24	91	273	542	934	2,197	-	-	-	-	
1988	25	120	350	450	730	1,140	1,560	-	-	-	
1989	40	100	320	490	780	1,040	1,440	-	-	-	
1990	42	148	370	827	988	1,247	1,425	-	-	-	
1991	40	140	490	840	1,630	1,710	1,600	1,860	2,480	-	
1992	30	150	450	940	1,510	2,280	2,510	2,170	2,980	4,870	
1993	27	98	329	788	1,331	2,030	2,324	-	-	-	
1994	25	91	251	555	1,026	1,578	1,813	-	-	-	
1995	30	71	207	374	750	1,278	1,650	-	-	-	
1996	30	92	224	557	745	1,017	1,783	-	-	-	
1997[1]	35	91	200	469	650	1,076	1,327	-	-	-	
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
1984	36	127	438	815	1,777	2,395	2,688	-	-	-	-
1985	37	105	282	817	1,530	2,262	2,263	-	-	-	-
1986	38	88	209	419	919	2,240	-	3,100	-	-	-
1987	-	95	196	330	497	1,055	-	-	-	-	-
1988	35	106	248	398	627	997	1,431	-	-	-	-
1989	52	105	181	606	903	1,287	1,587	2,004	2,716	-	-
1990	62	143	288	667	1,337	1,533	1,778	2,233	2,731	3,092	-
1991	57	133	292	690	1,570	1,863	2,206	2,320	2,568	3,525	-
1992	40	108	279	850	1,542	2,199	2,363	3,045	3,391	3,400	4,200
1993	31	96	217	535	1,077	1,493	2,094	2,509	2,374	2,621	3,160
1994	27	106	205	337	841	1,602	2,256	2,913	2,934	3,033	3,163
1995	28	95	196	345	628	1,234	1,908	2,430	2,815	3,323	3,479
1996	30	103	209	347	743	1,152	1,650	2,442	3,218	3,333	4,648

[1] Adjusted weights.

5 NORTHEAST ARCTIC SAITHE (SUB-AREAS I AND II)

5.1 Status of the Fishery

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

Since the early 1960s the fishery has been dominated by purse seine and trawl fisheries, usually accounting for about 75% of the landings (Table 5.2). A traditional gill net fishery for spawning saithe accounts for about 15%. The remaining catches are by-catches or from mixed fisheries. Catches declined sharply after 1976 (Table 5.1). This was partly caused by the introduction of national economical zones in 1977. The stock was accepted as exclusively Norwegian and quota restrictions were put on fishing by other countries while the Norwegian fishery for some years remained unrestricted. However, in recent years the purse seine and trawl fisheries have been regulated by quotas where account has been taken of expected landings from other gears. Quotas can be transferred between purse seine and trawl fisheries if the quota allocated to one of the gears will not be taken. The target set for the total landings has generally been consistent with the scientific recommendations. Norway presently accounts for about 95% of the landings.

The purse seine fishery is based on schools of immature saithe in coastal areas and fjords. The trawlers operate on the coastal banks and catch both immature and mature fish. Over the years purse seiners and trawlers have taken roughly equal shares of the catches. In the recent years, trawlers have taken a bigger share while purse seine landings have declined. Thus, the purse seine landings were only about 20% of the total in 1992–1995, whereas, trawl landings accounted for more than half of the total. The decline in purse seine landings appears to have been caused predominantly by changing market conditions. However, purse seine landings in 1996 and 1997 more than doubled and made up 27 and 30%, respectively, of the total, while trawl landings had a corresponding decline and made up around 40% in 1996 and only 34% of the total in 1997.

5.1.2 Landings prior to 1998 (Table 5.1, Figure 5.1A)

Landings of saithe were highest from 1970–1976 with an average of 238,000 t and a maximum of 265,000 t in 1970. This was followed by a sharp decline to a level of about 160,000 t in the years 1978–1984. Another decline followed and from 1985 to 1991 the landings ranged from 67,000–122,000 t (Table 5.1). An increasing trend is seen after 1990 to 171,498 t in 1996. It has been an aim for the managers to reduce the exploitation rate to a sustainable level and the TAC for 1997 was set at 125,000 t. Provisional reports of landings in 1997 indicate, however, an overfishing to a total of 143,355 t, but which was close to 140,000 t expected by last years Working Group.

5.1.3 Expected landings in 1998

Norwegian authorities set quotas for other countries and for Norwegian conventional (of which gillnet is the most important), purse seine and trawl fisheries. The goal for 1998 was to limit Norwegian landings to 118,500 t (similar to 1997). In addition, about 6,500 t can be expected from other countries, giving a target of 125,000 t for the total fishery. Due to a request from the Norwegian Ministry of Fisheries the Institute of Marine Research (IMR) conducted an inter-sessional stock assessment on Northeast Arctic saithe in April 1998 (Anon. 1998). The reason behind the request was several reports from Norwegian fishermen about great abundance of saithe with extremely good catchabilities suggesting that the previous assessment was underestimating the stock and that the quotas had been set too low. Based on this assessment IMR advised the catch for 1998 not to exceed 150,000 t. Norwegian authorities increased the TAC for the Norwegian fishery to 137,500 t, giving a total TAC of 144,000 t for 1998. However, there is basis for assuming overfishing of about 2,500 t in the Norwegian saithe fishery in 1998 and the total catch is expected to be approximately 146,500 t (about 3,000 t more than in 1997).

5.2 Status of Research

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

Table C1 shows the number of vessels of different size categories which have taken part in the purse seine fishery since 1977, with corresponding catches and catch per vessel. On the basis of these data, indices of fishing effort were calculated. The unit of effort is the number of vessels of 20–24.9 m length. This category has in recent years accounted for approximately half of the purse seine landings, decreasing to 35–45% in the three last years, 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 1997 fishing effort increased by nearly 40% (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 maximum recorded level in 1995, and then decreased by more than 60% towards 1997 to the lowest effort during the last ten years. Quota regulations and rather good availability of saithe explain this reduction.

Catches from purse seine and trawl fisheries have historically been of the same magnitude. The fleets can therefore be assumed to have represented roughly equal shares of the effort and together they account for a relatively stable proportion of the total landings. Using 1977–1990 as a reference period and multiplying the trawl indices by 2.75 raises them to the same level as the purse seine indices. The indices were then added to give a combined effort index which should reflect the main trends in total effort (Table C3). From 1992 to 1995 the total effort increased with more than 50%, while it decreased by more than 40% from 1995 to 1997.

5.2.2 Survey results (Tables C4)

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

Since 1995 a Norwegian acoustic survey specially designed for coastal cod has been conducted along the coast and in the fjords from Varanger to Stad in September just prior to the saithe survey described above. This survey covers coastal areas not included in the regular saithe survey, and since saithe also is acoustically registered, this survey may thus provide supplementary information, especially about the 2- and 3 year old saithe which have not migrated out to the banks. Results from the coastal cod survey from the areas not overlapping with the saithe survey are shown in Table C5. The time series are too short to be used for tuning.

5.3 Data used in the Assessment

5.3.1 Catch numbers at Age (Table 5.6)

The age composition of Norwegian landings in 1996 was revised, resulting in a rather extensive increase in numbers caught (almost 20 million specimens) due to a revised allocation of biological samples to the landings. This revision first of all led to more 4 year olds (1992-year class) in the catches. Age composition data for 1997 was available from Norway and Germany, accounting for 97% of the landings. A Russian length composition was also available, and was applied on the Russian landings together with an age-length-key from the Norwegian trawl landings. Other countries were assumed to have the same age composition as Norwegian trawlers.

5.3.2 Weight at Age (Tables 5.7)

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

5.3.3 Natural mortality

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

5.3.4 Maturity at age (Table 5.13)

Traditionally, knife-edge maturity at age 6 has been used for this stock. In 1995, the data on spawning zones recorded in otoliths in Norway were investigated. There was no evidence of change in maturation rates over the period in the assessment and it was decided to use the same ogive for all years. This ogive, given in Table 5.13, 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.

5.3.5 Tuning data (Table 5.3)

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

5.3.6 Recruitment indices

Reliable recruitment indices are crucial for the predictions. Attempts at establishing year class strength at age 0 or 1 have so far failed. Acoustic survey data show promise for improving the estimate of year class strength at age 2, although there are conflicting results between the catch and survey data in recent years, especially in 1995 (i.e., the 1993-year class). It may vary from year to year to what extent the two year old saithe have migrated out from the near coast areas and are available for the acoustic saithe survey on the banks.

5.3.7 Prediction data (Tables 5.13–14)

The input data to the prediction are given in Table 5.14. The stock number at age in 1998 was taken from the XSA for age 5 and older. The recruitment at age 2 and 3 in 1997 (1994 and 1995 year classes) was estimated using RCT3 (Section 5.5.2). The corresponding numbers at age 3 and 4 in 1998 was calculated applying a natural mortality of 0.2 and fishing mortalities according to the catches taken of these year classes. The long-term geometric mean recruitment of 210 million was used for the 1996 and subsequent year classes. The natural mortality and the maturity ogive are the same as used in the assessment. For the exploitation pattern the average of 1995–1997 has been used, scaled to the 1997 level. For weight-at-age in the catch and stock, the average weight at age for the last three years in the VPA has been used (Table 5.13).

5.4 Methods used in the Assessment

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

Extended Survivors Analysis (XSA) was used for the assessment with the same settings as last year. Catchability was assumed to be independent of stock size for all ages. The tuning diagnostics are given in Table 5.5. Figures 5.2A-C shows plots of the tuning indices versus stock numbers from the VPA. Trial runs showed that changes made to the input data gave a higher estimate of the 1992 year class.

5.4.2 Recruitment (Table 5.4)

Estimates of the recruiting year classes up to the 1993 year class from the XSA were accepted. The 1994 and 1995 year classes were poorly represented both in the Norwegian acoustic surveys and in the purse seine fishery at age 2 in 1996 and 1997. RCT3-runs were therefore conducted to estimate these year classes, with 2 and 3 year olds from the survey as input for the estimation of the 1995 and 1994 year classes, respectively (Table 5.4). The 1992 year class comes out strong both in the surveys and in the landings. The strength of the 1993 year class, however, is uncertain in the current assessment. It has so far been weakly represented as 2–4 year olds in the landings (Table 5.3), as well as 5 year olds in preliminary catch data for 1998, but comes out as above average in the survey.

5.5 Results of the Assessment

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

The fishing mortality (F_{3-6}) in 1997 was 0.38 which is somewhat lower than the value of 0.41 expected last year (Figure 5.3A). Using the RCT3 estimation of the 1994 year class would give a fishing mortality (F_{3-6}) in 1997 of about 0.36.

The XSA-estimates of the 1994–1996 year classes are not considered to be valid and these estimates are therefore put in brackets (Tables 5.9–10). In Table 5.13 the long-term average recruitment and recalculated total biomass are presented. The 1989–1991 year classes are still abundant, and the 1992 year class is well represented in the catches, though it seems to be a little weaker than the 1989 year class.

The SOP corrected stock biomass tables are included (Tables 5.10–5.12). There are considerable SOP discrepancies in the early part of the time series which are caused by the fixed weights in the data base prior to 1980. SOP correction should therefore give better estimates of biomass, but it is not advisable to recalculate the weights on this basis because they could be interpreted as observed values.

5.5.2 Recruitment (Tables 5.4, 5.9, 5.12)

The XSA estimates of the 1993 year classes at age 2 is 113 million individuals (Table 5.9). Using 3 year olds as input to the RCT3 and backcalculating the strength as 2 year olds when knowing the catches and the natural mortality, gave 236 million individuals for the 1993 year class. Hence, whether we believe more in the XSA or the survey regarding the size of the 1993 year class will have considerable impact on the current stock size and the projections. The RCT3 estimate (with 3 year olds as input and backcalculating the strength as 2 year olds) of the 1994 year class gives 153 million individuals, while the RCT3 estimates (with 2 year olds as input) of the 1995 year class is 143 million individuals. It was decided to use these estimates and the long-term geometric mean of 210 million individuals for the 1996 and subsequent year classes.

5.6 Reference points and safe biological limits (Figures 5.4 and 5.1C, Table 5.15)

5.6.1 Biomass reference points

In 1995 MBAL for Northeast Arctic saithe was set at 170,000 t. (ICES 1996/Assess:4). The stock and recruitment plot (Figure 5.4) shows that 65% of the year classes less than the long-term geometric mean of 210 millions have been produced by spawning stocks below 200,000 t. Almost 70% of the year classes above the long-term geometric mean are produced by spawning stocks well above 200,000 t. The new reference point B_{pa} is supposed to ensure a high probability of avoiding reducing the SSB to a point at which the probability of recruitment failure is high. It is suggested to set B_{pa} = MBAL. The WG therefore finds 200,000 t to be a more appropriate MBAL than 170,000 t.

5.6.2 Fishing mortality reference points

Yield and SSB per recruit were based on the parameters in Table 5.14 and are presented in Table 5.15. $F_{0.1}$ was estimated to be 0.08 which is slightly lower than the value of 0.10 obtained last year. F_{max} was estimated as 0.14 (Figure 5.1C) which is also lower than the result from last year (0.18). The plot of SSB versus recruitment is shown in Figure 5.4. F_{low}, F_{med} and F_{high} were estimated as 0.17, 0.32 and 0.58, respectively, which are also somewhat lower than the estimates from last year (0.21, 0.36 and 0.62). These changes may be caused by changes in exploitation pattern and growth.

The Comprehensive Fishery Evaluation Working Group (ICES 1996/Assess:20) suggested a $F_{comfie} = \min\{F_{med}, F_{MSY}, F_{max}\}$. F_{MSY} for saithe was not estimated by the present WG. Since F_{MSY} is commonly less than F_{max}, the latter should be considered an upper bound on fishing mortality in absence of data on F_{MSY} (Anon. *op. cit.*). F_{max} for saithe is presently 0.14, which means that there is a large potential for increased yields by lowering the fishing mortality from $F_{status\ quo}$ (0.38) to F_{max} (0.14) (Figure 5.1C). The SGPAFM (ICES 1998/ACFM:10) has suggested a limit reference point, $F_{lim} = F_{med}$ for Northeast Arctic saithe. A F_{pa} is defined as $F_{pa} = F_{lim} \cdot e^{-1.654\ \sigma}$ (σ is set to 0.2 for saithe and is a measure of uncertainty in the total F estimate, normally 0.2–0.3). This gives $F_{pa} = 0.23$, which is also suggested as an upper bound on fishing mortality rate for saithe to be used by ACFM when providing advice.

5.7 Catch options for 1999 (short term predictions) (Table 5.15)

The management option table (Table 5.15) shows that the expected catch of 146,500 t in 1998 will increase fishing mortality from F_{97} (*status quo*) of 0.38 to 0.43. The *status quo* catch in 1999 is 117,000 t compared to a catch at F_{med} of 102,000 t. SSB will decrease to 170,000 t (MBAL) at the beginning of 1999 and will continue to decrease in 1999 if fishing mortalities are above 0.29. A *status quo* catch in 1999 would reduce the SSB to 150,000 t at the beginning of 2000. The F_{max} catch for 1999 is 50,000 t, and the corresponding SSB in 2000 would be 214,000 t., while the proposed $F_{pa} = 0.23$ will give a catch of 78,000 t in 1999 and a SSB of 187,000 t in 2000.

5.8 Medium-term forecasts and management scenarios (Tables 5.17–5.19, Figures 5.1D, 5.5A-F, 5.6A-F, 5.7A-B, 5.8A-B)

5.8.1 Input data

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

5.8.2 Methods

Single option predictions were run up to year 2002 using IFAP and following standard procedures.

The risk analyses performed last year were repeated. A spreadsheet reproducing the single option prediction was run under the program @RISK, using 100 iterations and fixed seed for the random number generator. Two probability distribution functions were used to add uncertainty and sample sets of possible values during the simulations. For the initial stock size a lognormal distribution was applied, LOGNORM(mean, standard deviation), with the initial stock numbers by age from the RCT3 and XSA as mean and standard deviation calculated by multiplying the mean by the external standard error from the XSA diagnostics. A truncated lognormal distribution, TLOGNORM(mean, standard deviation, minimum, maximum), was used for the recruitment at age 2. The mean, standard deviation, minimum and maximum were found from the XSA for the years 1962–1994, and the corresponding values were 210, 100, 78 and 459 million, respectively.

5.8.3 Results

Single option predictions for $F_{0.1}$, F_{max}, F_{pa}, F_{med}, $F_{status\ quo}$ and F_{high} up to 2002 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 2002 is 125,000 t, but this level of F would bring the SSB below the most conservative MBAL already in 2000 and down to 153,000 t in 2001. At F_{med} the catch in 2002 will also be 124,000 t, the SSB will fall below MBAL in 2000 and then increase slowly and reach 197,000 t in 2002. The "COMFIE-recommended" $F_{max} = 0.14$ would increase the SSB to 355,000 t in 2002. With this fishing mortality the catch would be reduced to 50,000 t in 1999, increasing to about 96,000 t in 2002. The new "SGPAFM-suggested" F_{pa} would give a catch of 116,000 t in 2002 and a SSB of 261,000 t.

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

Fishing mortality	MBAL (tonnes)	
	170,000	200,000
$F_{0.1} = 0.08$	0	0
$F_{max} = 0.14$	0	0
$F_{pa} = 0.23$	0	7
$F_{med} = 0.32$	26	62
$F_{sq} = 0.38$	65	90
$F_{high} = 0.58$	100	100

With $F_{status\ quo}$ the chances of getting below both MBAL levels are high. Also for F_{med} there is a risk of falling bellow, while with F_{pa} one is on the safe side with respect to the SSB.

5.9 Comments on the assessment and the forecast

During the 1990s the stock has recovered somewhat after a long period of low stock size and the exploitation patterns are better than in the past. The stock is, however, not considered to be completely within safe biological limits. The fishing mortality has been above F_{med} in most of the period. Though the fishing mortality decreased a little in 1996 and 1997 it is expected to increase again in 1998. A reduction below F_{med} is advisable to prevent the SSB from being reduced to previous low levels below MBAL. Reduction in the fishing mortality might also improve the stability in the fishery and increase the long-term yield.

The present assessment seems to be quite similar to the previous assessment. Prediction of growth has been a small problem in some periods, especially for abundant year classes. Last years prediction of the 1997 weights at age was, however, reasonable close to the actual weights used in the assessment this year (± 2–18%). 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. This year the assessment of the 1993 year class caused additional problems. Whether we believe more in the XSA or the survey regarding the size of the year class will have considerable impact on the current stock size and the projections. Using the XSA estimate of the 1993 year class the stock may not be within safe biological limits, while RCT3 estimates based on survey indices brings the whole stock well above MBAL, both in short and medium term. In view of this, management advice for longer periods than one year must be considered unreliable. However, if the fishing mortality is further reduced this dependence will be less and multi-year TAC advice should be considered.

Table 5.1 North-East Arctic SAITHE. Nominal catch (t) by countnes. (Sub-area I and Divisions IIa and IIb combined.) as officially reported to ICES.

Year	Faroe Islands	France	Germany Dem.Rep	Fed.Rep. Germany	Norway	Poland	Portugal	Russia[3]	Spain	UK (England & Wales)	UK (Scotland)	Others[5]	Total all countries
1960	23	1.700	-	25.948	96.050	-	-	-	-	9,780	-	14	133,515
1961	61	3,625	-	19,757	77,875	-	-	-	-	4,595	20	18	105,951
1962	2	544	-	12,651	101,895	-	-	912	-	4,699	-	4	120,707
1963	-	1,110	-	8,108	135,297	-	-	-	-	4,112	-	-	148,627
1964	-	1,525	-	4,420	184,700	-	-	84	-	6,511	-	186	197,506
1965	-	1,618	-	11,387	165,531	-	-	137	-	6,741	5	181	185,600
1966	-	2,987	813	11,269	175,037	-	-	563	-	13,078	-	41	203,788
1967	-	9,472	304	11,822	150,860	-	-	441	-	8,379	-	48	181,326
1968	-	-	70	4,753	96,641	-	-	-	-	8.781	2	-	110,246
1969	20	193	6,744	4,355	115,140	-	-	-	-	13,585	-	23	140,033
1970	1,097	-	29,362	23,466	151,759	-	-	43,550	-	15,469	221	-	264,924
1971	215	14,536	16,840	12,204	128,499	6,017	-	39,397	13,097	10,361	106	-	241,272
1972	109	14,519	7,474	24,595	143,775	1,111	-	1,278	13,125	8,223	125	-	210,456
1973	7	11,320	12,015	30,338	148,789	23	-	2,411	2,115	6,593	248	-	213,769
1974	46	7,119	29,466	33,155	152,699	2,521	-	38,931	7,075	3,001	103	5	264,121
1975	28	3,156	28,517	41,260	122,598	3,860	6,430	13,389	11,397	2,,623	140	55	233,453
1976	20	5,609	10,266	49,056	131,675	3,164	7,233	9,013	21,661	4,651	73	47	242,486
1977	270	5,658	7,164	19,985	139,705	1	783	989	1,327	6,853	82	-	182,817
1978	809	4,345	6,484	18,190	121,069	35	203	381	121	2,790	37	-	154,464
1979	1,117	2,601	2,435	14,823	141,346	-	-	3	685	1,170	-	-	164,180
1980	532	1,016	-	12,511	128,878	-	-	43	780	794	-	-	144,554
1981	236	194	-	8,431	166,139	-	-	121	-	395	-	-	175,498
1982	339	82	-	7,224	159,643	-	-	14	-	731	1	-	168,034
1983	539	418	-	4,933	149,556	-	-	206	33	1,251	-	-	156,936
1984	503	431	6	4,532	152,818	-	-	161	-	335	-	-	158,786
1985	490	657	11	1,873	103,899	-	-	51	-	202	-	-	107,147
1986	426	308	-	3,470	66,152	-	-	27	-	54	21	-	67,396
1987	712	576	-	4,909	85,710	-	-	426	-	54	3	1	92,391
1988	441	411	-	4,574	108,244	-	-	130	-	436	6	-	114,242
1989	388	460 [2]	-	606	119,625	-	-	23	506	-	702	-	122,310
1990	1,207	340 [2]	-	1,143	92,397	-	-	52	-	681	28	-	95,848
1991	963	77 [2]	**Greenland**	2,003	103,283	-	-	504 [4]	-	449	42	5	107,326
1992	165	1,890 [2]	734	3,451	119,765	-	-	964	6	516	25	-	127,606
1993	31	566 [2]	78	3,687	139,288	-	1	9,509	4	408	7	5	153,584
1994	67	151 [2]	15	1,863	137,298	-	1	1,640	655	548	9	6	142,253
1995	172 [2]	222 [2]	53	934	166,205	-	4	1,148	-	589	99	18	169,444
1996	248 [2]	365 [2]	176 [2]	2,615	166,149	-	24	1,159	9 [2]	690 [2]	16	47 [2]	171,498
1997 [1]	193 [2]	559 [2]	363 [2]	2,915	136,655	-	12	1,774	45 [2]	676	123	40 [2]	143,355

[1] Provisional figures.
[2] As reported to Norwegian authorities.
[3] USSR prior to 1991.
[4] Includes Estonia.
[5] Includes Denmark,Netherlands, Iceland, Ireland and Sweden

Table 5.2 North-East Arctic SAITHE. Landings ('000 tonnes) by gear category for Sub-area I, Division IIa and Division IIb combined.

Year	Purse Seine	Trawl	Gill Net	Others	Total
1977	75.2	69.5	19.3	12.7	176.7 [2]
1978	62.9	57.7	21.1	13.9	155.6 [2]
1979	74.7	52.0	21.6	15.8	164.1
1980	61.3	46.8	21.1	15.4	144.6
1981	64.3	72.4	24.0	14.8	175.5
1982	76.4	59.4	16.7	15.6	168.0
1983	54.1	68.2	19.6	15.1	156.9
1984	36.4	85.6	23.7	13.1	158.8
1985	31.1	49.9	14.6	11.5	107.1
1986	7.9	36.2	12.3	8.2	64.6 [2]
1987	34.9	28.0	19.0	10.8	92.7 [2]
1988	43.5	45.4	15.3	10.0	114.2
1989	48.6	44.8	16.8	12.4	122.7
1990	24.6	44.0	19.3	7.9	95.8
1991	38.9	40.1	18.9	9.4	107.3
1992	27.1	66.9	21.2	12.4	127.6
1993	33.1	75.9	21.2	15.7	145.9 [4]
1994	29.3	79.3	20.5	13.1	142.2
1995	22.0 [3]	104.3	27.1	16.0	169.4
1996	46.9	72.7	31.6	20.3	171.5
1997 [1]	43.9	55.1	24.5	19.8	143.3

[1] Preliminary.
[2] Unresolved discrepancy between Norwegian catch by gear figures and the total reported to ICES for these years.
[3] Includes 0.144 tonnes not categorized by vessel size in Table 5.3.
4 As reported by Working Group members.

Table 5.3. Tuning data

SAI-ARCT: Saithe in the North-East Arctic (Areas I and II)

FLT06: Norway Ac Survey (Catch: Thousands)

Fishing Year	Catch, effort	Catch, age 2	Catch, age 3	Catch, age 4	age 5
1988	1	15.7	22.5	19.0	7.1
1989	1	24.8	28.4	17.0	10.1
1990	1	99.6	31.9	14.7	5.1
1991	1	87.8	104.0	4.6	4.0
1992	1	163.5	273.6	57.5	6.2
1993	1	106.9	227.7	103.9	12.7
1994	1	34.4	87.8	112.4	39.5
1995	1	38.7	165.2	87.0	46.8
1996	1	37.0	118.9	214.7	32.1
1997	1	5.1	36.7	185.8	79.8

FLT07: Norway Purse Seine

Fishing Year	Catch, effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	age 7
1977	206	30547	81152	8964	2144	133	9
1978	214	43402	37652	8788	2126	456	98
1979	199	23054	41942	6706	6575	1362	363
1980	215	15615	23353	15280	3280	1683	681
1981	203	10325	68716	5770	2219	154	36
1982	213	14490	28360	43980	250	140	0
1983	161	8924	12402	9775	12090	463	179
1984	124	8576	21699	3842	2144	1363	21
1985	98	632	28815	2688	1096	340	95
1986	96	1408	9869	593	181	108	51
1987	94	1848	12364	32183	386	19	2
1988	103	375	3253	27063	13169	72	6
1989	131	4231	5250	8521	18011	2880	24
1990	96	8551	7207	3319	2582	1845	673
1991	107	3694	43110	1907	453	162	95
1992	90	3954	29527	5214	89	45	38
1993	79	1762	8010	24251	1302	39	23
1994	71	1099	6365	16182	8997	1151	90
1995	90	14	5524	13357	4368	1335	105
1996	105	231	4053	36274	6022	2610	589
1997	109	199	9569	6627	18231	1819	1307

FLT08: Norway Trawl

Fishing Year	Catch, effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	age 10
1976	37	11184	583	1080	1137	869	612	332	284
1977	53	4557	9047	3260	202	660	322	361	209
1978	51	498	3104	3440	1400	319	591	254	304
1979	43	7374	6538	2340	762	845	419	294	129
1980	57	10270	10301	1726	2891	1392	406	24	108
1981	71	5698	12137	10877	1901	1053	1351	83	108
1982	58	1719	10344	10006	5519	420	306	215	134
1983	59	3341	10024	14949	2189	1720	535	181	60
1984	86	14876	25819	7038	7161	656	744	180	176
1985	64	10070	6177	3844	3877	2446	441	564	66
1986	45	4388	8150	4078	3172	2044	779	208	215
1987	30	470	7862	2452	1169	1405	189	153	67
1988	50	1539	2241	14077	3031	1438	609	346	137
1989	60	3923	9038	9226	8659	1154	178	83	150
1990	60	8909	7960	3932	3722	3967	479	54	66
1991	52	20741	7106	2683	2456	1516	1044	139	37
1992	58	10361	13228	3067	2269	2660	2029	890	214
1993	68	10746	26279	17961	1947	657	604	190	240
1994	79	1456	16229	28224	10542	1045	151	68	83
1995	106	7626	27085	24940	21565	2560	329	18	61
1996	75	3663	13890	8701	9304	10312	763	152	3
1997	41	3721	3940	16568	5867	4042	1903	178	20

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Table 5.4A

```
NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds
1,13,2                  (No. of surveys, No. of years, VPA Column No.)
1982,   99,     4.9
1983,  220,    48.0
1984,  164,    22.0
1985,   80,    22.5
1986,   59,    28.4
1987,   62,    31.9
1988,  221,   104.0
1989,  361,   273.6
1990,  229,   227.7
1991,  165,    87.8
1992,  278,   165.2
1993,   93,   118.9
1994,  102,    36.7
```

Analysis by RCT3 ver3.1 of data from file :

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NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds

Data for 1 surveys over 13 years : 1982 - 1994

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

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

Forecast/Hindcast variance correction used.

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1985	164	5.10	.18	.03	.03	81	4.39
1986	137	4.92	.43	.11	.07	60	4.09
1987	115	4.75	.52	.17	.11	62	4.14
1988	106	4.66	.53	.57	1.15	222	5.40
1989	138	4.93	.55	.78	2.02	361	5.89
1990	200	5.30	.57	.68	1.42	230	5.44
1991	167	5.12	.52	.22	.18	165	5.11
1992	199	5.30	.49	.41	.71	278	5.63
1993	193	5.26	.46	.24	.28	94	4.54
1994	124	4.82	.49	.23	.23	102	4.63

Table 5.4B

```
NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds
1,13,2                  (No. of surveys, No. of years, VPA Column No.)
1983,  271,      3.1
1984,  204,     19.5
1985,  102,      1.8
1986,   78,     15.7
1987,   88,     24.8
1988,  282,     99.6
1989,  447,     87.8
1990,  295,    163.5
1991,  205,    106.9
1992,  341,     34.4
1993,  113,     38.7
1994,  125,     37.0
1995,   -11,     5.1
```

Analysis by RCT3 ver3.1 of data from file :

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NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds

Data for 1 surveys over 13 years : 1983 - 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

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1986	182	5.21	.50	.15	.10	78	4.37
1987	143	4.97	.58	.30	.27	89	4.49
1988	122	4.81	.54	.54	.99	282	5.65
1989	159	5.07	.58	.47	.66	447	6.10
1990	216	5.38	.64	.66	1.05	296	5.69
1991	228	5.43	.60	.44	.54	205	5.33
1992	193	5.26	.55	.04	.00	341	5.83
1993	209	5.34	.55	.06	.01	113	4.74
1994	195	5.28	.55	.03	.00	125	4.84
1995	143	4.97	.55	.63	1.35		

Table 5.5

Lowestoft VPA Version 3.1

25-Aug-98 15:50:54

Extended Survivors Analysis

Arctic Saithe (run: XSAAGE06/X06)

CPUE data from file /users/fish/ifad/ifapwork/afwg/sai_arct/FLEET.X06

Catch data for 38 years. 1960 to 1997. Ages 2 to 11.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT06: Norway Ac Sur,	1988,	1997,	2,	5,	.750,	.850
FLT07: Norway Purse ,	1977,	1997,	2,	7,	.000,	1.000
FLT08: Norway Trawl ,	1976,	1997,	3,	10,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 8

Terminal population estimation :

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

S.E. of the mean to which the estimates are shrunk = .500

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

Prior weighting not applied

Tuning converged after 14 iterations

Regression weights

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

Fishing mortalities

Age,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
2,	.074,	.151,	.046,	.015,	.055,	.018,	.005,	.001,	.008,	.018
3,	.119,	.262,	.468,	.462,	.165,	.139,	.063,	.067,	.130,	.174
4,	.409,	.473,	.507,	.516,	.299,	.329,	.292,	.553,	.354,	.248
5,	.549,	.826,	.406,	.390,	.423,	.544,	.436,	.541,	.425,	.494
6,	.583,	.713,	.580,	.423,	.926,	.604,	.854,	.613,	.533,	.599
7,	1.117,	.529,	.742,	.376,	.955,	.787,	.710,	.638,	.845,	.780
8,	1.038,	.522,	.682,	.430,	.982,	.711,	.595,	.555,	.957,	.755
9,	1.079,	.430,	.418,	.340,	.660,	.862,	.352,	.324,	1.420,	.766
10,	.832,	.579,	.536,	.406,	.755,	.695,	.634,	.674,	1.124,	.688

Table 5.5 (Cont'd)

XSA population numbers (Thousands)

YEAR ,	AGE 2,	3,	4,	5,	6,	7,	8,	9,	10,
1988 ,	7.81E+04,	9.03E+04,	1.19E+05,	6.59E+04,	1.14E+04,	3.92E+03,	2.09E+03,	1.62E+03,	6.26E+02,
1989 ,	9.80E+04,	5.94E+04,	5.84E+04,	6.40E+04,	4.16E+04,	5.22E+03,	1.02E+03,	6.05E+02,	4.50E+02,
1990 ,	2.32E+05,	6.21E+04,	3.74E+04,	2.99E+04,	2.30E+04,	1.63E+04,	2.52E+03,	4.98E+02,	3.22E+02,
1991 ,	4.47E+05,	2.21E+05,	3.19E+04,	1.95E+04,	1.62E+04,	1.05E+04,	6.36E+03,	1.04E+03,	2.68E+02,
1992 ,	2.96E+05,	3.61E+05,	1.14E+05,	1.56E+04,	1.02E+04,	8.71E+03,	5.93E+03,	3.39E+03,	6.07E+02,
1993 ,	2.05E+05,	2.29E+05,	2.80E+05,	6.92E+04,	9.35E+03,	3.32E+03,	2.74E+03,	1.82E+03,	1.43E+03,
1994 ,	3.41E+05,	1.65E+05,	1.63E+05,	1.47E+05,	3.29E+04,	3.74E+03,	1.24E+03,	1.10E+03,	6.29E+02,
1995 ,	1.13E+05,	2.78E+05,	1.26E+05,	9.89E+04,	7.80E+04,	1.15E+04,	1.50E+03,	5.59E+02,	6.36E+02,
1996 ,	1.26E+05,	9.25E+04,	2.13E+05,	8.96E+04,	4.76E+04,	3.46E+04,	4.96E+03,	7.07E+02,	3.31E+02,
1997 ,	1.94E+04,	1.02E+05,	6.65E+04,	1.22E+05,	3.19E+04,	2.29E+04,	1.22E+04,	1.56E+03,	1.40E+02,

Estimated population abundance at 1st Jan 1998

, .00E+00, 1.56E+04, 7.02E+04, 4.25E+04, 6.11E+04, 1.43E+04, 8.58E+03, 4.68E+03, 5.93E+02,

Taper weighted geometric mean of the VPA populations:

, 1.51E+05, 1.40E+05, 9.03E+04, 4.72E+04, 2.07E+04, 8.49E+03, 3.10E+03, 1.17E+03, 5.09E+02,

Standard error of the weighted Log(VPA populations) :

, .8437, .5889, .7083, .8017, .7320, .7395, .7154, .5781, .6453,

Log catchability residuals.

Fleet : FLT06: Norway Ac Sur

Age ,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997
2 ,	-.31,	.09,	.23,	-.38,	.69,	.60,	-1.05,	.17,	.02,	-.08
3 ,	-.80,	-.15,	.09,	.00,	.24,	.49,	-.20,	-.09,	.73,	-.50
4 ,	-1.15,	-.50,	-.18,	-1.17,	-.09,	-.26,	.21,	.42,	.64,	1.58
5 ,	-1.16,	-.30,	-.55,	-.33,	.31,	-.37,	-.08,	.57,	.61,	.86
6 ,	No data for this fleet at this age									
7 ,	No data for this fleet at this age									
8 ,	No data for this fleet at this age									
9 ,	No data for this fleet at this age									
10 ,	No data for this fleet at this age									

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

Age ,	2,	3,	4,	5
Mean Log q,	-7.9851,	-7.1278,	-7.1003,	-7.6396,
S.E(Log q),	.5150,	.4428,	.8285,	.6130,

Regression statistics :

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

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	1.03,	-.164,	7.85,	.76,	10,	.57,	-7.99,
3,	.86,	.686,	7.81,	.76,	10,	.39,	-7.13,
4,	.77,	.724,	8.12,	.57,	10,	.66,	-7.10,
5,	.87,	.509,	8.06,	.69,	10,	.56,	-7.64,

Table 5.5 (Cont'd)

Fleet : FLT07: Norway Purse

Age	1976	1977
2	99.99	99.99
3	99.99	99.99
4	99.99	99.99
5	99.99	99.99
6	99.99	99.99
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	

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	2.32	2.29	1.00	1.50	1.91	1.85	1.93	-1.17	-.06	.93
3	.91	.54	.44	.63	.56	.08	1.27	1.67	-.47	.07
4	-.52	-.29	-.26	-.54	.46	.05	-.54	-.13	-1.73	.79
5	-.41	.66	.44	-.70	-2.17	1.04	.20	-.06	-1.45	-.89
6	-.22	.82	.89	-.84	-1.77	.56	1.05	.27	-.80	-2.04
7	-.07	1.04	1.41	-1.53	99.99	.16	-.92	.27	-.13	-3.21
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	.38	1.63	1.43	.01	.68	.35	-.53	-4.03	-1.48	.21
3	-.65	-.04	.64	1.05	.21	-.52	-.35	-1.25	-.58	.16
4	.83	.17	-.01	-.51	-.70	.20	.31	.25	.49	-.13
5	1.14	1.64	.58	-.80	-2.07	-.69	.54	.02	.65	1.03
6	-1.12	1.11	1.49	-.77	-1.20	-1.15	1.08	.02	1.00	1.03
7	-1.61	-1.02	1.58	-.21	-.52	.00	1.32	.09	.64	1.79
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2	3	4	5	6	7
Mean Log q	-9.3706	-7.0396	-6.6473	-7.3003	-8.2116	-8.8931
S.E(Log q)	1.5933	.7508	.6051	1.1018	1.1554	1.2986

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.97	.056	9.45	.23	20	1.62	-9.37
3	1.40	-.731	5.11	.25	20	1.07	-7.04
4	.67	2.272	8.23	.82	20	.34	-6.65
5	.51	3.083	8.99	.80	20	.42	-7.30
6	.48	3.022	9.11	.77	20	.42	-8.21
7	.56	1.594	8.97	.57	19	.68	-8.89

Table 5.5 (Cont'd)

Fleet : FLT08: Norway Trawl

Age	1976	1977
2	No data for this fleet at this age	
3	99.99	99.99
4	99.99	99.99
5	99.99	99.99
6	99.99	99.99
7	99.99	99.99
8	99.99	99.99
9	99.99	99.99
10	99.99	99.99

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	No data for this fleet at this age									
3	-1.79	.55	1.16	-.60	-.73	.01	1.48	1.26	-.32	-1.84
4	-.80	.56	.00	.58	-.36	.43	1.07	.47	.98	-.14
5	-.31	-.64	-.69	.14	1.01	.47	-.04	-.18	.62	.30
6	-.65	-1.20	-.23	-.26	.22	.16	.10	.16	.35	.24
7	-1.11	-.32	-.31	-.85	-1.01	-.30	-.86	.20	.56	.73
8	-.71	.35	-.24	.63	-1.01	.19	-.59	-.09	.53	-.43
9	-.44	-.61	-2.18	-1.28	-.07	-.91	-.31	.13	.14	.14
10	-.43	-.18	-1.20	-.32	.06	-.58	-.58	-.07	.24	.08

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
2	No data for this fleet at this age									
3	-.47	.67	1.53	1.26	-.17	.14	-1.71	-.88	-.13	.41
4	-1.61	.34	.66	.88	.01	-.24	-.46	.13	-.80	-.35
5	.12	-.06	-.34	-.09	.11	.28	-.22	-.21	-.45	.11
6	.35	.02	-.33	-.30	.18	-.07	.21	-.34	-.37	.19
7	.83	-.12	.06	-.47	.42	-.25	-.08	-.64	.09	.14
8	.81	-.09	.06	-.04	.82	.10	-.69	-.43	-.25	.28
9	.52	-.37	-.62	-.29	.42	-.59	-1.48	-2.44	.26	-.03
10	.44	.58	.07	-.23	.75	-.19	-.60	-1.20	-3.02	.16

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

Age	3	4	5	6	7	8	9	10
Mean Log q	-7.2543	-5.9910	-5.4958	-5.2306	-5.1397	-5.4073	-5.4073	-5.4073
S.E(Log q)	1.0457	.6989	.3162	.2734	.4805	.4875	.9602	1.0550

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	3.25	-1.344	-3.10	.03	20	3.28	-7.25
4	3.29	-3.159	-6.46	.16	20	1.71	-5.98
5	1.11	-.824	4.92	.85	20	.36	-5.50
6	1.21	-1.676	4.24	.86	20	.31	-5.23
7	1.00	.019	5.15	.70	20	.50	-5.14
8	.80	1.221	5.92	.79	20	.38	-5.41
9	.58	1.731	6.34	.63	20	.46	-5.82
10	.89	.260	5.78	.35	20	.93	-5.72

Table 5.5 (Cont'd)

Terminal year survivor and F summaries :

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	14337.,	.542,	.000,	.00,	1,	.434,	.020
FLT07: Norway Purse ,	19175.,	1.658,	.000,	.00,	1,	.046,	.015
FLT08: Norway Trawl ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	16435.,	.50,,,,				.520,	.017

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
15601.,	.36,	.07,	3,	.194,	.018

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	52985.,	.353,	.259,	.73,	2,	.512,	.224
FLT07: Norway Purse ,	61429.,	.707,	.632,	.89,	2,	.128,	.196
FLT08: Norway Trawl ,	105603.,	1.088,	.000,	.00,	1,	.054,	.119
F shrinkage mean ,	110788.,	.50,,,,				.305,	.113

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
70221.,	.26,	.22,	6,	.844,	.174

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	82566.,	.328,	.334,	1.02,	3,	.409,	.135
FLT07: Norway Purse ,	23918.,	.471,	.707,	1.50,	3,	.210,	.406
FLT08: Norway Trawl ,	31973.,	.606,	.098,	.16,	2,	.129,	.318
F shrinkage mean ,	26946.,	.50,,,,				.252,	.368

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
42477.,	.22,	.28,	9,	1.267,	.248

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	61673.,	.298,	.425,	1.43,	4,	.284,	.490
FLT07: Norway Purse ,	64145.,	.441,	.507,	1.15,	4,	.128,	.475
FLT08: Norway Trawl ,	58158.,	.292,	.246,	.84,	3,	.370,	.514
F shrinkage mean ,	63812.,	.50,,,,				.218,	.477

Table 5.5 (Cont'd)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
61105.,	.18,	.16,	12,	.896,	.494

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

Year class = 1991

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	19759.,	.306,	.214,	.70,	4,	.146,	.467
FLT07: Norway Purse ,	21298.,	.449,	.239,	.53,	5,	.086,	.440
FLT08: Norway Trawl ,	13618.,	.216,	.212,	.98,	4,	.549,	.623
F shrinkage mean ,	11309.,	.50,,,,				.220,	.713

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
14340.,	.17,	.11,	14,	.644,	.599

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

Year class = 1990

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	14508.,	.302,	.080,	.26,	4,	.101,	.530
FLT07: Norway Purse ,	16225.,	.467,	.354,	.76,	6,	.081,	.486
FLT08: Norway Trawl ,	7099.,	.210,	.111,	.53,	5,	.509,	.887
F shrinkage mean ,	8350.,	.50,,,,				.310,	.795

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
8576.,	.19,	.10,	16,	.526,	.780

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

Year class = 1989

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	4392.,	.306,	.140,	.46,	4,	.058,	.789
FLT07: Norway Purse ,	6422.,	.471,	.106,	.22,	6,	.046,	.600
FLT08: Norway Trawl ,	4674.,	.238,	.119,	.50,	6,	.480,	.756
F shrinkage mean ,	4572.,	.50,,,,				.416,	.768

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4683.,	.24,	.05,	17,	.223,	.755

Table 5.5 (cont'd.)

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	538.,	.324,	.130,	.40,	4,	.023,	.820
FLT07: Norway Purse ,	653.,	.542,	.327,	.60,	6,	.024,	.716
FLT08: Norway Trawl ,	525.,	.284,	.126,	.45,	7,	.341,	.833
F shrinkage mean ,	635.,	.50,,,,				.612,	.730

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
593.,	.32,	.06,	18,	.195,	.766

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT06: Norway Ac Sur,	58.,	.349,	.275,	.79,	4,	.012,	.682
FLT07: Norway Purse ,	49.,	.521,	.543,	1.04,	6,	.012,	.775
FLT08: Norway Trawl ,	57.,	.395,	.100,	.25,	8,	.235,	.694
F shrinkage mean ,	58.,	.50,,,,				.740,	.685

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
58.,	.38,	.05,	19,	.120,	.688

Table 5.6

Run title : Arctic Saithe (run: XSAAGE06/X06)

At 25-Aug-98 15:51:43

Table 1 Catch numbers at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
2,	5297,	4090,	28952,	19840,	11608,	13809,	21159,	91601,	54151,	31662,
3,	25196,	77333,	43540,	77019,	65178,	76296,	36782,	60832,	125030,	99049,
4,	18394,	11949,	62846,	59280,	52389,	25206,	44027,	11691,	30576,	34317,
5,	5111,	16939,	13987,	26961,	29146,	26911,	15671,	16366,	7947,	10140,
6,	3292,	4747,	18189,	9556,	10186,	16031,	20419,	4436,	8712,	2062,
7,	787,	4798,	5122,	9590,	5616,	7114,	12148,	7809,	3435,	4332,
8,	1913,	1126,	7950,	2901,	3547,	3935,	4802,	6789,	3212,	1456,
9,	900,	1711,	2504,	4352,	1965,	2871,	3259,	2914,	2679,	1606,
10,	577,	675,	3697,	2195,	2140,	2610,	2505,	2350,	1724,	963,
+gp,	1166,	511,	2799,	5490,	3149,	3924,	3821,	4140,	2880,	1134,
TOTALNUM,	67603,	123879,	184586,	217188,	184824,	178727,	164592,	198927,	240346,	186721,
TONSLAND,	107191,	140379,	260404,	244732,	210508,	215659,	262301,	233453,	242486,	182808,
SOPCOF %,	113,	98,	96,	80,	82,	82,	97,	102,	100,	101,

Table 1 Catch numbers at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
2,	45758,	28334,	18226,	10467,	17225,	11638,	14624,	2216,	3311,	3867,
3,	48969,	61963,	40796,	83954,	34733,	17244,	41466,	48917,	22115,	17869,
4,	27685,	23329,	36644,	21822,	65052,	23768,	33233,	11974,	12895,	49829,
5,	12476,	14122,	9211,	21528,	13060,	32700,	12064,	7189,	6062,	4339,
6,	4534,	4400,	6379,	3619,	9212,	3226,	11204,	5279,	4525,	3118,
7,	1468,	2901,	3200,	2550,	1054,	3008,	1135,	3740,	2805,	3490,
8,	1848,	963,	1338,	2008,	1251,	1177,	1772,	775,	1399,	755,
9,	938,	1356,	147,	369,	461,	760,	560,	978,	351,	620,
10,	976,	438,	730,	279,	263,	247,	557,	134,	454,	257,
+gp,	2150,	1192,	1629,	629,	448,	760,	897,	701,	285,	797,
TOTALNUM,	146802,	138997,	118300,	147225,	141759,	94528,	117512,	81803,	54202,	84941,
TONSLAND,	154465,	164234,	154379,	175516,	170903,	155405,	158796,	107147,	70458,	91679,
SOPCOF %,	103,	114,	100,	100,	100,	100,	100,	99,	99,	102,

Table 1 Catch numbers at age

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
2,	5017,	11157,	11543,	6135,	14333,	3379,	1389,	70,	961,	320,
3,	8126,	12378,	21002,	73878,	49750,	26933,	9088,	16411,	10225,	14707,
4,	35847,	19915,	13463,	11619,	26640,	63451,	37361,	48600,	57448,	13232,
5,	32827,	32643,	8996,	5395,	4865,	26254,	47178,	37726,	18667,	43150,
6,	4560,	18751,	9152,	5066,	5594,	3427,	17101,	32365,	17805,	13000,
7,	2328,	1939,	7735,	2988,	4850,	1636,	1720,	4891,	17861,	11208,
8,	1219,	377,	1126,	2009,	3353,	1263,	502,	580,	2765,	5834,
9,	966,	191,	154,	272,	1480,	950,	296,	140,	485,	755,
10,	320,	179,	121,	81,	291,	650,	267,	282,	202,	63,
+gp,	102,	149,	253,	132,	267,	106,	676,	300,	443,	160,
TOTALNUM,	91312,	97679,	73545,	107575,	111423,	128049,	115578,	141365,	126862,	102429,
TONSLAND,	114508,	122664,	95393,	107326,	127606,	153584,	142253,	169444,	171498,	143355,
SOPCOF %,	99,	100,	100,	99,	100,	100,	100,	100,	100,	100,

Table 5.7

Run title : Arctic Saithe (run: XSAAGE06/X06)

At 25-Aug-98 15:51:44

Table 2 Catch weights at age (kg)

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
2,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,
3,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,
4,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,
5,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,
6,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,
7,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,
8,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,
9,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,
10,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,
+gp,	7.7160,	7.4790,	7.4040,	7.0520,	7.4770,	7.3850,	7.2170,	7.1270,	7.3200,	7.3940,
SOPCOFAC,	1.1338,	.9756,	.9575,	.7953,	.8212,	.8167,	.9694,	1.0155,	1.0020,	1.0061,

Table 5.7 (Cont'd)

Table 2 Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
2,	.3400,	.3400,	.4500,	.4300,	.5100,	.6000,	.5300,	.3800,	.3200,	.3400,
3,	.7100,	.7100,	.7900,	.7300,	.7700,	1.0500,	.7100,	.7500,	.5900,	.5300,
4,	1.1100,	1.1100,	1.2700,	1.4000,	1.1200,	1.3300,	1.2600,	1.3300,	1.2200,	.8400,
5,	1.6300,	1.6300,	2.0300,	2.0500,	2.0200,	1.8600,	2.0200,	2.0700,	1.9700,	1.6600,
6,	2.3300,	2.3300,	2.5500,	2.7600,	2.6100,	2.9000,	2.7000,	2.6300,	2.3000,	2.3200,
7,	3.1600,	3.1600,	3.2900,	3.3000,	3.2700,	4.0000,	3.8800,	3.2800,	2.8700,	2.9700,
8,	4.0300,	4.0300,	4.3400,	4.3600,	3.9100,	4.1900,	4.4700,	3.9600,	3.7200,	4.0000,
9,	4.8700,	4.8700,	5.1500,	5.9500,	4.6900,	5.3300,	5.3600,	4.5400,	4.3000,	4.7200,
10,	5.6300,	5.6300,	5.7500,	6.3900,	5.6300,	5.6800,	6.0600,	5.5500,	4.6900,	5.4400,
+gp,	7.5270,	7.8090,	6.9370,	6.8410,	7.5580,	8.6650,	7.1900,	8.0120,	6.5970,	6.9040,
SOPCOFAC,	1.0278,	1.1388,	.9991,	.9975,	.9961,	.9991,	.9997,	.9930,	.9929,	1.0154,

Table 2 Catch weights at age (kg)

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
2,	.3300,	.4500,	.5400,	.4000,	.4500,	.4600,	.3500,	.5000,	.4000,	.3800,
3,	.6200,	.7400,	.7600,	.7200,	.7000,	.6300,	.5200,	.5600,	.5900,	.6200,
4,	.8700,	.9700,	1.0800,	1.1900,	1.1000,	1.0200,	.7400,	.7800,	.8200,	.9200,
5,	1.3100,	1.3900,	1.5600,	1.7800,	1.9800,	1.7000,	1.2200,	1.2100,	1.3200,	1.1900,
6,	2.4300,	1.8100,	2.1200,	2.2400,	2.3400,	2.5000,	2.1600,	1.7400,	1.8300,	1.6600,
7,	3.8700,	3.0200,	2.4000,	2.8600,	2.8100,	2.8800,	3.1900,	2.8000,	2.4700,	2.3100,
8,	5.3800,	3.7600,	3.6500,	3.3200,	3.2500,	3.0900,	3.9700,	3.7400,	3.7200,	3.1000,
9,	5.8300,	4.6400,	3.6000,	4.5300,	4.0600,	3.7000,	4.6200,	4.4000,	4.4900,	4.3400,
10,	5.3600,	4.7500,	6.3700,	5.7000,	6.1900,	6.1900,	5.2800,	5.2800,	5.3000,	6.0400,
+gp,	7.4480,	7.5000,	4.7950,	7.1250,	7.3760,	8.1750,	6.0700,	7.4900,	7.0160,	7.6200,
SOPCOFAC,	.9902,	.9978,	1.0001,	.9912,	1.0000,	1.0008,	1.0038,	1.0008,	.9999,	1.0011,

Table 5.8

Run title : Arctic Saithe (run: XSAAGE06/X06)

At 25-Aug-98 15:51:44

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
2,	.0160,	.0131,	.0785,	.1053,	.0472,	.1397,	.1204,	.2763,	.2183,	.2179,
3,	.2042,	.3402,	.1880,	.3511,	.5894,	.4908,	.6673,	.5965,	.9056,	.7878,
4,	.1709,	.1406,	.5146,	.4216,	.4300,	.4768,	.5916,	.4596,	.6947,	.6811,
5,	.1024,	.2354,	.2432,	.4349,	.3782,	.4111,	.6234,	.4563,	.6623,	.5214,
6,	.1649,	.1308,	.3709,	.2611,	.2895,	.3694,	.6373,	.3555,	.4715,	.3534,
7,	.0391,	.1356,	.2035,	.3930,	.2410,	.3375,	.5337,	.5384,	.5171,	.4555,
8,	.0747,	.0721,	.3481,	.1697,	.2452,	.2656,	.4019,	.6565,	.4438,	.4316,
9,	.1275,	.0885,	.2271,	.3263,	.1569,	.3212,	.3676,	.4568,	.5929,	.4172,
10,	.1020,	.1330,	.2801,	.3189,	.2636,	.3431,	.5169,	.4965,	.5419,	.4390,
+gp,	.1020,	.1330,	.2801,	.3189,	.2636,	.3431,	.5169,	.4965,	.5419,	.4390,
FBAR 3- 6,	.1606,	.2118,	.3292,	.3672,	.4218,	.4370,	.6299,	.4670,	.6835,	.5859,

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
2,	.1965,	.2067,	.0582,	.0788,	.1460,	.1145,	.1250,	.0091,	.0181,	.0427,
3,	.6159,	.4448,	.5173,	.4110,	.4039,	.2135,	.7510,	.7848,	.1178,	.1284,
4,	.5262,	.6838,	.5186,	.5845,	.6561,	.5377,	.8214,	.5021,	.4842,	.4218,
5,	.5681,	.5647,	.6411,	.6689,	.8688,	.8425,	.5824,	.4103,	.5163,	.2957,
6,	.4680,	.3997,	.5425,	.5642,	.5863,	.5405,	.8058,	.5488,	.4943,	.5526,
7,	.4598,	.6281,	.5735,	.4333,	.3142,	.4412,	.3683,	.7032,	.6435,	.9219,
8,	.3576,	.6306,	.6781,	.9003,	.3930,	.7004,	.5091,	.4641,	.6275,	.3523,
9,	.5529,	.4865,	.1789,	.3957,	.5268,	.4420,	.8905,	.5137,	.3956,	.6396,
10,	.4850,	.5466,	.5311,	.6055,	.5492,	.6048,	.6883,	.5444,	.5518,	.5691,
+gp,	.4850,	.5466,	.5311,	.6055,	.5492,	.6048,	.6883,	.5444,	.5518,	.5691,
FBAR 3- 6,	.5445,	.5232,	.5549,	.5572,	.6288,	.5335,	.7402,	.5615,	.4031,	.3496,

Table 5.8 (Cont'd)

Table 8	Fishing mortality (F) at age										
YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
2,	.1736,	.1515,	.1462,	.1153,	.1551,	.2164,	.1345,	.1117,	.2088,	.0184,	.0092,
3,	.1156,	.2616,	.4677,	.4616,	.1684,	.1392,	.0631,	.1674,	.1303,	.1735,	.1237,
4,	.4192,	.4732,	.5067,	.5157,	.2969,	.3239,	.2916,	.5526,	.3541,	.2463,	.3851,
5,	.5466,	.5263,	.4363,	.3699,	.4233,	.5435,	.4364,	.5407,	.4251,	.4941,	.4866,
6,	.5627,	.7130,	.5796,	.4226,	.9263,	.6040,	.6543,	.6132,	.5334,	.5990,	.5819,
7,	1.1170,	.8269,	.7424,	.3759,	.9553,	.7669,	.7102,	.6375,	.5451,	.7805,	.7545,
8,	1.0384,	.8219,	.6621,	.4297,	.9617,	.7216,	.5950,	.5553,	.9573,	.7546,	.7558,
9,	1.1765,	.4298,	.4134,	.3405,	.6896,	.8617,	.3516,	.3243,	1.4197,	.7661,	.8367,
10,	.8316,	.5756,	.5364,	.4161,	.7551,	.6952,	.6336,	.6741,	1.1242,	.6883,	.8269,
+gp,	.8316,	.5756,	.5364,	.4161,	.7551,	.6952,	.6336,	.6741,	1.1242,	.6883,	
FBAR 3- 6,	.4149,	.5658,	.4911,	.4475,	.4835,	.4039,	.4113,	.4435,	.3607,	.3787,	

Table 5.9

Run title : Arctic Saithe (run: XSAAGE06/X06)

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Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)						Numbers*10**-3			
YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
2,	367813,	347400,	379777,	219495,	278361,	117249,	206167,	373507,	305106,	178747,
3,	150780,	296346,	280726,	287453,	161754,	217399,	83482,	149650,	231966,	200802,
4,	129312,	100650,	172654,	190443,	165657,	73457,	108956,	35068,	67480,	76786,
5,	57918,	89237,	71593,	84492,	102283,	88225,	37334,	49368,	18133,	27581,
6,	60219,	42804,	57734,	45960,	44781,	57369,	47882,	16387,	25611,	7655,
7,	22707,	41809,	30750,	32621,	28982,	27447,	32465,	20727,	9403,	13085,
8,	29375,	17879,	29889,	20541,	18028,	18647,	16034,	15588,	9905,	4590,
9,	8312,	22319,	13619,	17278,	14193,	11551,	11706,	8783,	6619,	5203,
10,	6575,	5991,	16725,	8885,	10208,	9933,	6859,	6636,	4554,	2995,
+gp,	13242,	4518,	12583,	22068,	14930,	14824,	10356,	11576,	7527,	3496,
TOTAL,	846252,	968954,	1066051,	929235,	839176,	636100,	561243,	687291,	686304,	520941,

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)						Numbers*10**-3			
YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
2,	283511,	167664,	356378,	152674,	140121,	118849,	137598,	271024,	203778,	102332,
3,	117696,	190716,	111634,	275286,	115528,	99135,	86775,	99415,	219891,	163844,
4,	74779,	52053,	100078,	54484,	149421,	63159,	65562,	33525,	37132,	160021,
5,	31816,	36174,	21509,	48780,	24862,	63474,	30204,	23607,	16614,	18733,
6,	13407,	14760,	16838,	9276,	20459,	8539,	22380,	13813,	12823,	8117,
7,	4402,	6874,	9103,	8014,	4320,	9320,	4072,	8185,	6532,	6404,
8,	6794,	2275,	3003,	3739,	4254,	2583,	4909,	2307,	3317,	2810,
9,	2441,	3890,	992,	1248,	1244,	2351,	1050,	2415,	1187,	1450,
10,	2807,	1150,	1958,	679,	688,	601,	1237,	353,	1183,	654,
+gp,	6123,	3095,	4324,	1513,	1159,	1829,	1967,	1826,	735,	2007,
TOTAL,	543776,	478650,	624818,	555693,	462056,	369840,	355743,	456470,	503192,	466373,

Table 5.9. (Cont'd)

Table 10	Stock number at age (start of year)					Numbers*10**-3					
YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 60-95
AGE												
2,	[illegible]	55025,	262496,	447214,	295712,	234676,	341287,	113192,	[125672]	[19406]	[0]	210043,
3,	61263,	59399,	62137,	221844,	361597,	229131,	164517,	276166,	92523,	[102022]	[15601]	157874,
4,	117975,	58376,	37432,	31571,	113964,	250216,	163227,	126472,	212693,	66504,	[70221]	88509,
5,	55927,	64154,	29776,	18465,	15580,	69201,	147447,	99833,	59571,	122321,	42477,	46121,
6,	11412,	41645,	22988,	16239,	10236,	8354,	32901,	76031,	47600,	31882,	61105,	23454,
7,	3824,	5217,	16313,	10546,	8711,	3319,	3738,	11464,	34631,	22861,	14340,	12057,
8,	2086,	1025,	2517,	6357,	5926,	2744,	1237,	1504,	4960,	12168,	8576,	6323,
9,	1615,	605,	496,	1042,	3387,	1616,	1103,	559,	707,	1559,	4683,	3517,
10,	626,	450,	322,	266,	617,	1434,	629,	636,	331,	140,	593,	2047,
+gp,	197,	371,	666,	433,	549,	231,	1573,	668,	711,	351,	202,	
TOTAL,	362343,	316471,	455146,	753271,	615256,	771122,	857659,	710423,	[579575]	[379217]	[217798]	

Table 5.10

Run title : Arctic Saithe (run: XSAAGE06/X06)

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Terminal Fs derived using XSA (With F shrinkage)

Table 14	Stock biomass at age with SOP (start of year)					Tonnes				
YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
2,	141788,	115238,	123632,	59354,	77723,	32558,	67951,	128964,	103941,	61145,
3,	121377,	205278,	190838,	162320,	94314,	126061,	57458,	107900,	165022,	143440,
4,	162741,	108999,	183495,	168126,	151007,	66592,	117239,	39530,	75050,	85753,
5,	107038,	141912,	111733,	109534,	136916,	117447,	58992,	81719,	29615,	45232,
6,	159083,	97303,	128800,	85168,	85686,	109169,	108150,	38775,	59791,	17945,
7,	81356,	128897,	93036,	81983,	75210,	70834,	99448,	66513,	29772,	41602,
8,	134220,	70297,	115329,	65838,	59665,	61372,	62640,	63794,	39995,	18612,
9,	45896,	106046,	63505,	66920,	56762,	45941,	55264,	43436,	32300,	25493,
10,	41969,	32908,	90158,	39784,	47196,	45670,	37435,	37942,	25690,	16967,
+gp,	115844,	32966,	89201,	123773,	91677,	89406,	72454,	83783,	55209,	26006,
TOTALBIO,	1111314,	1039843,	1189729,	962800,	876157,	765050,	737031,	692357,	616384,	482195,

Terminal Fs derived using XSA (With F shrinkage)

Table 14	Stock biomass at age with SOP (start of year)					Tonnes				
YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
2,	99073,	64917,	160221,	65488,	71184,	71245,	72903,	102268,	64746,	35328,
3,	85887,	154201,	88108,	200463,	88611,	103998,	61595,	74039,	128814,	88173,
4,	85312,	65798,	126981,	76090,	166702,	83925,	82587,	45275,	44979,	136484,
5,	53301,	67146,	43623,	99753,	50027,	117954,	60996,	48994,	32496,	31576,
6,	32106,	39164,	42898,	25538,	53190,	23886,	60410,	36073,	29284,	19121,
7,	14296,	24736,	26634,	26381,	14071,	37245,	15794,	26659,	18614,	19313,
8,	28139,	10443,	13021,	16336,	16569,	10787,	21936,	9093,	12253,	11413,
9,	12217,	21574,	5102,	7407,	5812,	12520,	5625,	10865,	5069,	6950,
10,	16241,	7370,	11248,	4327,	3858,	3413,	7495,	1941,	5509,	3615,
+gp,	47369,	27525,	29966,	10324,	8727,	15837,	14136,	14850,	4813,	14071,
TOTALBIO,	473940,	482874,	547802,	532107,	478752,	480809,	403478,	370057,	346577,	366045,

Table 14	Stock biomass at age with SOP (start of year)					Tonnes				
YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
2,	25519,	39613,	152564,	177320,	133065,	94226,	119904,	56590,	[50266]	[7383]
3,	49289,	43858,	47229,	157616,	252416,	144468,	85874,	155894,	54589,	63325,
4,	101635,	56500,	40431,	37593,	125360,	255425,	121246,	98724,	174564,	61252,
5,	111463,	88975,	46455,	32580,	30848,	117736,	180568,	120892,	78630,	145726,
6,	27459,	73408,	48741,	36056,	23953,	20901,	71337,	135879,	87104,	52984,
7,	14656,	15720,	39155,	29881,	24478,	9567,	11971,	32123,	85460,	52869,
8,	11111,	3824,	9187,	20920,	19259,	8484,	4930,	5631,	18451,	37762,
9,	9338,	2799,	1792,	4678,	13750,	6732,	5117,	2460,	3174,	6774,
10,	3324,	2134,	2052,	1515,	3756,	8882,	3333,	3358,	1753,	846,
+gp,	1450,	2774,	3196,	3061,	4049,	1888,	9583,	5004,	4988,	2676,
TOTALBIO,	355243,	329604,	390802,	501221,	630933,	668309,	613863,	616554,	[558978]	[431598]

Table 5.11

Run title : Arctic Saithe (run: XSAAGE06/X06)

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1627,	1090,	1835,	1681,	1510,	666,	1172,	395,	751,	858,
5,	58871,	78052,	61453,	60244,	75304,	64596,	32446,	44946,	16298,	24878,
6,	135220,	92707,	109480,	72393,	72833,	92794,	91928,	32958,	50822,	15253,
7,	79729,	126319,	91175,	80343,	73706,	69417,	97459,	65183,	29176,	40770,
8,	134220,	70297,	115329,	65939,	59665,	61372,	62640,	63794,	39995,	18612,
9,	45896,	106046,	63505,	66920,	56762,	45941,	55264,	43436,	32300,	25493,
10,	41969,	32908,	90158,	39784,	47196,	45670,	37435,	37942,	25690,	16967,
+gp,	115844,	32966,	89201,	123773,	91677,	89406,	72454,	83783,	55209,	26006,
TOTSPBIO,	613377,	530384,	622138,	510977,	478653,	469862,	450797,	372439,	250231,	168837,

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	853,	658,	1270,	761,	1667,	839,	826,	453,	450,	1365,
5,	29316,	36931,	23993,	54864,	27515,	64875,	33548,	26947,	17873,	17367,
6,	27290,	33289,	36463,	21707,	45211,	20303,	51349,	30662,	24891,	16253,
7,	14010,	24242,	26102,	25854,	13789,	36500,	15478,	26126,	18242,	18927,
8,	28139,	10443,	13021,	16336,	16569,	10787,	21936,	9093,	12253,	11413,
9,	12217,	21574,	5102,	7407,	5812,	12520,	5625,	10865,	5069,	6950,
10,	16241,	7370,	11248,	4327,	3858,	3413,	7495,	1941,	5509,	3615,
+gp,	47369,	27525,	29966,	10324,	8727,	15837,	14136,	14850,	4813,	14071,
TOTSPBIO,	175434,	162031,	147164,	141580,	123149,	165074,	150393,	120937,	89100,	89962,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1016,	565,	404,	376,	1254,	2554,	1212,	987,	1746,	613,
5,	61305,	48937,	25550,	17919,	16966,	64755,	99312,	66490,	43246,	80149,
6,	23340,	62397,	41430,	30648,	20360,	17766,	60636,	115497,	74039,	45036,
7,	14362,	15406,	38372,	29284,	23988,	9375,	11731,	31481,	83751,	51812,
8,	11111,	3824,	9187,	20920,	19259,	8484,	4930,	5631,	18451,	37762,
9,	9338,	2799,	1792,	4678,	13750,	6732,	5117,	2460,	3174,	6774,
10,	3324,	2134,	2052,	1515,	3756,	8882,	3333,	3358,	1753,	846,
+gp,	1450,	2774,	3196,	3061,	4049,	1898,	9583,	5004,	4988,	2676,
TOTSPBIO,	125246,	138834,	121984,	108401,	103383,	120436,	195855,	230908,	231146,	225668,

Table 5.12

Run title : Arctic Saithe (run: XSAAGE06/X06)

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Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 3- 6,
1960,	121646,	623159,	320643,	136006,	.4242,	1.2793,	.2667,
1961,	213265,	777147,	406911,	109821,	.2699,	1.4354,	.2338,
1962,	355492,	863498,	423035,	122841,	.2904,	1.2489,	.2289,
1963,	121806,	925401,	439248,	148036,	.3370,	1.2026,	.2244,
1964,	368886,	1072550,	525376,	198110,	.3771,	1.1684,	.2262,
1965,	210338,	997874,	519888,	184548,	.3550,	1.0721,	.2254,
1966,	241187,	1075168,	563338,	201860,	.3583,	1.0963,	.2768,
1967,	191846,	986298,	581111,	191191,	.3290,	.9990,	.2752,
1968,	367812,	1111314,	613377,	107181,	.1747,	1.1338,	.1606,
1969,	347400,	1039842,	530384,	140379,	.2647,	.9756,	.2118,
1970,	379777,	1189729,	622138,	260404,	.4186,	.9575,	.3292,
1971,	219495,	962800,	510977,	244732,	.4789,	.7953,	.3672,
1972,	278361,	876157,	478653,	210508,	.4398,	.8212,	.4218,
1973,	117249,	765050,	469862,	215659,	.4590,	.8167,	.4370,
1974,	206167,	737030,	450797,	262301,	.5819,	.9694,	.6299,
1975,	373508,	692357,	372439,	233453,	.6268,	1.0155,	.4670,
1976,	305106,	616384,	250231,	242486,	.9690,	1.0020,	.6835,
1977,	178747,	482195,	168837,	182809,	1.0827,	1.0061,	.5859,
1978,	283511,	473940,	175434,	154465,	.8805,	1.0278,	.5445,
1979,	167664,	482874,	162031,	164234,	1.0136,	1.1388,	.5232,
1980,	356378,	547802,	147164,	154379,	1.0490,	.9991,	.5549,
1981,	152674,	532106,	141580,	175516,	1.2397,	.9975,	.5572,
1982,	140121,	478752,	123149,	170903,	1.3878,	.9961,	.6288,
1983,	118849,	480809,	165074,	155405,	.9414,	.9991,	.5335,
1984,	137588,	403478,	150393,	158796,	1.0559,	.9997,	.7402,
1985,	271024,	370057,	120937,	107147,	.8860,	.9930,	.5615,
1986,	203778,	346577,	89100,	70458,	.7908,	.9929,	.4031,
1987,	102332,	366045,	89962,	91679,	1.0191,	1.0154,	.3496,
1988,	78095,	355243,	125246,	114508,	.9143,	.9902,	.4148,
1989,	88225,	329604,	138834,	122664,	.8835,	.9978,	.5696,
1990,	282496,	390802,	121984,	95393,	.7820,	1.0001,	.4901,
1991,	447214,	501221,	108401,	107326,	.9901,	.9912,	.4475,
1992,	295702,	630933,	103383,	127606,	1.2343,	1.0000,	.4535,
1993,	204676,	668309,	120436,	153584,	1.2752,	1.0008,	.4039,
1994,	341287,	613863,	195855,	142253,	.7263,	1.0038,	.4113,
1995,	113092,	616554,	230908,	169444,	.7338,	1.0008,	.4435,
1996,	152514,	569718,	231146,	171498,	.7419,	.9999,	.3607,
1997,	143000,	492110,	225668,	143355,	.6352,	1.0011,	.3787,
Arith. Mean ,	228377,	669599,	295103,	161656,	.7215		.4216,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

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Table 5.13

The SAS System 17:38 Friday, August 21, 1998

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

Prediction with management option table: Input data

Year: 1998								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.430	0.0088	0.430
3	116789.00	0.2000	0.0000	0.0000	0.0000	0.590	0.1187	0.590
4	88268.000	0.2000	0.0100	0.0000	0.0000	0.840	0.3698	0.840
5	42477.000	0.2000	0.5500	0.0000	0.0000	1.240	0.4673	1.240
6	61105.000	0.2000	0.8500	0.0000	0.0000	1.740	0.5588	1.740
7	14340.000	0.2000	0.9800	0.0000	0.0000	2.530	0.7246	2.530
8	8576.000	0.2000	1.0000	0.0000	0.0000	3.520	0.7259	3.520
9	4683.000	0.2000	1.0000	0.0000	0.0000	4.410	0.8035	4.410
10	593.000	0.2000	1.0000	0.0000	0.0000	5.540	0.7961	5.540
11+	202.000	0.2000	1.0000	0.0000	0.0000	7.380	0.7961	7.380
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1999								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.430	0.0088	0.430
3	.	0.2000	0.0000	0.0000	0.0000	0.590	0.1187	0.590
4	.	0.2000	0.0100	0.0000	0.0000	0.840	0.3698	0.840
5	.	0.2000	0.5500	0.0000	0.0000	1.240	0.4673	1.240
6	.	0.2000	0.8500	0.0000	0.0000	1.740	0.5588	1.740
7	.	0.2000	0.9800	0.0000	0.0000	2.530	0.7246	2.530
8	.	0.2000	1.0000	0.0000	0.0000	3.520	0.7259	3.520
9	.	0.2000	1.0000	0.0000	0.0000	4.410	0.8035	4.410
10	.	0.2000	1.0000	0.0000	0.0000	5.540	0.7961	5.540
11+	.	0.2000	1.0000	0.0000	0.0000	7.380	0.7961	7.380
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
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.430	0.0088	0.430
3	.	0.2000	0.0000	0.0000	0.0000	0.590	0.1187	0.590
4	.	0.2000	0.0100	0.0000	0.0000	0.840	0.3698	0.840
5	.	0.2000	0.5500	0.0000	0.0000	1.240	0.4673	1.240
6	.	0.2000	0.8500	0.0000	0.0000	1.740	0.5588	1.740
7	.	0.2000	0.9800	0.0000	0.0000	2.530	0.7246	2.530
8	.	0.2000	1.0000	0.0000	0.0000	3.520	0.7259	3.520
9	.	0.2000	1.0000	0.0000	0.0000	4.410	0.8035	4.410
10	.	0.2000	1.0000	0.0000	0.0000	5.540	0.7961	5.540
11+	.	0.2000	1.0000	0.0000	0.0000	7.380	0.7961	7.380
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANSME04
Date and time: 21AUG98:17:39

Table 5.14

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

Yield per recruit: Summary table

F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	13865.217	2.713	11952.601	2.713	11952.601
0.0500	0.0189	0.093	330.372	5.054	11106.225	2.265	9211.772	2.265	9211.772
0.1000	0.0379	0.161	519.804	4.717	9211.933	1.941	7335.076	1.941	7335.076
0.1500	0.0568	0.213	629.911	4.458	7847.830	1.696	5988.024	1.696	5988.024
0.2000	0.0757	0.254	693.251	4.252	6829.358	1.503	4986.084	1.503	4986.084
0.2500	0.0947	0.288	728.170	4.083	6046.862	1.347	4219.623	1.347	4219.623
0.3000	0.1136	0.317	745.487	3.941	5431.419	1.218	3619.735	1.218	3619.735
0.3500	0.1325	0.341	751.805	3.821	4937.748	1.110	3141.163	1.110	3141.163
0.4000	0.1515	0.363	751.252	3.716	4535.025	1.017	2753.100	1.017	2753.100
0.4500	0.1704	0.381	746.457	3.624	4201.640	0.937	2433.953	0.937	2433.953
0.5000	0.1893	0.398	739.115	3.543	3922.064	0.867	2168.212	0.867	2168.212
0.5500	0.2083	0.413	730.324	3.470	3684.897	0.806	1944.492	0.806	1944.492
0.6000	0.2272	0.426	720.801	3.404	3481.620	0.751	1754.289	0.751	1754.289
0.6500	0.2461	0.438	711.008	3.344	3305.760	0.702	1591.144	0.702	1591.144
0.7000	0.2651	0.449	701.242	3.290	3152.328	0.658	1450.084	0.658	1450.084
0.7500	0.2840	0.459	691.691	3.240	3017.431	0.618	1327.229	0.618	1327.229
0.8000	0.3029	0.469	682.467	3.193	2897.995	0.582	1219.517	0.582	1219.517
0.8500	0.3219	0.478	673.635	3.151	2791.566	0.549	1124.507	0.549	1124.507
0.9000	0.3408	0.486	665.226	3.111	2696.167	0.519	1040.232	0.519	1040.232
0.9500	0.3597	0.494	657.249	3.073	2610.191	0.491	965.096	0.491	965.096
1.0000	0.3787	0.501	649.702	3.039	2532.319	0.465	897.791	0.465	897.791
1.0500	0.3976	0.507	642.572	3.006	2461.461	0.442	837.239	0.442	837.239
1.1000	0.4165	0.514	635.841	2.975	2396.712	0.420	782.542	0.420	782.542
1.1500	0.4354	0.520	629.489	2.946	2337.311	0.399	732.949	0.399	732.949
1.2000	0.4544	0.526	623.495	2.918	2282.618	0.380	687.828	0.380	687.828
1.2500	0.4733	0.531	617.836	2.892	2232.088	0.363	646.643	0.363	646.643
1.3000	0.4922	0.536	612.490	2.867	2185.257	0.346	608.939	0.346	608.939
1.3500	0.5112	0.541	607.438	2.844	2141.728	0.330	574.326	0.330	574.326
1.4000	0.5301	0.546	602.658	2.821	2101.156	0.316	542.466	0.316	542.466
1.4500	0.5490	0.550	598.133	2.800	2063.245	0.302	513.069	0.302	513.069
1.5000	0.5680	0.554	593.845	2.779	2027.735	0.289	485.883	0.289	485.883
1.5500	0.5869	0.558	589.777	2.760	1994.399	0.277	460.688	0.277	460.688
1.6000	0.6058	0.562	585.916	2.741	1963.039	0.266	437.291	0.266	437.291
1.6500	0.6248	0.566	582.246	2.723	1933.480	0.255	415.523	0.255	415.523
1.7000	0.6437	0.570	578.755	2.705	1905.565	0.245	395.233	0.245	395.233
1.7500	0.6626	0.573	575.431	2.689	1879.158	0.235	376.291	0.235	376.291
1.8000	0.6816	0.577	572.263	2.673	1854.135	0.226	358.577	0.226	358.577
1.8500	0.7005	0.580	569.241	2.657	1830.388	0.217	341.988	0.217	341.988
1.9000	0.7194	0.583	566.355	2.642	1807.817	0.209	326.430	0.209	326.430
1.9500	0.7384	0.586	563.598	2.628	1786.335	0.201	311.820	0.201	311.820
2.0000	0.7573	0.589	560.961	2.614	1765.861	0.194	298.081	0.194	298.081
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDSME04
Date and time : 22AUG98:12:58
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.2063
F-max factor : 0.3690
F-0.1 reference F : 0.0781
F-max reference F : 0.1397
Recruitment : Single recruit

Table 5.15

The SAS System 09:36 Saturday, August 22, 1998

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

Prediction with management option table

Year: 1998					Year: 1999					Year: 2000	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.1437	0.4330	484241	211255	146500	0.0000	0.0000	463769	170548	0	622526	265796
.	.	.	.	.	0.0500	0.0189	.	170548	7444	613179	258135
.	.	.	.	.	0.1000	0.0379	.	170548	14687	604090	250709
.	.	.	.	.	0.1500	0.0568	.	170548	21734	595252	243512
.	.	.	.	.	0.2000	0.0757	.	170548	28593	586656	236534
.	.	.	.	.	0.2500	0.0947	.	170548	35268	578296	229771
.	.	.	.	.	0.3000	0.1136	.	170548	41766	570164	223213
.	.	.	.	.	0.3500	0.1325	.	170548	48091	562252	216856
.	.	.	.	.	0.4000	0.1515	.	170548	54250	554554	210693
.	.	.	.	.	0.4500	0.1704	.	170548	60246	547065	204716
.	.	.	.	.	0.5000	0.1893	.	170548	66086	539776	198921
.	.	.	.	.	0.5500	0.2083	.	170548	71773	532682	193301
.	.	.	.	.	0.6000	0.2272	.	170548	77312	525778	187852
.	.	.	.	.	0.6500	0.2461	.	170548	82708	519057	182566
.	.	.	.	.	0.7000	0.2651	.	170548	87966	512513	177440
.	.	.	.	.	0.7500	0.2840	.	170548	93088	506143	172469
.	.	.	.	.	0.8000	0.3029	.	170548	98080	499939	167646
.	.	.	.	.	0.8500	0.3219	.	170548	102945	493898	162968
.	.	.	.	.	0.9000	0.3408	.	170548	107687	488014	158430
.	.	.	.	.	0.9500	0.3597	.	170548	112309	482282	154027
.	.	.	.	.	1.0000	0.3787	.	170548	116816	476699	149756
.	.	.	.	.	1.0500	0.3976	.	170548	121210	471259	145612
.	.	.	.	.	1.1000	0.4165	.	170548	125495	465958	141591
.	.	.	.	.	1.1500	0.4354	.	170548	129674	460793	137689
.	.	.	.	.	1.2000	0.4544	.	170548	133751	455758	133902
.	.	.	.	.	1.2500	0.4733	.	170548	137727	450851	130228
.	.	.	.	.	1.3000	0.4922	.	170548	141607	446068	126662
.	.	.	.	.	1.3500	0.5112	.	170548	145392	441404	123201
.	.	.	.	.	1.4000	0.5301	.	170548	149086	436857	119841
.	.	.	.	.	1.4500	0.5490	.	170548	152692	432423	116580
.	.	.	.	.	1.5000	0.5680	.	170548	156211	428098	113415
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSME04
Date and time : 22AUG98:09:41
Computation of ref. F: Simple mean, age 3 - 6
Basis for 1998 : TAC constraints

Table 5.16

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
1998	1.1437	0.4331	100564	146504	547033	484241	104291	211255	104291	211255
1999	0.2063	0.0781	20258	29443	567797	463764	80050	170544	80050	170544
2000	0.2063	0.0781	27131	40713	656600	585585	106277	235666	106277	235666
2001	0.2063	0.0781	33564	54001	723108	707464	151747	330734	151747	330734
2002	0.2063	0.0781	38874	67905	771760	827660	195399	442285	195399	442285
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	1.1437	0.4331	100564	146504	547033	484241	104291	211255	104291	211255
1999	0.3690	0.1397	35042	50450	567797	463764	80050	170544	80050	170544
2000	0.3690	0.1397	44722	64810	643303	559297	97877	214487	97877	214487
2001	0.3690	0.1397	53274	80818	696401	648633	132597	280550	132597	280550
2002	0.3690	0.1397	59774	96314	732174	729968	164280	354826	164280	354826
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	1.1437	0.4331	100564	146504	547033	484241	104291	211255	104291	211255
1999	0.7923	0.3000	69208	97318	567797	463764	80050	170544	80050	170544
2000	0.7923	0.3000	78783	104570	612704	500880	79210	168376	79210	168376
2001	0.7923	0.3000	86799	114184	640855	534334	94675	186014	94675	186014
2002	0.7923	0.3000	91946	122830	656707	561451	108151	209033	108151	209033
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	1.1437	0.4331	100564	146504	547033	484241	104291	211255	104291	211255
1999	0.8450	0.3200	73073	102462	567797	463764	80050	170544	80050	170544
2000	0.8450	0.3200	82094	107816	609256	494491	77171	163426	77171	163426
2001	0.8450	0.3200	89734	116115	635080	523147	90911	177044	90911	177044
2002	0.8450	0.3200	94569	123745	649366	546473	102982	196548	102982	196548
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	1.1437	0.4331	100564	146504	547033	484241	104291	211255	104291	211255
1999	1.0000	0.3787	83992	116814	567797	463764	80050	170544	80050	170544
2000	1.0000	0.3787	90891	115765	599529	476695	71496	149753	71496	149753
2001	1.0000	0.3787	97262	120111	619287	493289	80819	153427	80819	153427
2002	1.0000	0.3787	101176	125009	629749	507802	89489	164841	89489	164841
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1998	1.1437	0.4331	100564	146504	547033	484241	104291	211255	104291	211255
1999	1.5317	0.5800	116947	158396	567797	463764	80050	170544	80050	170544
2000	1.5317	0.5800	112816	130149	570321	425410	55221	111454	55221	111454
2001	1.5317	0.5800	114431	122940	575976	417392	54952	96203	54952	96203
2002	1.5317	0.5800	115819	122041	579141	417798	57311	95184	57311	95184
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRAGE01
Date and time : 22AUG98:16:35
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors

Figure 5.1A - D Saithe in the Northeast Arctic (Areas I and II)

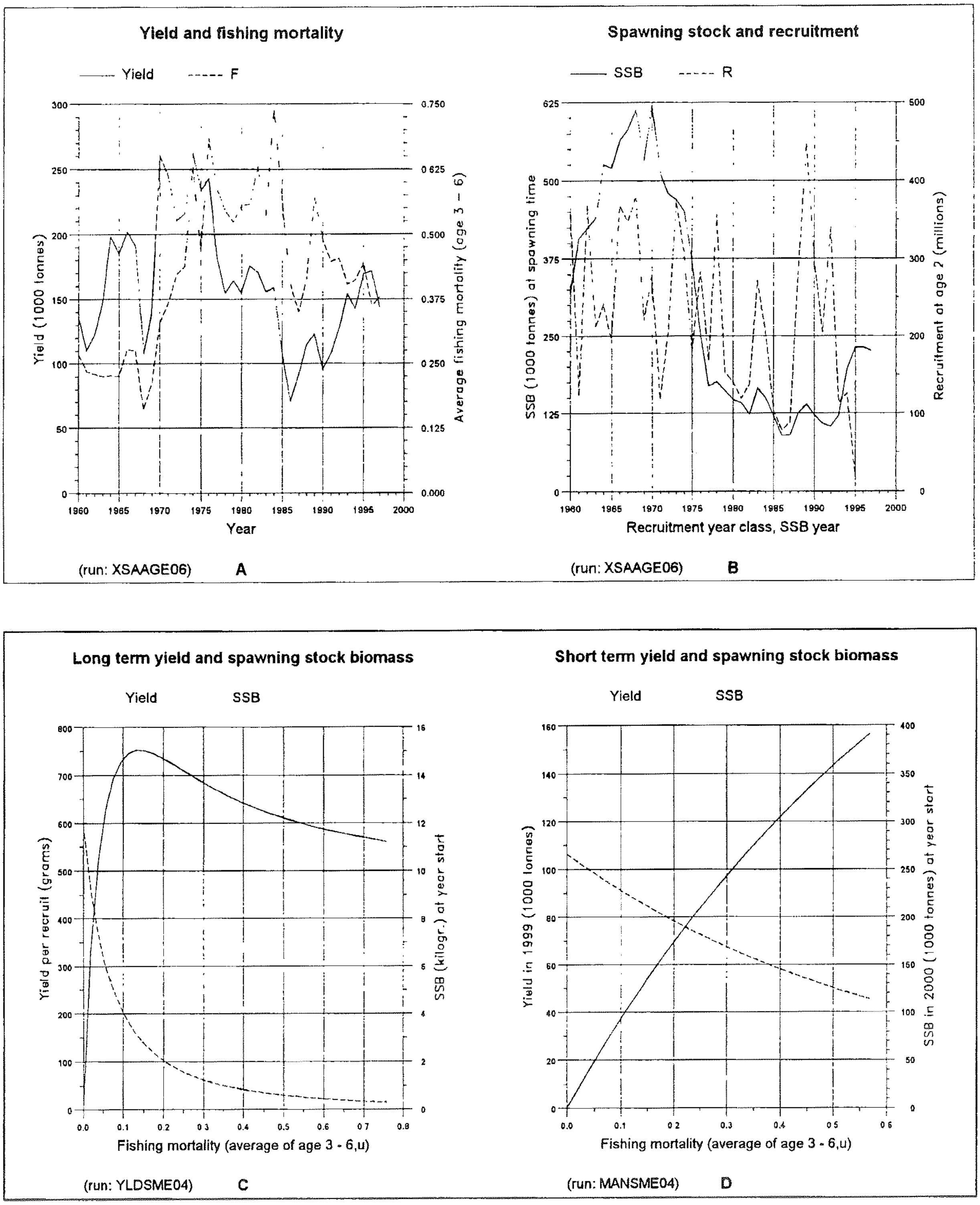
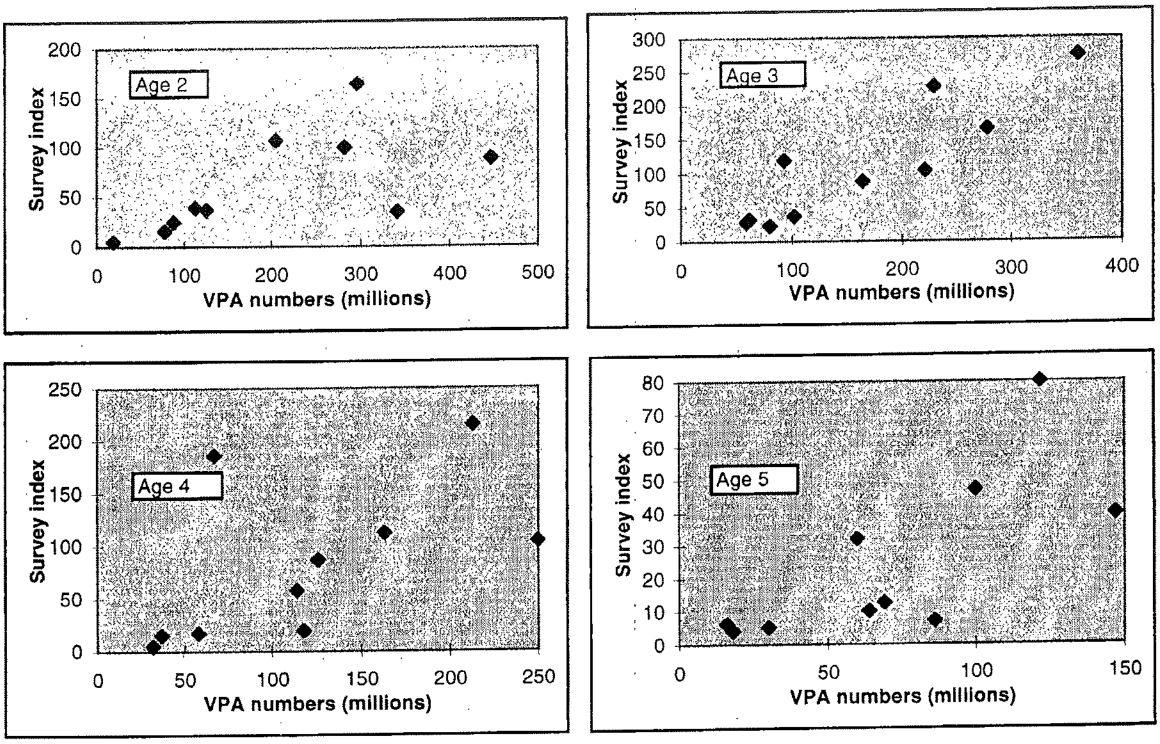


Figure 5.2A. North-East Arctic Saithe - Acoustic survey vs VPA



 F-5-2A.XLS

Figure 5.2B. North-East Arctic Saithe - Norwegian purse seine vs VPA

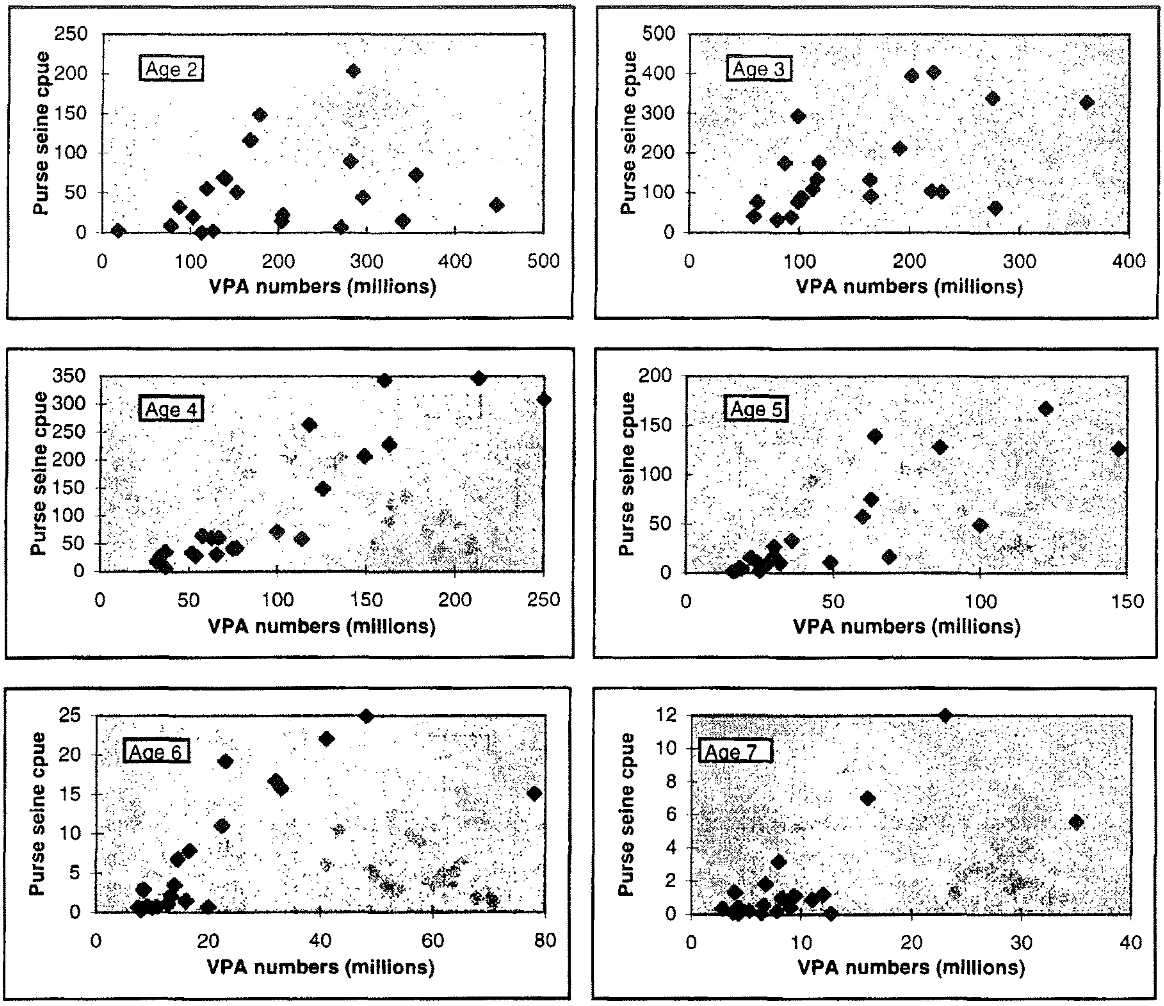
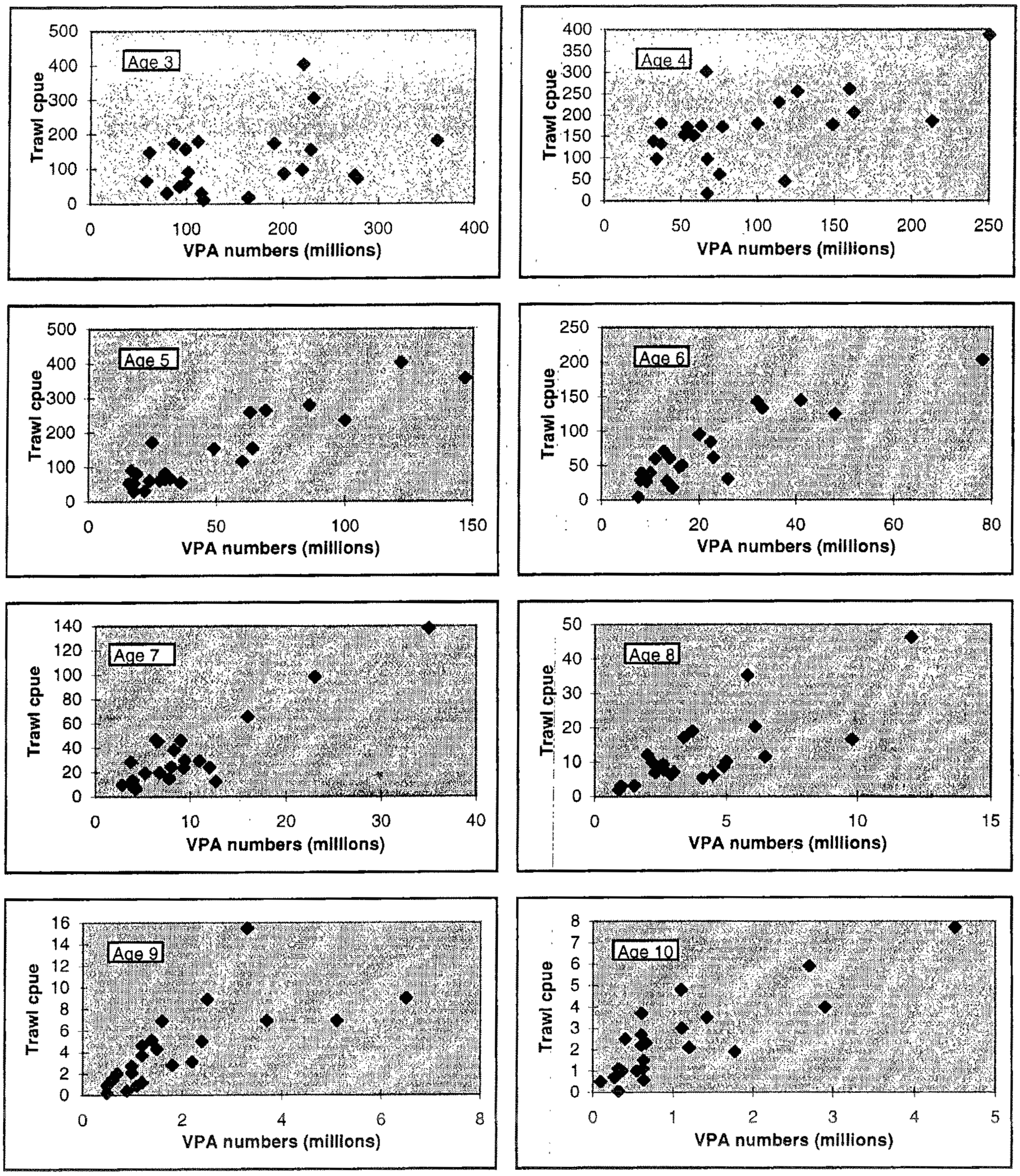


Figure 5.2C. North-East Arctic Saithe - Norwegian trawl vs VPA



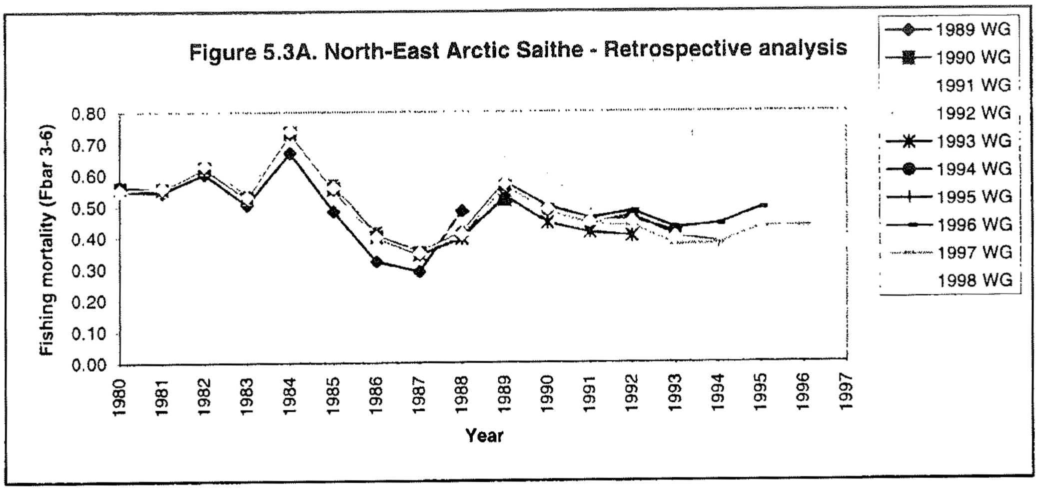


Figure 5.3A. North-East Arctic Saithe - Retrospective analysis
Fishing mortality (Fbar 3-6)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
Year
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG

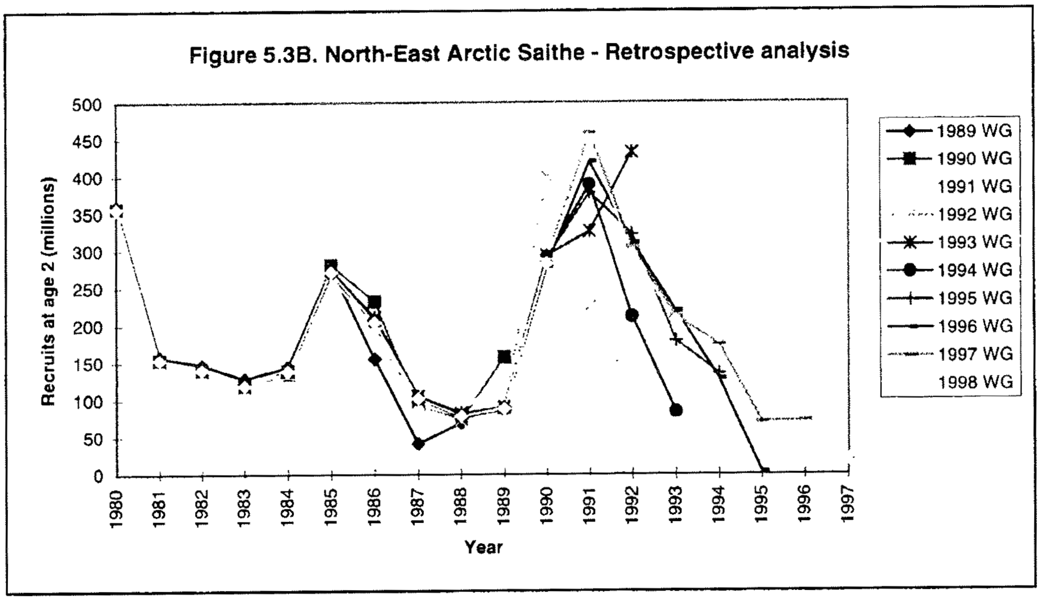


Figure 5.3B. North-East Arctic Saithe - Retrospective analysis
Recruits at age 2 (millions)
500
450
400
350
300
250
200
150
100
50
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
Year
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG

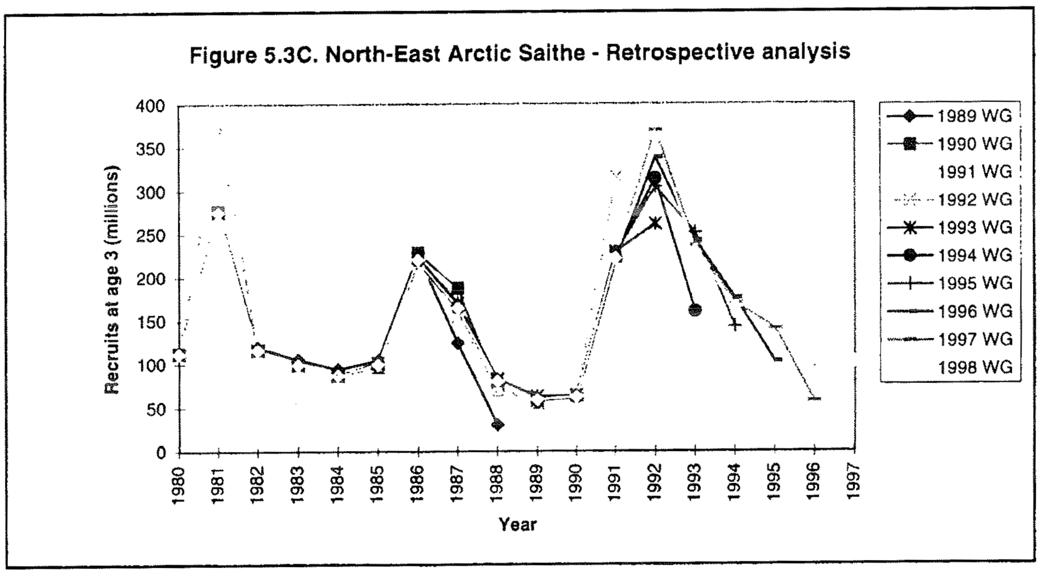


Figure 5.3C. North-East Arctic Saithe - Retrospective analysis
Recruits at age 3 (millions)
400
350
300
250
200
150
100
50
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
Year
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG

Stock - Recruitment

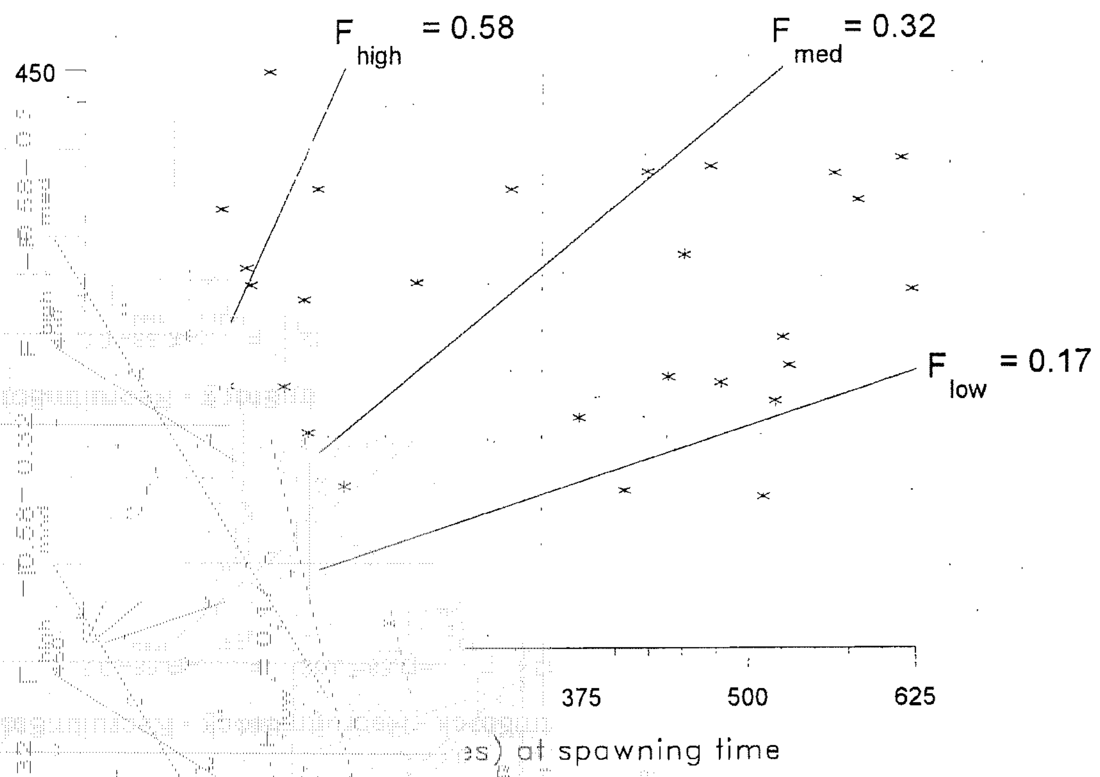
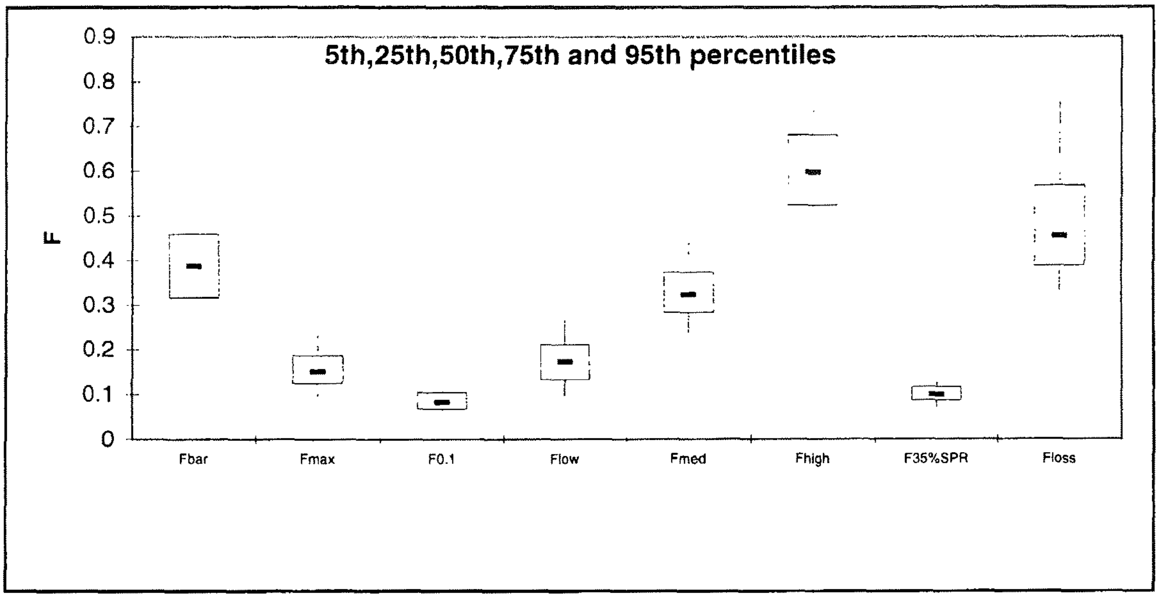


Figure 5.5. Results of precautionary reference points analysis for Northeast Arctic saithe using the PASoft package.



Reference point	Deterministic	Median	95th percentile	80th percentile
MedianRecruits	211802	211802	276760	232510
MBAL	170000			
Bloss	89100			
SSB90%R90%Surv	168813	172767	275972	206322
SPR%ofVirgin	7.51	7.98	12.46	9.95
VirginSPR	11.95	11.96	18.12	14.87
SPRloss	0.78	0.79	1.09	0.99
	Deterministic	**Median**	**5th percentile**	**20th percentile**
FBar	0.38	0.38	0.27	0.32
Fmax	0.14	0.14	0.10	0.12
F0.1	0.08	0.08	0.05	0.06
Flow	0.17	0.17	0.11	0.14
Fmed	0.32	0.32	0.23	0.28
Fhigh	0.59	0.58	0.40	0.50
F35%SPR	0.10	0.10	0.07	0.08
Floss	0.42	0.43	0.30	0.35

Figures 5.6A - F, Northeast Arctic saithe. MBAL set at 170,000 t.

Figure 5.6A Quantiles of the SSB distribution, F_{01}=0,0781

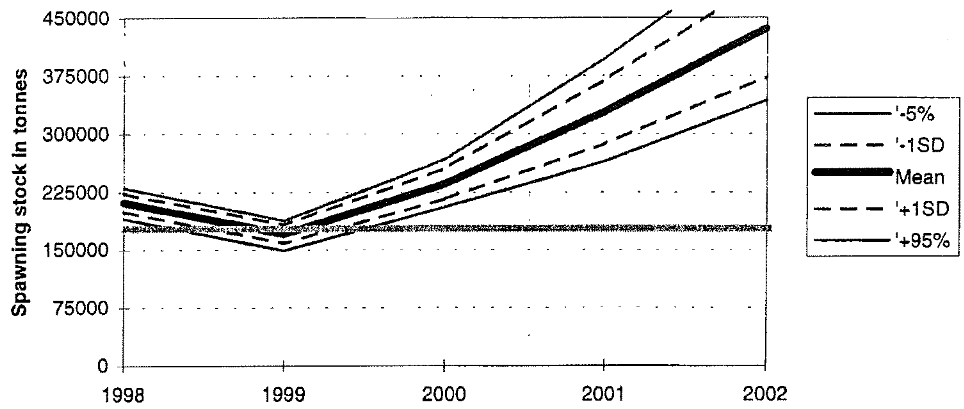


Figure 5.6B Quantiles of the SSB distribution, F_{max}=0,1397

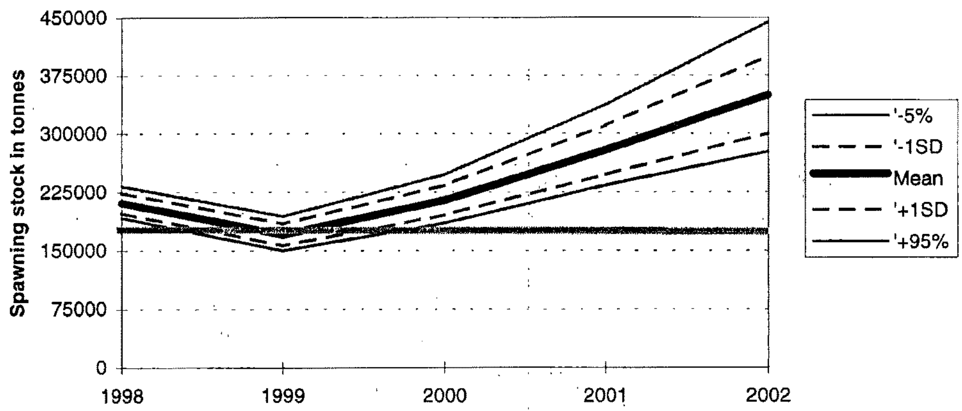
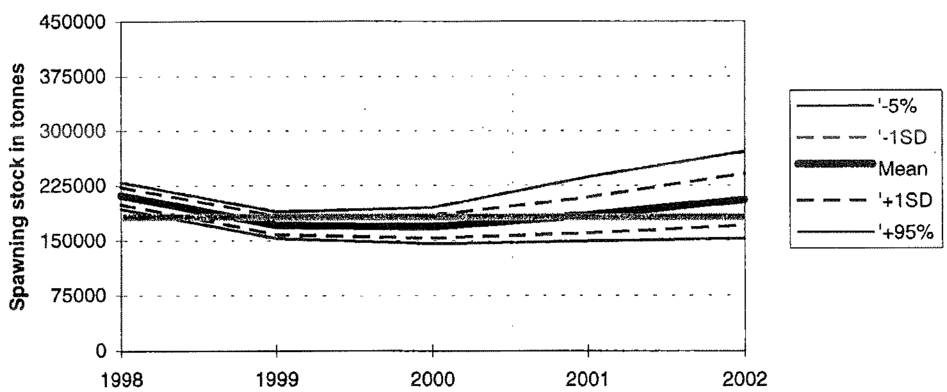
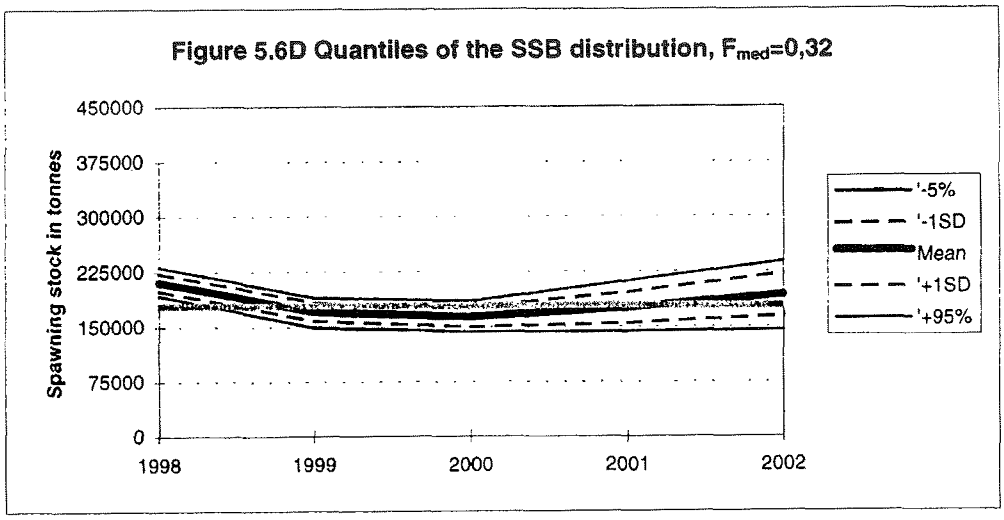
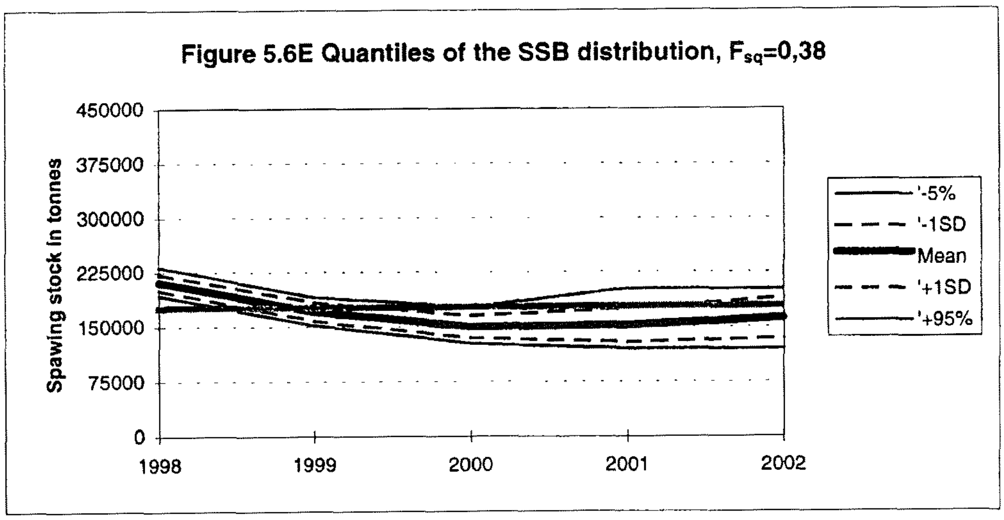


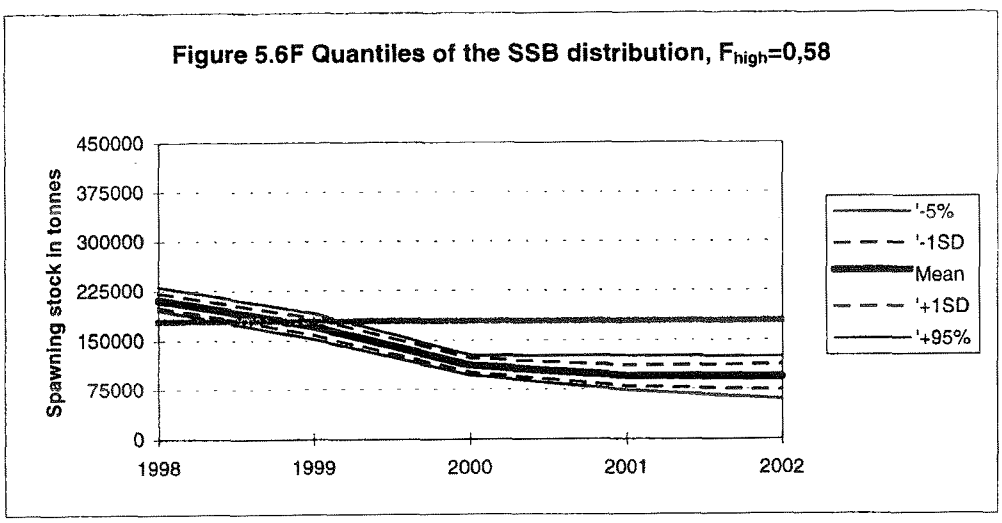
Figure 5.6C Quantiles of the SSB distribution, F_{pa}=0,30



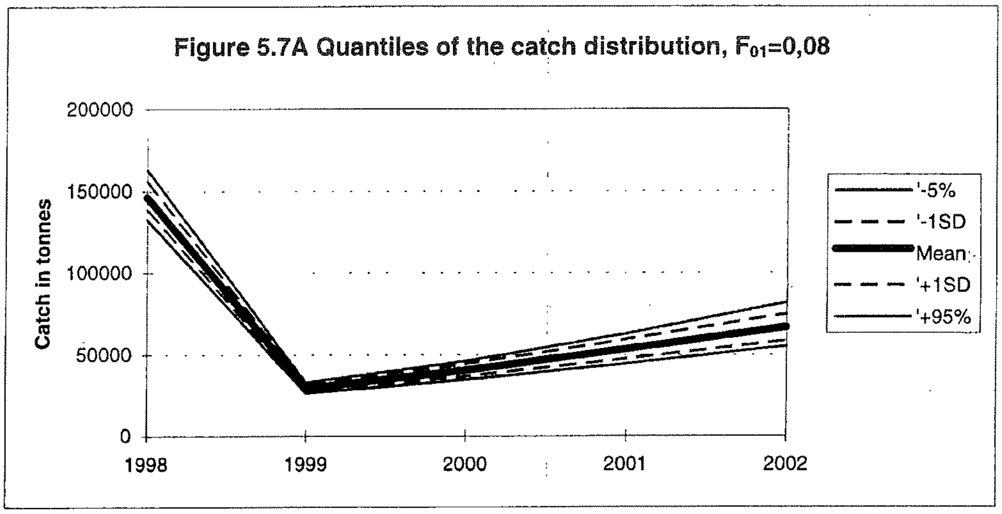
Figures 5.6A - F, Northeast Arctic saithe. MBAL set at 170,000 t.

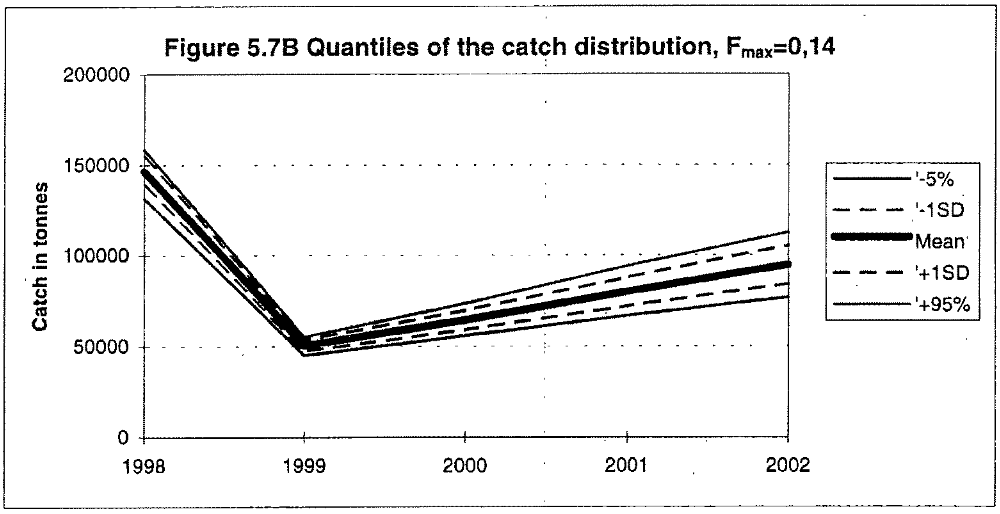


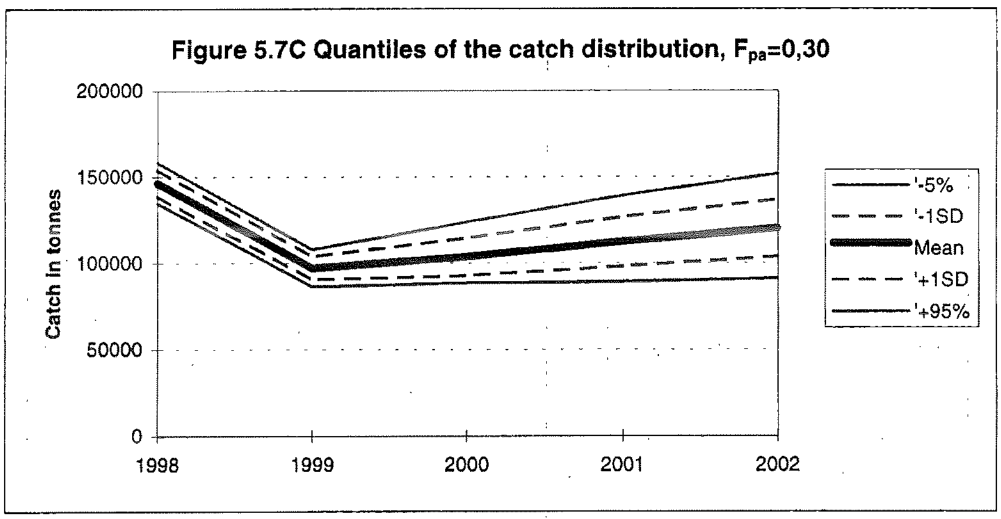




Figures 5.7A - F, Northeast Arctic saithe







F-5-7.XLS

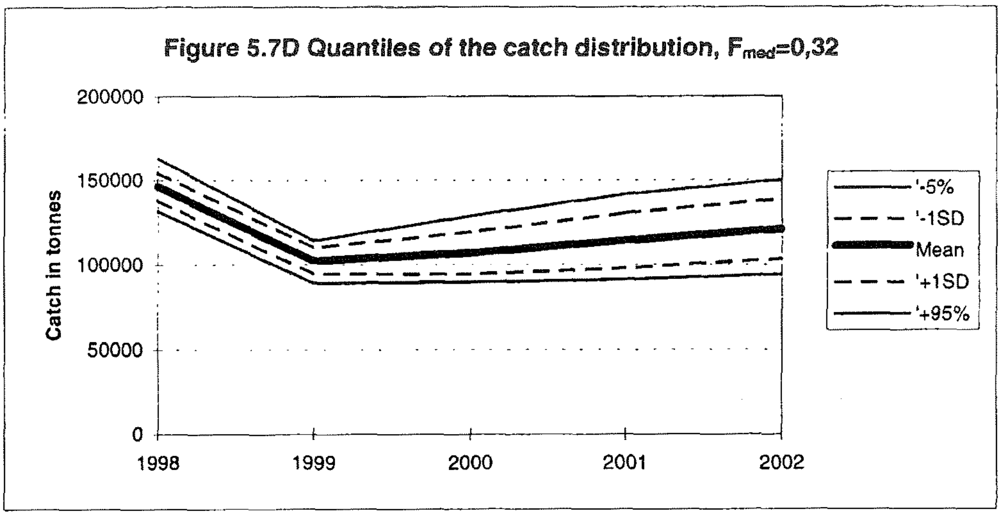


Figure 5.7D Quantiles of the catch distribution, F_{med}=0,32
200000
150000
100000
50000
0
Catch in tonnes
1998
1999
2000
2001
2002
'-5%
'-1SD
Mean
'+1SD
'+95%

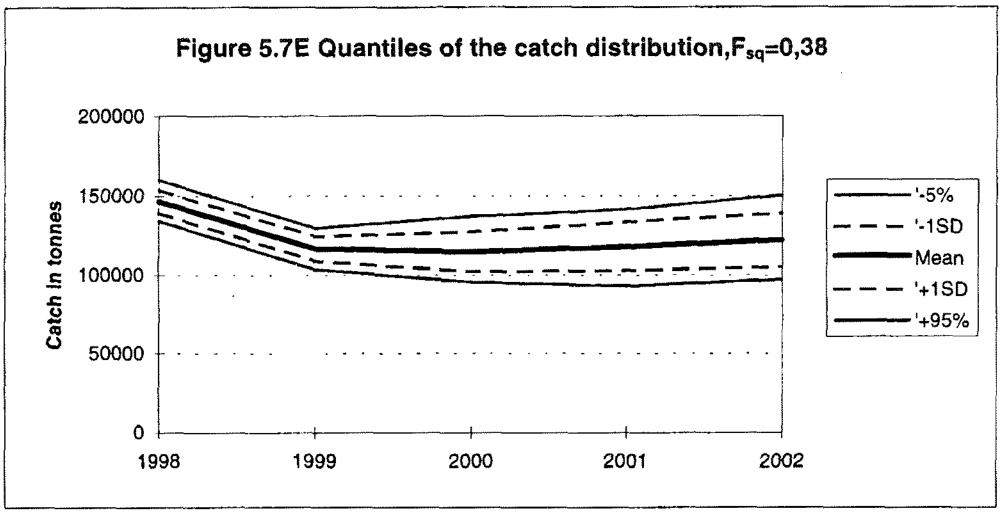


Figure 5.7E Quantiles of the catch distribution,F_{sq}=0,38
200000
150000
100000
50000
0
Catch in tonnes
1998
1999
2000
2001
2002
'-5%
'-1SD
Mean
'+1SD
'+95%

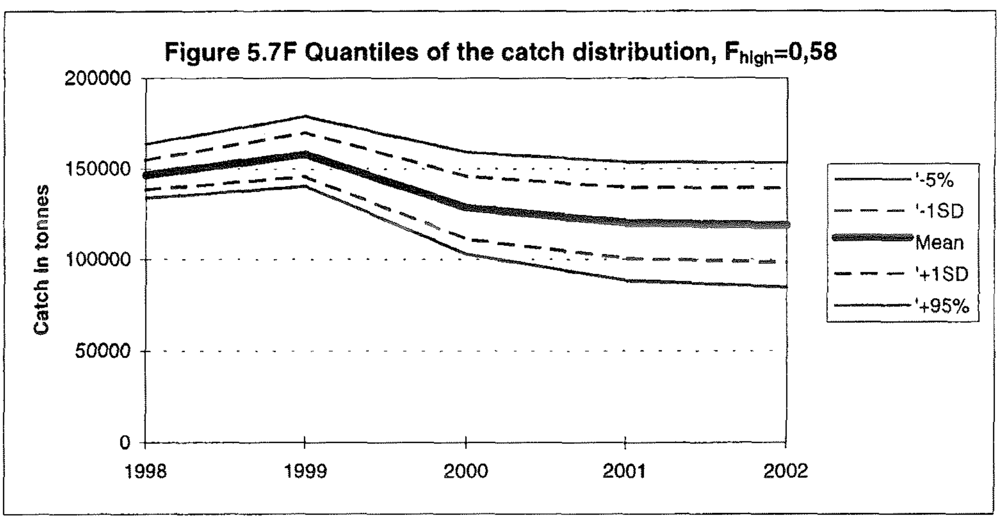


Figure 5.7F Quantiles of the catch distribution, F_{high}=0,58
200000
150000
100000
50000
0
Catch in tonnes
1998
1999
2000
2001
2002
'-5%
'-1SD
Mean
'+1SD
'+95%

Table C.1 North-East Arctic SAITHE. Norwegian purse seiners taking part in the saithe fishery. Data given are: number of vessels, catch in tonnes, catch per vessel.

	Vessel length (m)								
	-19.9			20.0-24.9			25.0-		
Year	Number	Catch	C/V	Number	Catch	C/V	Number	Catch	C/V
1977	208	21,398	103	66	25,324	384	19	5,655	298
1978	184	16,288	89	72	21,224	295	19	6,094	321
1979	250	21,224	85	72	27,057	376	25	9,122	365
1980	269	21,243	79	96	27.551	287	39	10,234	262
1981	312	25,984	83	89	29,108	327	23	7,354	320
1982	308	30,228	98	98	35,969	367	23	9,303	404
1983	222	19,925	90	80	28,348	354	12	5,524	460
1984	168	8,834	53	69	20,668	300	15	6,713	448
1985	90	4,150	46	57	18,328	322	16	8,391	524
1986	55	1,281	23	43	3,581	83	21	2,643	126
1987	106	9,084	86	46	16,766	364	15	8,185	546
1988	120	13,111	109	48	20,413	425	13	8,981	691
1989	195	14,993	77	61	23,000	377	13	10,466	805
1990	89	2,533	28	53	13,360	257	19	8,406	442
1991	122	8,726	72	56	20,378	364	19	9,797	516
1992	100	7,076	71	49	14,783	302	20	5,020	251
1993	48	6,110	127	45	19,502	433	19	7,433	391
1994	76	9,086	120	39	14,579	374	18	5,672	315
1995	67	3,502	52	34	8,290	244	19	10,108	532
1996	105	12,441	118	37	16,459	495	21	17,931	854
1997 [1]	98	10,172	103.8	49	19,771	403.5	24	13,874	578

[1] Preliminary

Table C.2 North-East Arctic SAITHE. Catch, effort, and catch per unit effort for Norwegian trawlers directing for saithe.

Year	Catch[1] (t)	Effort[1] (h)	CPUE[1] (kg/h)
1976	12,982	21,615	601
1977	15,583	29,308	532
1978	12,506	27,094	462
1979	16,609	24,258	685
1980	27,618	39,290	703
1981	43,682	49,191	888
1982	30,358	33,164	915
1983	38,846	37,856	1026
1984	56,128	60,282	931
1985	29,260	39,894	733
1986	20,897	25,037	835
1987	8,631	11,860	728
1988	16,589	21,034	789
1989	28,753	40,813	705
1990	28,445	42,689	666
1991	26,362	35,680	739
1992	42,785	43,885	975
1993	47,468	46,613	1018
1994	54,402	57,612	944
1995	72,846	76,732	949
1996	39,594	43,788	904
1997[2]	21,825	18,303	1192

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

Table C.3 North-East Arctic SAITHE. Norwegian effort indices.

Year	Purse seine[1]	Trawl[2]	Combined[3]
1976	-	36.8	-
1977	206	52.7	351
1978	214	51.3	355
1979	199	42.7	316
1980	215	57.4	373
1981	203	71.0	398
1982	213	58.2	373
1983	161	57.7	320
1984	124	85.5	359
1985	98	63.7	273
1986	96	45.2	220
1987	94	30.1	177
1988	103	50.4	242
1989	131	59.8	295
1990	96	60.4	262
1991	107	51.5	249
1992	90	57.6	248
1993	76	68.0	266
1994	78	78.7	294
1995	90	106.4	383
1996	105	74.7	310
1997	109	41.1	222

[1] Total effort. No. of vessels 20-24.9 m. length, raised to total effort by total purse seine catch.
[2] Hours trawling ('000). Effort in table C-2 scaled to total Norwegian trawleffort.
[3] Trawl indices scaled up to give the same average for 1977-1990 as
the purse seine indices (i.e. x 2.75) before adding the two.

Effort indices for both categories where raised to represent total Norwegian landings for the gear.

Table C.4 North-East Arctic Saithe. Acoustic abundance indices from Norwegian surveys in october-november. In 1985 - 1987 the area was incomplete. Numbers in millions.

Year	Age					
	2	3	4	5	6+	Total
1985	3.1	4.9	2.4	0.5	0.0	10.9
1986	19.5	40.8	3.6	1.8	1.8	67.5
1987	1.8	22.0	48.4	1.8	1.7	75.7
1988	15.7	22.5	19.0	7.1	0.6	64.9
1989	24.8	28.4	17.0	10.1	12.4	92.7
1990	99.6	31.9	14.7	5.1	7.4	158.7
1991	87.8	104.0	4.6	4.0	7.1	207.5
1992	163.5	273.6	57.5	6.2	8.8	509.6
1993	106.9	227.7	103.9	12.7	3.2	454.4
1994	34.4	87.8	112.4	39.5	10.0	284.1
1995	38.7	165.2	87.0	46.8	20.0	357.7
1996	37.0	118.9	214.7	32.1	19.3	422.0
1997	5.1	36.7	185.8	79.8	61.7	369.1

T-C4.XLS

Table C.5 North-East Arctic saithe. *Acoustic abundance indices from Norwegian coast and fjord* surveys by Fiskeriforskning, using ALKs from IMR's survey the same year. Numbers in thousands.

	agegroup											
Year	1	2	3	4	5	6	7	8	9	10	6+	Total
1995	680	13686	33703	9365	5695	2404	1342	708	110	171	4735	67864
1996	453	8332	21694	39385	7477	9440	3868	1249	0	0	14557	91898
1997	713	3410	7249	25713	7163	3741	2001	727	66	114	6649	50897

Only inner parts of area A,C and D (which are not covered by IMR) are included.

T-C5.XLS

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

6.1 Status of the Fisheries

6.1.1 Historical development of the fishery

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

6.1.2 Landings prior to 1998 (Tables 6.1–6.4, D1-D2)

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 (i.e., *S. mentella* and *S. marinus*) in Table D1. The nominal catches by country for Sub-area I and Divisions IIa and IIb are shown in Tables 6.2–6.4. The landings used by the Working Group (WG) are those officially reported to ICES except where such reporting are not available but reportings have been made to Norwegian authorities during the fishery. In such cases the reportings to Norwegian authorities have been used as preliminary figures. For Germany and Norway some area adjustments of the official statistics were made prior to the Working Group. The historical landings (up to 1990) from FRG and GDR have been added and are given under Germany.

Reliable estimates of species breakdown by area were available to the Working Group back to 1989. The national landings of redfish for Germany, Norway and Russia are split into species by the respective national laboratories. For other countries (and areas) the Working Group has split the landings into *S. mentella* and *S. marinus* based on reports from different fleets to the Norwegian fisheries authorities.

The total landings decreased from 48,727 t in 1991 to 15.590 t in 1992 and have continued to decline. Most of the reduction in landings of *S. mentella* during the last years has occurred in Division IIb, but a decline is also seen in Sub-area I and Division IIa. The provisional landings figure in 1997 is 8,261 t which is almost similar to the year before and the lowest level on record. Landings from Division IIa in 1997 represent 86% of the total. The landings in 1997 are about 3,000 t more than the 5,000 t expected by last year's Working Group. The regulations enforced in the fishery in 1997 (see chapter 6.1.3) have therefore not been sufficient for reducing the catches.

The redfish population in Sub-area IV (North Sea) is believed to belong to the north-east Arctic stock. Since this area is outside the traditional areas handled by this Working Group, the catches are not included in the assessment. The landings from Sub-area IV have been 1,000–2,000 t per year (Table D2). In 1992, however, the landings increased to 2,783 t due to an increase in the French fishery. 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, and e.g., about 80% of the Norwegian catches are considered to be *S. mentella*.

6.1.3 Expected landings in 1998

The only directed Russian fishery for *S. mentella* at present is within the Norwegian EEZ where Russia received a quota of 2,000 t for 1998. In addition to this, and based on reports from the eight first months in 1998, a by-catch of approx. 1,500 t in other fisheries and areas should give an expected total Russian catch in 1998 of about 3,500 t. Strong regulations were enforced in the fishery in 1997. It is now forbidden to fish redfish (both *S.marinus* and *S. mentella*) in the Norwegian EEZ north and west of straight lines through the positions:

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

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

Based on the landings of *S. mentella* halfway through the year, and a possible increase in interest for this species later in the year due to the closure of the saithe fishery, the total Norwegian landings in 1998 are expected to be around 7,000 t. On this basis, and assuming unchanged catch level for other countries, the landings of *S. mentella* for 1998 is expected to be 11,000 t.

6.2 Data used in the Assessment

All input data sets were updated up to and including 1997. Maturity ogives and some of the XSA tuning series were updated to 1998.

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

For 1997, catch-per-hour-trawling data for the *S. mentella* fishery were available from the Russian PST vessels fishing in ICES Division IIa in 1997, accounting for 35% of the total international trawl catch (Table D3). The CPUE has been fluctuating about the 1997-level since 1985 with no clear trend. However, this CPUE series does not represent the trend in stock size but is more a reflection of stock density. This is because the fishery on which these data are based is carried out on a localised spawning concentration. It was considered inappropriate, therefore, to utilise these in a surplus production analysis.

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

6.2.2 Catch at age (Table 6.5)

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

Catch at age for 1991–1996 was revised according to new catch data. Data on age for 1997 for *S. mentella* were only available from Russia in Division IIa and Norway. For Division IIa, a German length distribution was available, and were converted to age using a Russian age-length key from the fishing area. The landings from other countries in Sub-area I and Division IIb were distributed on age according to the Norwegian age distribution, and in Division IIa according to the Russian age distribution.

6.2.3 Weight at age (Table 6.6)

Catch weight-at-age data for 1997 were available from Norway and from Russia in Division IIa (Table 6.6). The weight at age in the stock was set equal to the weight at age in the catch. It should be further investigated whether it would be better to use a constant weight-at-age series (e.g., based on survey information) instead of catch weight-at-age which may vary due to changes and selections in the fisheries and not due to growth changes in the stock.

6.2.4 Maturity at age (Tables 6.7 and D8)

Age-based maturity ogives for *S. mentella* (sexes combined) are available for 1986–1993, 1995 and 1997–1998 from Russian research vessel observations in spring (Table D8). Average ogives for 1966-1972 and 1975-1983 have been used for the periods 1965-1975 and 1976-1983, respectively. Average ogives for 1975-1983, 1984-1985 and data for 1986-1993 (Table D8) was used to generate a smoothed maturity ogive for 1984-1992 (3 years running average). 1992-1993 average was used for 1993 and 1994, the 1995 data for 1995, the average for 1995 and 1997 for 1996 and the collected 1997 data were taken as representative for 1997.

6.2.5 Survey results (Tables A14, D4-D7, Figures 6.1–6.5)

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

1) The international 0-group survey in the Svalbard and Barents Sea areas in August-September Table A14 and Figure 6.1).

2) Russian bottom trawl survey in the Svalbard and Barents Sea areas in October-December from 1978–97 in fishing depths of 100–900 m (Table D4, Figure 6.2).

3) Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1986–97 in fishing depths of < 100–500 m. Data disaggregated on age only for the years 1992–97 (Table D5a,b and Figure 6.3a,b).

4) Norwegian Barents Sea bottom trawl survey (February) from 1986–98 in fishing depths of < 100–500 m. Data disaggregated on age only for the years 1992–98 (Tables D6a.b and Figures 6.4a,b).

5) Russian acoustic survey in April-May from 1992–98 (except 1994 and 1996) on spawning grounds in the western Barents Sea (Table D7).

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, Figure 6.1). The survey design has improved and the indices earlier than 1980 are not directly comparable with subsequent years. A considerable reduction in the abundance of 0-group redfish was observed in the 1991 survey: abundance decreased to only 20% of the 1979–1990 average. With the exception of an abundance index of twice the 1991-level in 1994, the indices have remained low. Record low levels of less than 20% of the 1991–1995 average have been observed for the 1996- and 1997-year classes.

The Norwegian Svalbard groundfish survey in August-September (Table D5a,b and Figures 6.3a,b), with age disaggregated data from 1992 onwards, shows some relative good year classes (1988–1990) followed by weak ones after 1991. From 1995 onwards the survey covers both Svalbard and the Barents Sea and indices including both areas are therefore expected to be used in future.

Since 1981, a stratified random bottom trawl survey, targeted for cod and haddock, has been carried out by Norway in February in the Barents Sea. The results for *S. mentella* are available on length from 1986–1998 and are age disaggregated from 1992 onwards (Tables D6a,b and Figures. 6.4a,b). Also in this survey the 1988–1990 year classes (possibly also the 1987 year class) are stronger than the adjacent ones. In this survey the 1991–1992 year classes are poor, while the 1993–1995 year classes seem to be at an intermediate level.

Although the Norwegian Svalbard (August-September) and Barents Sea (February) groundfish surveys are conducted at different times of the year and may overlap in the south of Bear Island area, the two series can be combined to get an approximate correct total estimate for the whole area. This has been done in Figures 6.5a,b.

In the Russian bottom trawl survey the most recent estimates are among the lowest observed. (Table D4, Figure 6.2). The area outside Spitsbergen was not properly covered in 1993 and 1996, and this may account for the generally low values these years because no correction was applied. In 1997 the Russian survey did not cover the eastern part of Sub-area I where there generally are small amounts of redfish. The method used to calculate the numbers per trawlhour may have led to some increased values this survey year especially for the youngest age groups. The overall picture of the relative strength of the year classes is, however, very similar in the Russian and Norwegian surveys.

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 1992–1993, 1995 and 1997–1998. Table D7 shows a 43% decrease in the estimated spawning stock biomass in 1997 and the same low level was observed again in 1998. This could be explained by the strong 1982-year class migrating west-southwest and out of the surveyed area and by the fact that the next year classes expected to contribute significantly to the spawning stock (i.e., the 1987–1990 year classes) are just about to mature (males before females). This is the only survey targeting commercially sized *S. mentella*, but only a limited area of its distribution.

6.3 Results of the Assessment

All new available information since last year's assessment confirm the bad situation for this stock. The surveys have not detected any improved recruitment.

Length and age data from Norwegian and Russian surveys show that the 1982 and 1983 year classes are stronger than those just before and after. The 1988–1989 year classes (possibly also the 1987 year class) appear to be at a similar level as the

1982–1983 ones. The 0-group survey indicates at present record low levels of *S. mentella*. Although the groundfish surveys show some varying results regarding the absolute size of the seven most recent year classes, there is no doubt that the recruitment to the fishable biomass will be poor after a short period of some increase in the spawning stock due to the 1987–1989 year classes.

According to last year's analytical assessment the spawning stock biomass has been low for several years despite the relative strong 1982–1983 year classes. Due to the 1987–1989 year classes the spawning stock biomass is expected to increase in near future, but according to last year's assessment the spawning stock biomass will remain well below the MBAL of 300,000 tonnes. Since these are the last relatively rich year classes in the stock they should be protected from fishing to conserve the reproductive potential of the stock.

According to last year's assessment the current fishing mortalities are low, probably less than 0.1. Despite this, any improvement of the stock condition is not expected until an improved recruitment in the surveys is detected. As long as the recruitment of new year classes is very poor and no signs of improved recruitment have appeared, it is of crucial importance that the 1987–1989 year classes (approx. 25–32 cm) which currently are about to recruit to the spawning stock (males slightly before the females) are protected.

It is also of vital importance that the younger recruiting year classes be given the strongest possible protection from being caught as by-catch in any fishery, e.g., the shrimp fisheries in the Barents Sea and Svalbard area. This will ensure that they can contribute as much as possible to the stock rebuilding.

6.4 Biological reference points

No biological reference points could be derived from the available data at this time.

6.5 Catch options

ICES recommended last year that no directed fishing should be carried out on this stock until improved recruitment is observed in the surveys for this stock, and a significant increase in spawning stock biomass has been detected. The current assessment indicates no improvement in recruitment and only slight improvement in the spawning stock biomass, which remains low. Therefore the previous advice should be maintained for 1999. Given the current depleted state of the stock it is imperative that data collection be maintained in order to monitor the progress of the resource.

Table 6.1 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I and Divisions IIa and IIb combined.

Year	Canada	Den-mark	Faroe Islands	France	Ger-many[3]	Green-land	Ireland	Norway	Poland	Portugal	Russia[4]	Spain	UK England and Wales	UK Scotland	Total
1986	-	-	-	-	1,252	-	-	1,274	-	1,273	17,815	-	84	-	23,112[2]
1987	-	-	200	63	1,321	-	-	1,488	-	1,175	6,196	25	49	1	10,518
1988	No species specific data available by country.														15,586
1989	-	-	335	1,093	3,833	-	-	4,633	-	340	13,080	5	174	1	23,494
1990	-	-	108	142	6,354	36	-	10,173	-	830	17,355	-	72	-	35,070
1991	-	-	487	85	-	23	-	33,592	-	166	14,302	1	68	3	48,727
1992	-	-	23	12	-	-	-	10,751	-	972	3,577	14	238	3	15,590
1993	8	4	13	50	35	1	-	4,939	-	963	6,260	57	293	-	12,623
1994	-	28	4	74	18	1	3	6,029	-	895	5,021	30	124	12	12,239
1995	-	-	3	16	176	2	4	2,534	-	927	6,346	67	93	4	10,172
1996	-	-	4	75	119	3	2	5,727	-	467	925	328	76	23	7,749
1997[1]	-	-	17	35	80	16	7	4,371	1	474	2,972	210	71	7	8,261

[1] Provisional figures.
[2] Including 1,414 tonnes in Division IIb not split on countries.
[3] Includes former GDR prior to 1991.
[4] USSR prior to 1991.

Table 6.2 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Sub-area 1.

Year	Faroe Islands	Germany[4]	Greenland	Norway	Russia[5]	UK England & Wales	Total
1986[3]	-	-	-	1,274	911	-	2,185
1987[3]	-	2	-	1,166	234	3	1,405
1988	No species specific data presently available						
1989	13	-	-	60	484	9[2]	566
1990	2	-	-	-	100	-	102
1991	-	-	-	8	420	-	428
1992	-		-	561	408	-	969
1993	2[2]	-	-	24	588	-	614
1994	2[2]	2	-	37	308	-	349
1995	2[2]	-	-	23	203	-	228
1996[1]	-	-	-	5	101	-	106
1997[1]	-	-	3	12	174	1	190

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 6.3 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Norway	Portugal	Russia[5]	Spain	UK England & Wales	UK Scotland	Total
1986[3]	-	-	1,252	-	-	-	1,273	16,904	-	84	-	19,513
1987[3]	200	63	970	-	-	149	1,156	4,469	-	34	1	7,042
1988	No species specific data presently available											
1989	312[2]	1,065[2]	3,200	-	-	4,573	251	9,749	-	158[2]	1[2]	19,309
1990	98[2]	137[2]	1,673	-	-	8,842	824	6,492	-	9	-	18,075
1991	487[2]	72[2]	-	-	-	32,810	159[2]	7,596	-	23[2]	-	41,147
1992	23[2]	7[2]	-	-	-	9,816	824[2]	1,096	-	27[2]	-	11,793
1993	11[2]	15[2]	35	1[2]	-	4,870	648[2]	5,328	-	2[2]	-	10;910
1994	2[2]	33[2]	16[2]	1[2]	2[2]	5,629	687[2]	4,692	8[2]	4[2]	-	11,074
1995	1[2]	16[2]	176[2]	2[2]	2[2]	2,092	715[2]	5,916	65[2]	41[2]	2[2]	9,028
1996[1]	-[2]	75[2]	119[2]	3[2]	-	5,541	429[2]	677	5[2]	42[2]	19[2]	6,910
1997[1]	13[2]	22[2]	77	12[2]	2[2]	4,173	410	2,341	4[2]	48[2]	7[2]	7,109

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 6.4 *Sebastes mentella* in Sub-areas I and II. Nominal catch (t) by countries in Division IIb

Year	Canada	Denmark	Faroe Islands	France	Germany[5]	Greenland	Ireland	Norway	Poland	Portugal	Russia[6]	Spain	UK England and Wales	UK Scotland	Total
1986[4]						Data not available on countries								1,414	
1987[4]	-	-	-	-	349	-	-	173	-	19	1,493	25	12	-	2,071
1988						No species specific data presently available									
1989	-	-	10	28	633	-	-	-	-	89	2,847	5	7[2]	-	3,619
1990	-	-	8[2]	5[2]	4,681	36[2]	-	1,331	-	6	10,763	-	63[2]	-	16,893
1991	-	-	-	13[2]	-	23	-	774	-	7	6,286	1	45[2]	3[2]	7,152
1992	-	-	-	5[2]	-	-	-	374	-	148[2]	2,073	14	211[2]	3[2]	2,826
1993	8[2]	4[2]	-	35[2]	-	-	-	45	-	315[2]	344	57[3]	291[2]	-	1,099
1994	-	28[2]	-	41[2]	-	-	1[2]	363	-	208[2]	21	22[3]	120[2]	12[2]	816
1995	-	-	-	-	-	-	2[2]	419	-	212[2]	227	2[3]	52[2]	2[2]	916
1996[1]	-	-	4[2]	-	-	-	2[2]	181	-	38[2]	147	323[2]	34[2]	4[2]	733
1997[1]	-	-	4[2]	13[2]	3	1[2]	5[2]	186	1[2]	64[2]	457	206[2]	22[2]	-[2]	962

[1] Provisional figures. .
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.

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Table 6.5.

Run title : Arctic S. mentella (run: XSAKHN03/X03)

At 22-Aug-98 16:54:07

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

YEAR,	1965,	1966,	1967,
AGE			
1,	0,	0,	0,
2,	0,	0,	0,
3,	0,	0,	0,
4,	0,	0,	0,
5,	0,	0,	0,
6,	48,	0,	0,
7,	285,	0,	0,
8,	1592,	27,	7,
9,	2163,	279,	15,
10,	1141,	532,	182,
11,	1545,	465,	285,
12,	1972,	731,	343,
13,	2471,	1223,	394,
14,	2804,	1927,	489,
15,	1996,	2007,	496,
16,	2067,	1741,	628,
17,	1592,	1422,	613,
18,	1473,	944,	540,
+gp,	2589,	1980,	3254,
0 TOTALNUM,	23738,	13278,	7246,
TONSLAND,	15662,	10143,	6239,
SOPCOF %,	104,	102,	100,

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

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	7,	31,	0,	0,	466,	172,	606,	5834,	18891,	0,
7,	0,	94,	0,	0,	792,	1660,	4847,	19417,	29815,	2418,
8,	15,	409,	33,	114,	5728,	4865,	15451,	42425,	59395,	17175,
9,	89,	524,	131,	284,	3586,	9729,	28781,	82480,	78241,	33454,
10,	192,	838,	620,	681,	2049,	4636,	30144,	108462,	110712,	52102,
11,	355,	933,	2122,	1590,	1770,	2633,	19843,	119075,	112524,	49617,
12,	436,	954,	3428,	4429,	3865,	3148,	10603,	57231,	93144,	53938,
13,	554,	849,	3983,	4884,	4564,	5208,	8634,	29651,	49550,	33287,
14,	864,	618,	3526,	5451,	4704,	5666,	8634,	20894,	26134,	19095,
15,	768,	482,	2808,	4940,	4098,	4578,	6514,	16499,	13881,	12605,
16,	931,	807,	3983,	7496,	4704,	5380,	5908,	13465,	9839,	5796,
17,	694,	451,	2743,	4486,	3632,	3777,	3332,	13668,	6300,	4874,
18,	665,	849,	3559,	7382,	3167,	2747,	2878,	12207,	7233,	5499,
+gp,	1802,	2536,	5714,	14934,	3447,	3053,	5300,	22366,	11439,	13906,
0 TOTALNUM,	7372,	10375,	32650,	56671,	46572,	57252,	151475,	563674,	627098,	303766,
TONSLAND,	5413,	6836,	22916,	45063,	28862,	38380,	69372,	239070,	269022,	146365,
SOPCOF %,	94,	95,	94,	98,	101,	118,	99,	91,	98,	95,

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Run title : Arctic S. mentella (run: XSAKHN03/X03)

At 22-Aug-98 16:54:07

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	2905,	3633,	1065,	932,	5,	20,	0,	98,	29,	0,
7,	30158,	20497,	7412,	3000,	854,	86,	34,	571,	117,	0,
8,	65162,	43553,	26296,	8620,	4775,	1987,	525,	2009,	215,	109,
9,	53391,	46996,	44131,	26716,	12554,	4576,	2106,	4949,	1049,	1055,
10,	33569,	37469,	40441,	48290,	47348,	16695,	7969,	17096,	3079,	3145,
11,	19909,	26298,	27089,	39206,	57134,	31310,	22092,	31564,	5921,	2679,
12,	17242,	20717,	19950,	33394,	46529,	51099,	36763,	41511,	10701,	3580,
13,	9270,	16341,	11172,	21178,	37731,	48307,	47096,	33190,	15930,	6213,
14,	7410,	6059,	6400,	11853,	15506,	29973,	25468,	10519,	7051,	3702,
15,	5456,	3589,	5607,	6038,	9492,	17132,	12002,	4243,	2495,	1459,
16,	4134,	3465,	6801,	2697,	5780,	8347,	4336,	1971,	704,	656,
17,	2134,	2465,	3441,	2172,	3368,	5238,	1499,	658,	390,	210,
18,	1545,	1964,	3001,	1344,	2160,	2055,	517,	343,	81,	66,
+gp,	2917,	6579,	2546,	1910,	4184,	673,	472,	52,	67,	0,
0 TOTALNUM,	255202,	239625,	205352,	207350,	247420,	217498,	160879,	148774,	47829,	22874,
TONSLAND,	92611,	87145,	79354,	81546,	115383,	105273,	72934,	63068,	23112,	10518,
SOPCOF %,	101,	100,	97,	95,	100,	99,	104,	101,	100,	100,

Table 6.5, cont.

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

	YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
	AGE										
	1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	2,	0,	0,	0,	0,	0,	0,	5,	0,	0,	0,
	3,	0,	0,	0,	0,	0,	0,	60,	0,	0,	0,
	4,	0,	0,	0,	0,	1108,	558,	61,	0,	0,	0,
	5,	0,	0,	0,	2044,	957,	292,	85,	118,	128,	87,
	6,	0,	48,	1,	1653,	1873,	156,	710,	655,	212,	160,
	7,	0,	475,	748,	5453,	2498,	156,	702,	931,	550,	448,
	8,	0,	1933,	4036,	7994,	1898,	171,	695,	1265,	1474,	1601,
	9,	379,	3972,	6797,	6781,	1622,	502,	954,	711,	1361,	1258,
	10,	1838,	4432,	7297,	8226,	1780,	2054,	2464,	732,	1119,	1720,
	11,	3512,	4303,	6038,	5344,	1531,	3080,	2630,	1217,	978,	1092,
	12,	4084,	4667,	8568,	6227,	2108,	2581,	2944,	1991,	1096,	1064,
	13,	6958,	7062,	11600,	9880,	2288,	2264,	1477,	4250,	1331,	1322,
	14,	7313,	6068,	7499,	10824,	2258,	2931,	2168,	3264,	1761,	2211,
	15,	4022,	4412,	3174,	4049,	2506,	1840,	2099,	2138,	859,	1452,
	16,	1960,	3282,	1698,	2105,	2137,	1485,	3210,	1438,	591,	553,
	17,	983,	2399,	1419,	9603,	1512,	1033,	1235,	749,	437,	1484,
	18,	328,	1733,	1093,	6522,	677,	517,	706,	785,	674,	244,
	+gp,	106,	2220,	15595,	19299,	9258,	5908,	3134,	2378,	2124,	2027,
0	TOTALNUM,	31483,	47006,	75563,	106004,	36011,	25528,	25339,	22622,	14695,	16723,
	TONSLAND,	15586,	23494,	35070,	48727,	15590,	12623,	12239,	10172,	7749,	8261,
	SOPCOF %,	100,	99,	97,	100,	103,	100,	104,	100,	97,	100,
1											

Table 6.6.

Run title : Arctic S. mentella (run: XSAKHN03/X03)

At 22-Aug-98 16:54:07

Table 2 Catch weights at age (kg)

YEAR,	1965,	1966,	1967,
AGE			
1,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,
6,	.1680,	.1680,	.1680,
7,	.1830,	.1830,	.1830,
8,	.2250,	.2250,	.2250,
9,	.3110,	.3110,	.3110,
10,	.3670,	.3670,	.3670,
11,	.4320,	.4320,	.4320,
12,	.5080,	.5080,	.5080,
13,	.6110,	.6110,	.6110,
14,	.6790,	.6790,	.6790,
15,	.7530,	.7530,	.7530,
16,	.8210,	.8210,	.8210,
17,	.8720,	.8720,	.8720,
18,	.9100,	.9100,	.9100,
+gp,	.9990,	.9930,	1.0320,
0 SOPCOFAC,	1.0367,	1.0223,	1.0037,

Table 2 Catch weights at age (kg)

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,	.1680,
7,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,	.1830,
8,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,	.2250,
9,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,	.3110,
10,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,
11,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,	.4320,
12,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,	.5080,
13,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,	.6110,
14,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,	.6790,
15,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,	.7530,
16,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,	.8210,
17,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,	.8720,
18,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,
+gp,	1.0100,	1.0260,	1.0000,	1.0220,	.9770,	.9800,	1.0000,	1.0070,	1.0210,	1.0320,
0 SOPCOFAC,	.9372,	.9489,	.9357,	.9849,	1.0143,	1.1784,	.9888,	.9146,	.9847,	.9515,

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Run title : Arctic S. mentella (run: XSAKHN03/X03)

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Table 2 Catch weights at age (kg)

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.1680,	.1070,	.1070,	.1020,	.1020,	.1020,	.1020,	.1020,	.1020,	.1440,
7,	.1830,	.1550,	.1550,	.1380,	.1380,	.1380,	.1050,	.1350,	.1200,	.1800,
8,	.2250,	.2000,	.2000,	.1880,	.1880,	.1880,	.1650,	.1670,	.1370,	.1950,
9,	.3110,	.2520,	.2520,	.2520,	.2520,	.2520,	.2120,	.2150,	.2180,	.2190,
10,	.3670,	.3100,	.3100,	.3100,	.3100,	.3100,	.2830,	.3030,	.3010,	.2880,
11,	.4320,	.3740,	.3740,	.3640,	.3640,	.3200,	.3380,	.3520,	.3530,	.3300,
12,	.5080,	.4720,	.4720,	.4400,	.4400,	.4000,	.3830,	.4200,	.4480,	.4390,
13,	.6110,	.5680,	.5680,	.5600,	.5600,	.4660,	.4380,	.4810,	.5100,	.5110,
14,	.6790,	.7150,	.7150,	.6800,	.6800,	.5630,	.5020,	.5640,	.5810,	.5640,
15,	.7530,	.8980,	.8980,	.8280,	.8280,	.7300,	.5660,	.6730,	.6480,	.6360,
16,	.8210,	.9340,	.9340,	.9060,	.9060,	.9920,	.7110,	.8090,	.8450,	.7720,
17,	.8720,	1.0240,	1.0240,	.9700,	.9700,	1.1260,	.8610,	1.0140,	.9480,	.8090,
18,	.9100,	1.0500,	1.0500,	1.0500,	1.0500,	1.1490,	.9660,	1.0690,	1.0560,	.9540,
+gp,	1.0300,	1.1300,	1.1050,	1.1180,	1.1220,	1.2280,	1.2910,	1.1600,	1.2610,	1.1800,
0 SOPCOFAC,	1.0130,	.9966,	.9734,	.9503,	1.0022,	.9891,	1.0415,	1.0066,	1.0023,	.9976,

Table 6.6 cont.

Table 2 Catch weights at age (kg)

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0200,	.0200,	.0200,	.0200,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0600,	.0600,	.0600,	.0600,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0500,	.0500,	.0500,	.0500,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.1300,	.0900,	.1000,	.1900,	.1400,
6,	.1440,	.1980,	.1400,	.1300,	.1900,	.1700,	.1600,	.1400,	.2000,	.1800,
7,	.1800,	.2020,	.1460,	.1800,	.2200,	.2300,	.2200,	.1600,	.2000,	.2200,
8,	.1950,	.2420,	.1580,	.2100,	.2600,	.2500,	.2400,	.1900,	.2500,	.2500,
9,	.2090,	.2820,	.2060,	.2700,	.2800,	.2800,	.3000,	.2100,	.3100,	.2900,
10,	.2800,	.3310,	.2800,	.3400,	.3100,	.3300,	.3400,	.2800,	.4200,	.3400,
11,	.3330,	.3780,	.3550,	.3500,	.3300,	.3800,	.3700,	.3200,	.4400,	.3900,
12,	.3970,	.4560,	.4710,	.4200,	.3800,	.4400,	.4000,	.3700,	.4700,	.5000,
13,	.4680,	.5140,	.5430,	.4600,	.4600,	.4700,	.4400,	.4100,	.5900,	.4700,
14,	.5370,	.5680,	.6110,	.5100,	.4300,	.5000,	.4500,	.4700,	.6700,	.5200,
15,	.5850,	.5890,	.6250,	.5800,	.4300,	.5700,	.4900,	.5300,	.6900,	.5400,
16,	.7470,	.6720,	.7220,	.5900,	.4500,	.5800,	.5500,	.5800,	.7100,	.6200,
17,	.8080,	.7080,	.5760,	.5800,	.5200,	.6200,	.5800,	.6600,	.7400,	.6800,
18,	.9010,	.7740,	.6590,	.5900,	.5700,	.6500,	.6700,	.7100,	.7400,	.7400,
+gp,	1.0470,	.8380,	.6590,	.7000,	.6700,	.6620,	.7900,	.8060,	.8480,	.8440,
0 SOPCOFAC,	1.0000,	.9915,	.9668,	1.0032,	1.0291,	1.0022,	1.0365,	.9987,	.9706,	1.0018,

1

 O:\Acfm\Wgreps\Afwg\Reports\1999\T-65-7.Doc

Table 6.7.

Table 5 Proportion mature at age

YEAR,	1965,	1966,	1967,
AGE			
1,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,
8,	.0300,	.0300,	.0300,
9,	.0600,	.0600,	.0600,
10,	.0800,	.0800,	.0800,
11,	.2200,	.2200,	.2200,
12,	.3600,	.3600,	.3600,
13,	.5500,	.5500,	.5500,
14,	.7200,	.7200,	.7200,
15,	.8500,	.8500,	.8500,
16,	.8800,	.8800,	.8800,
17,	.9500,	.9500,	.9500,
18,	.9700,	.9700,	.9700,
+gp,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1968,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0090,	.0090,
8,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0160,	.0160,
9,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.1010,	.1010,
10,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.1950,	.1950,
11,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.3000,	.3000,
12,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.5400,	.5400,
13,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.7020,	.7020,
14,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.8620,	.8620,
15,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.9660,	.9660,
16,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.9940,	.9940,
17,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	1.0000,	1.0000,
18,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

1

Run title : Arctic S. mentella (run: XSAKHN03/X03)

At 22-Aug-98 16:54:07

Table 5 Proportion mature at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
7,	.0090,	.0090,	.0090,	.0090,	.0090,	.0090,	.0050,	.0000,	.0000,	.0000,
8,	.0160,	.0160,	.0160,	.0160,	.0160,	.0160,	.0080,	.0000,	.0000,	.0000,
9,	.1010,	.1010,	.1010,	.1010,	.1010,	.1010,	.0570,	.0100,	.0340,	.0450,
10,	.1950,	.1950,	.1950,	.1950,	.1950,	.1950,	.1680,	.0790,	.1130,	.0760,
11,	.3000,	.3000,	.3000,	.3000,	.3000,	.3000,	.3020,	.2180,	.2380,	.1780,
12,	.5400,	.5400,	.5400,	.5400,	.5400,	.5400,	.5340,	.4530,	.5070,	.4300,
13,	.7020,	.7020,	.7020,	.7020,	.7020,	.7020,	.7210,	.7810,	.7940,	.7350,
14,	.8620,	.8620,	.8620,	.8620,	.8620,	.8620,	.8790,	.8460,	.8720,	.8270,
15,	.9660,	.9660,	.9660,	.9660,	.9660,	.9660,	.9520,	.9000,	.9120,	.8850,
16,	.9940,	.9940,	.9940,	.9940,	.9940,	.9940,	.9850,	.9250,	.9500,	.9580,
17,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
18,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 6.7 cont.

Table 5 Proportion mature at age

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AGE										
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
7	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0180
8	.0000	.0000	.0150	.0150	.0150	.0000	.0000	.0000	.0000	.0000
9	.0830	.0040	.0500	.0550	.0620	.0230	.0230	.0000	.0140	.0270
10	.0950	.0780	.1260	.1320	.1330	.1130	.1130	.0550	.0930	.1300
11	.1940	.2010	.2050	.2020	.2240	.2670	.2670	.1110	.2120	.3120
12	.4620	.4860	.5060	.4810	.4110	.4380	.4380	.3680	.3250	.2810
13	.6890	.6530	.6230	.5450	.5390	.5740	.5740	.5870	.5770	.5660
14	.8010	.7670	.7260	.7410	.7740	.8430	.8430	.6960	.7160	.7360
15	.8620	.8320	.8010	.8500	.8880	.9510	.9510	.7290	.7800	.8310
16	1.0000	1.0000	1.0000	.9620	.9460	.9200	.9200	.7890	.8740	.9580
17	1.0000	1.0000	1.0000	1.0000	.9920	.9890	.9890	1.0000	.9750	.9500
18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

1

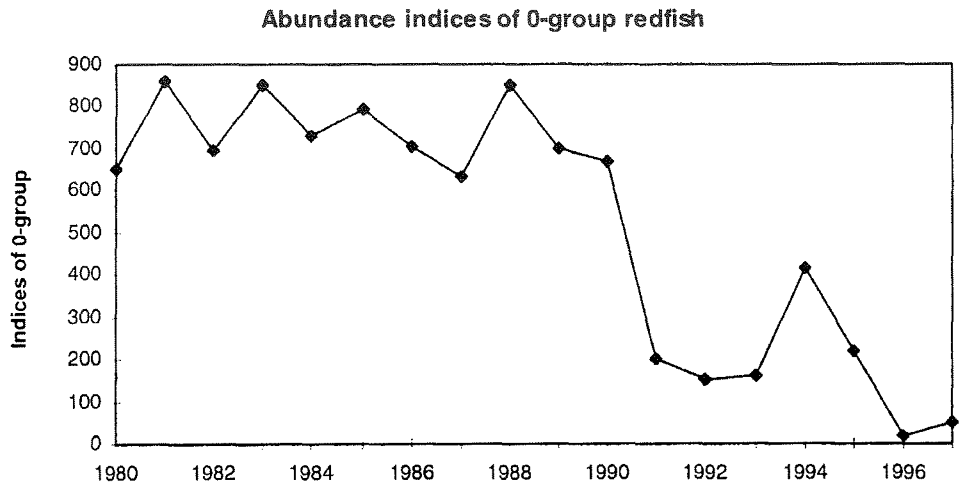


Figure 6.1. Abundance indices of 0-group redfish (believed to be mostly *S.mentella*) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-1997.

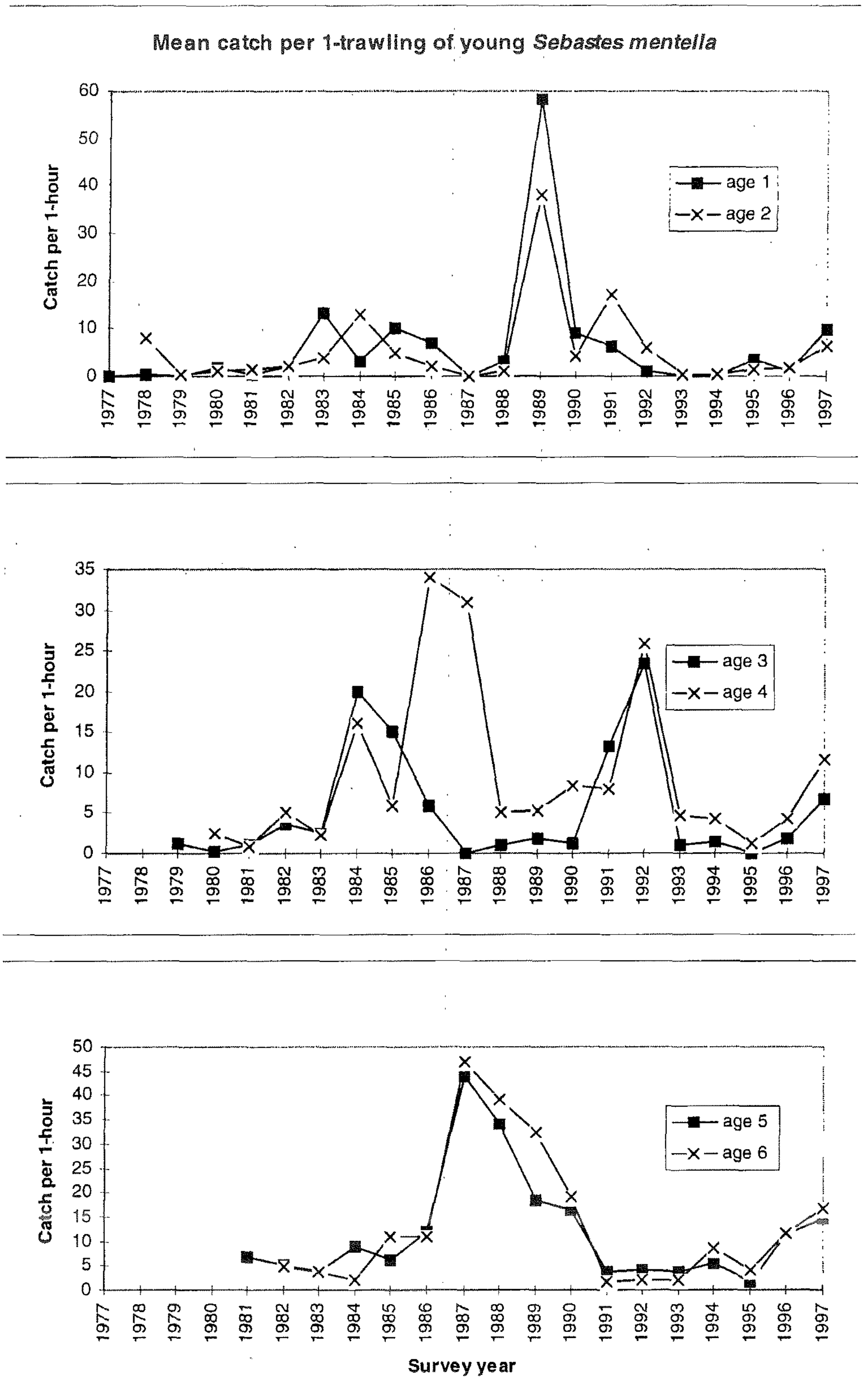
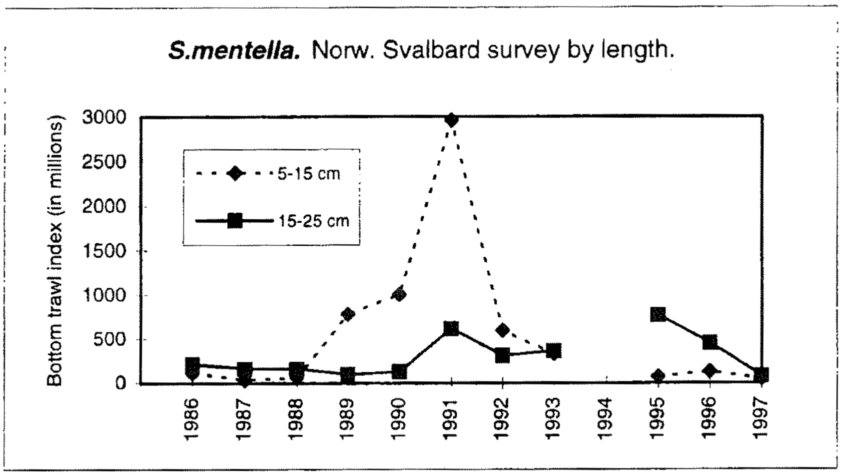


Figure 6.2. Catch (numbers of specimens) per hour trawling of diffrent ages of *Sebastes mentella* in the Russian groundfish survey in the Barents Sea and Svalbard areas (ref. Table D4).



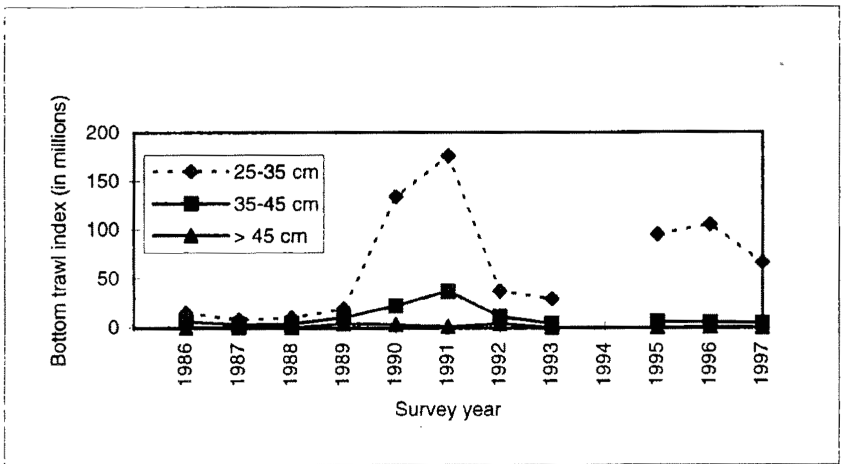
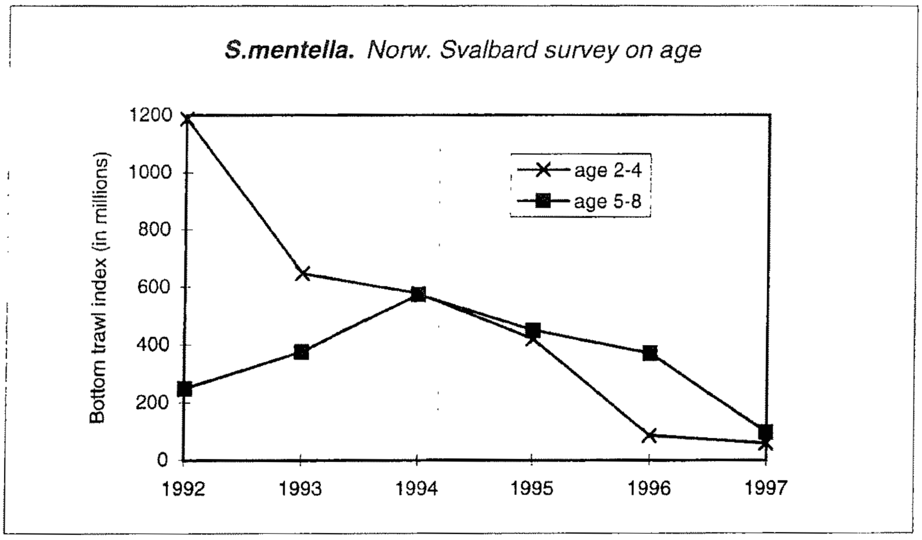


Figure 6.3a. *Sebastes mentella.* Abundance indices (on length) from the Norwegian bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1986-1997 (ref. Table D5a).



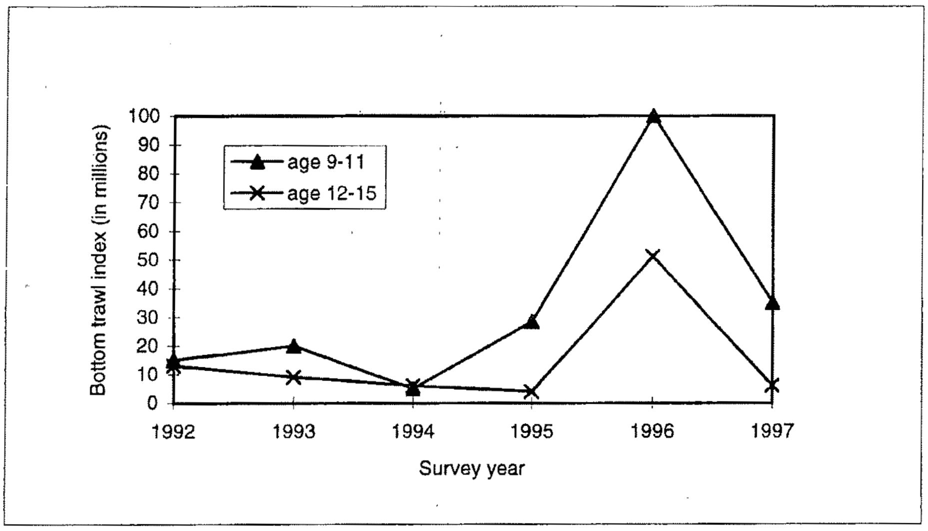
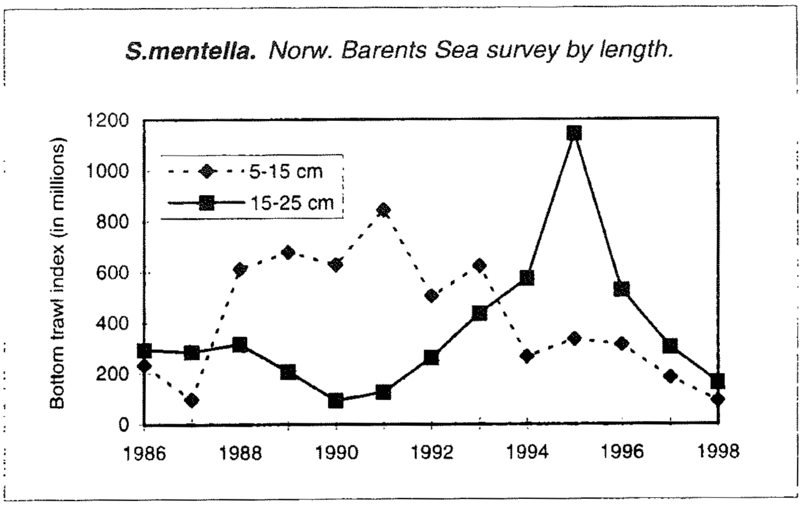


Figure 6.3b. *Sebastes mentella.* Abundance indices (on age) from the Norwegian bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1992-1997 (ref. Table D5b).



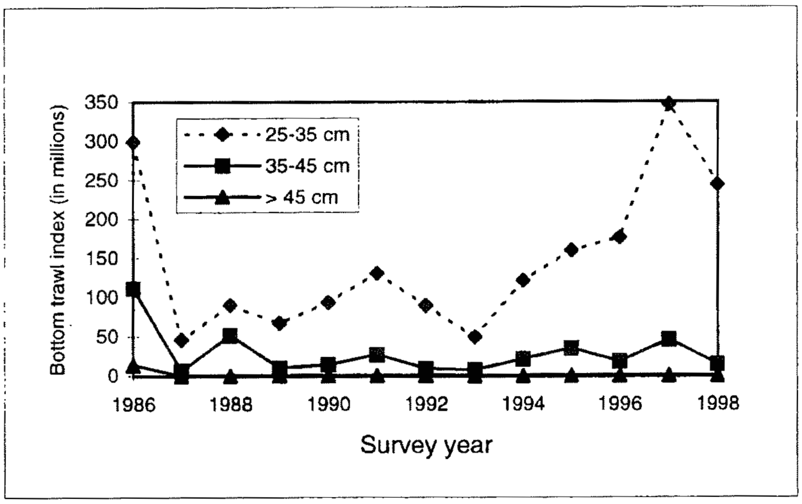
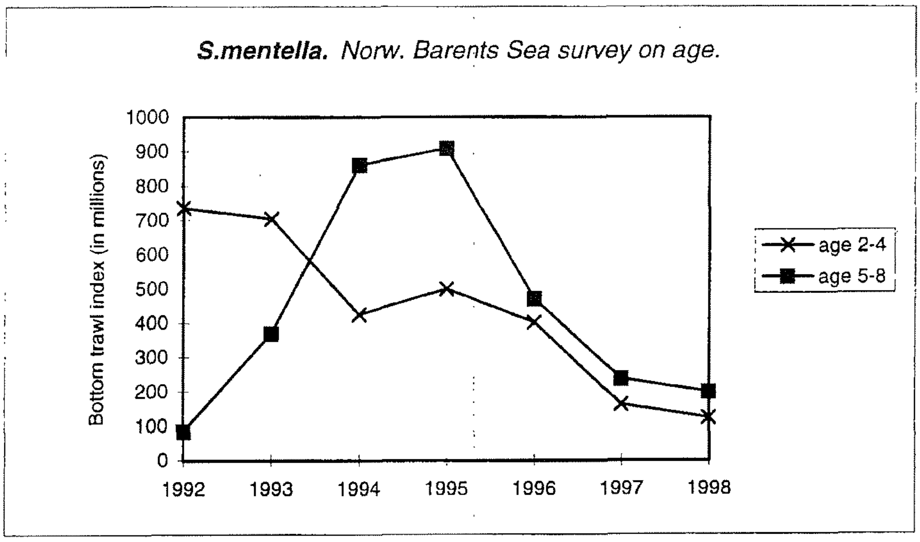


Figure 6.4a. *Sebastes mentella.* Abundance indices (on length) from the Norwegian bottom trawl survey in the Barents Sea in winter 1986-1998 (ref. Table D6a).

F-6-4A.XLS



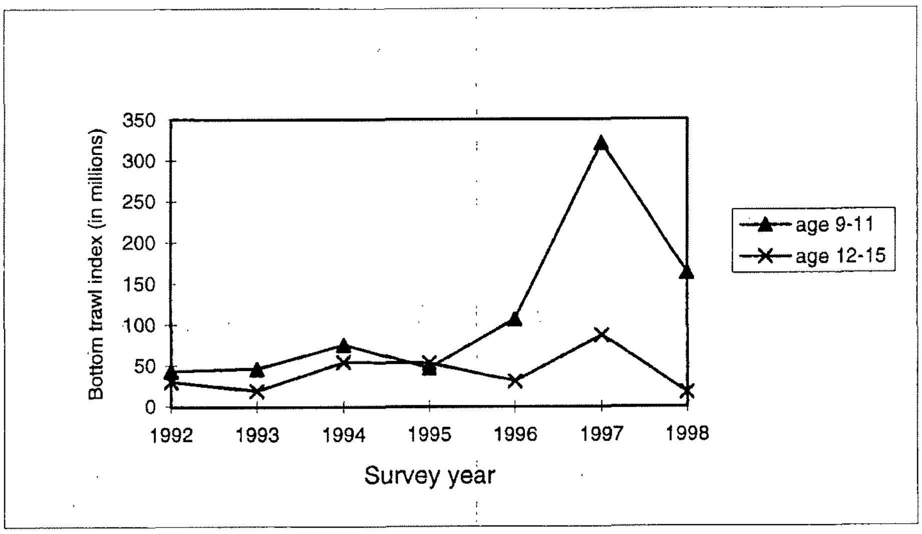


Figure 6.4b. *Sebastes mentella.* Abundance indices (on age) from the Norwegian bottom trawl survey in the Barents Sea in winter 1992-1998 (ref. Table D6b).

F-6-4B.XLS

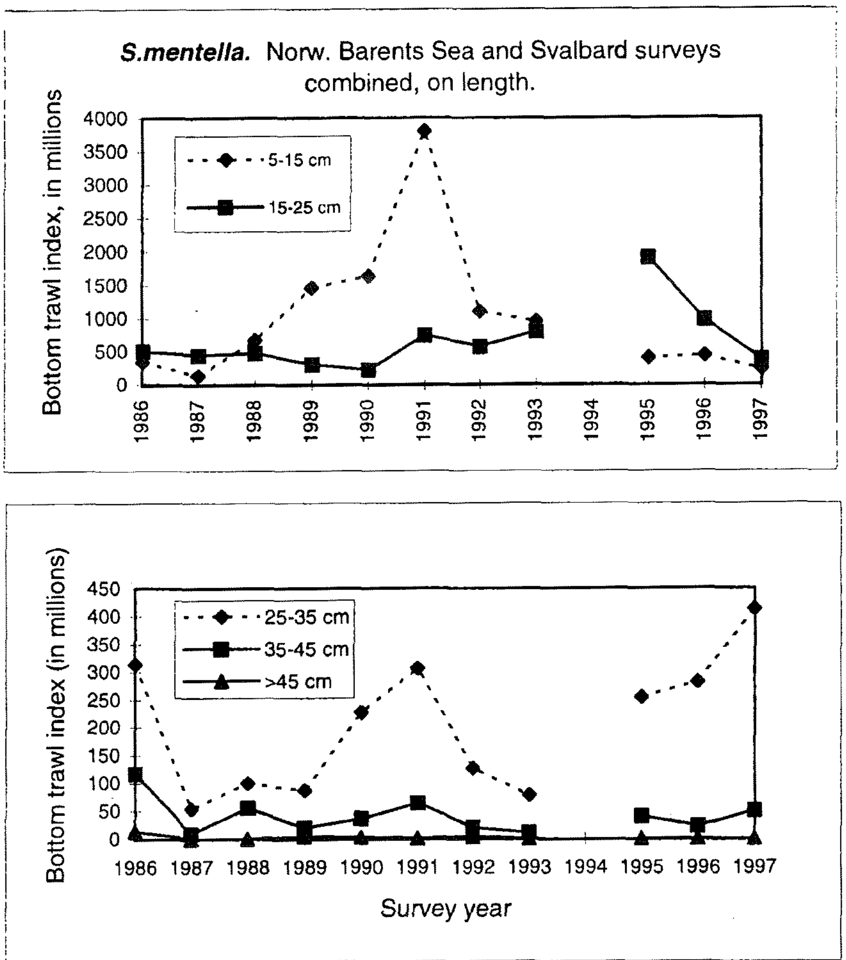
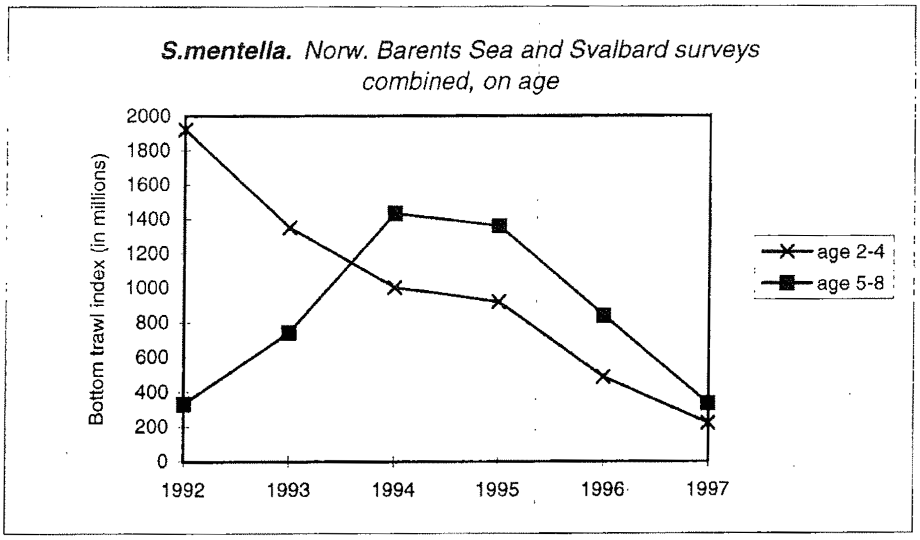


Figure 6.5a. *Sebastes mentella.* Abundance indices (on length) when combining the Norwegian bottom trawl surveys 1986-1997 at Svalbard (summer/fall) and in the Barents Sea (winter).



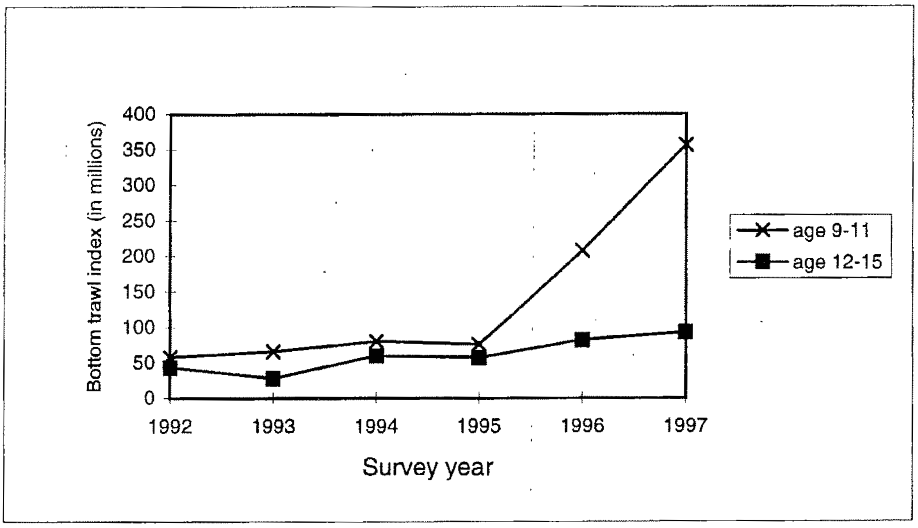


Figure 6.5b. *Sebastes mentella*. Abundance indices (on age) when combining the Norwegian bottom trawl surveys 1992-1997 at Svalbard (summer/fall) and in the Barents Sea (winter).

F-6-5B.XLS

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

7.1 Status of the Fisheries

7.1.1 Historical development of the fishery

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

7.1.2 Landings prior to 1998 (Tables 7.1–7.4, D1 and D2)

Nominal catches of *S. marinus* by country for Sub-areas I and II combined are presented in Table 7.1 and the totals for both *S. marinus* and *S. mentella* in Tables D1 and D2. Landings of *S. marinus* showed a decrease in 1991–1992 from a level of 23,000–30,000 t in 1984–1990 to a stable level of about 16,000 t in the years 1992–1997. The provisional total landings figure for *S. marinus* in 1997 is 16,765 t. This is 1,235 t less than expected by last year's Working Group.

Information describing the splitting of the redfish landings by species and area is given Section 6.1.2.

7.1.3 Expected landings in 1998

On the basis of reports from the first half of 1998, Norwegian landings of redfish have been at the same level as in the first half of 1997. The Russian catches are expected to be 1,500 t. On this basis landings of 17,000 t are expected in 1998.

7.2 Data Used in the Assessment

7.2.1 Fishing effort and catch-per-unit-effort (Tables D9-D10, Figure 7.1)

Data for *S. marinus* were available for Norwegian freezer trawlers (ISSCFV-code 07, 250–499.9 GRT) since 1981 (Table D9-D10) from which the total international effort was estimated. This series, which is based on statistical (GLM) analysis of monthly data from five Norwegian statistical areas along the Norwegian coast, was revised prior to this year's Working Group. The CPUEs have been standardised and scaled to a certain area (3) and month (2). Although typical *S. mentella* grounds have been sorted out, errors related to the splitting of the redfish species in the catches may contribute to fluctuations in the time trend.

A lower but stable effort is observed since 1991, and no significant year effect was observed in the standardised CPUEs (except for the increase in 1990) (Tables D9-D10, Figure 7.1). A surplus production analysis was therefore considered to be of little value in the evaluation of stock parameters. The provisional figure for 1997 of 1.25 t/hour is slightly less than the long-term average of 1.32 t/hour.

7.2.2 Catch at Age (Table 7.5).

Catch at age data for 1996 were revised. Age composition data for 1997 were only provided by Norway, accounting for 83% of the total landings. Russian catch-at-length from each Sub-area were converted to age by using the Norwegian overall age-length key for trawl. In Division IIa, German catch-at-length was converted to age also by using this Norwegian overall age-length key for trawl. 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 Russian scale readings exist.

7.2.3 Weight at Age (Table 7.6).

Weight-at-age data for ages 7–24+ were available from the Norwegian landings in 1997. A SOP-correction of the weights was made to make the sum of products fit the total nominal catch.

7.2.4 Maturity at age

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

7.2.5 Survey results (Tables D11a,b-D12a,b, Figures 7.2–7.3)

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

1) Norwegian Barents Sea bottom trawl survey (February) from 1986–98 in fishing depths of < 100–500 m. Data on length for the years 1986–1998 are shown in Table D11a and Fig 7.2a. Data disaggregated on age for the years 1992–98 are shown in Table D11b and Figure 7.2b. This survey covers important nursery areas for the stock.

2) Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1985–97 in fishing depths of < 100–500 m. Data disaggregated on age only for the years 1992–97 (Table D12a,b). This survey covers the northernmost part of the species' distribution.

Data on length and age from both these surveys have been added together and shown in Figures 7.3a,b.

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

7.3 Results of the Assessment

All new available information since last year's assessment confirm last year's evaluation of the stock situation.

Available data from both the surveys and commercial CPUE suggest that the abundance indices over the commercial size range (> 30 cm) appear to be relatively stable at least during the 1990's. This stability may reflect the rather constant effort in the fishery and an annual catch of about 16,000 tons during the last six years. Nevertheless, concerns were expressed about the low number of pre-recruit size groups in the recent surveys suggesting that future recruitment to the fishery may be poor. If this is the case then declines in the stock can be anticipated in the near future.

One of the terms of reference to this Working Group was to look into alternative methods to conventional catch-at-age analyses, such as the use of stock-production models. This was discussed during the meeting but the Working Group did not manage to conduct such alternative analyses at this stage. Also since no significant year effect was observed in the commercial CPUEs, a surplus production analysis was considered to be of little value.

7.4 Biological reference points

No limit or precautionary reference points for the fishing mortality or the biomass are proposed.

7.5 Catch options

The Working Group advises that a precautionary TAC based on recent catch levels should be the basis for the management advice.

Table 7.1 *Sebastes marinus* in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I and Divisions IIa and IIb combined.

Year	Faroe Islands	France	Germany[2]	Greenland	Iceland	Ireland	Netherlands	Norway	Portugal	Russia[3]	Spain	UK England & Wales	UK Scotland	Total
1986	29	2,719	3,369	-	-	-	-	21,680	-	2,350	-	42	14	30,203
1987	250	1,553	4,508	-	-	-	-	16,728	-	850	-	181	7	24,077
1988	No species specific data presently available on countries													25,908
1989	3	784	412	-	-	-	-	20,662	-	1,264	-	97	-	23,222
1990	278	1,684	387	1	-	-	-	23,917	-	1,549	-	261	-	28,077
1991	152	706[1]	981	-	-	-	-	15,872	-	1.052	-	268	10	19.041
1992	35	1,289[1]	530	623	-	-	-	12,700	5	758	2	241	2	16,185
1993	139	871[1]	650	14	-	-	-	13,380	77	1,313	8	441	1	16,894
1994	22	697[1]	1,008	5	4	-	-	13,935	90	1,199	4	135	1	17,100
1995	27	732[1]	517	5	1	1	1	13,023	9	639	-	159	9	15,123
1996	38	671[1]	499	34	-	-	-	14,806	55	716	81	229	98	17,227
1997[1]	8	581	457	23	-	5	-	13,842	61	1,584	18	164	22	16,765

[1] Provisional figures.
[2] Includes former GDR prior to 1991.
[3] USSR prior to 1991.

Table 7.2 *Sebastes marinus* in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I.

Year	Faroe Islands	Germany[4]	Greenland	Iceland	Norway	Russia[5]	UK England & Wales	UK Scotland	Total
1986[3]	-	50	-	-	2,972	155	32	3	3,212
1987[3]	-	8	-	-	2,013	50	11	-	2,082
1988			No species specific data presently available						
1989	-	-	-	-	1,763	110	4[2]	-	1,877
1990	5	-	-	-	1,263	14	-	-	1,282
1991	-	-	-	-	1,993	92	-	-	2,085
1992	-	-	-	-	2,162	174	-	-	2,336
1993	24[2]	-	-	-	1,800	330	-	-	2,154
1994	12[2]	72	-	4	1,652	109		-	1,849
1995	19[2]	1[2]	-	1[2]	2,250	201	1[2]	-	2,473
1996	7[2]	-	-	-	2,245	131	3[2]	-	2,386
1997[1]	-	-	5[2]	-	2,528	160	2[2]	-	2,695

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 7.3 *Sebastes marinus* in Sub-areas I and II. Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Netherlands	Norway	Portugal	Russia[5]	Spain	UK England & Wales	UK Scotland	Total
1986[3]	29	2,719	3,319	-	-	-	18,708	-	2,195	-	10	11	26,991
1987[3]	250	1,553	2,967	-	-	-	14,715	-	800	-	170	7	20,462
1988	No species specific data presently available												
1989	3[2]	784[2]	412	-	-	-	18,833	-	912	-	93[2]	-	21,037
1990	273	1,684	387	-	-	-	22,444	-	392	-	261	-	25,441
1991	152[2]	706[2]	678	-	-	-	13,835	-	534	-	268[2]	10[2]	16,183
1992	35[2]	1,294[2]	211	614	-	-	10,536	-	404	-	206[2]	2[2]	13,302
1993	115[2]	871[2]	473	14[2]	-	-	11,580	77[2]	940	-	431[2]	1[2]	14,502
1994	10[2]	697[2]	654[2]	5[2]	-	-	12,265	90[2]	1,030	-	129[2]	-	14,880
1995	8[2]	732[2]	328[2]	5[2]	1[2]	1	10,658	2[2]	405	-	158[2]	9[2]	12,307
1996	27[2]	671[2]	448[2]	34[2]	-	-	12,529	51[2]	449	5[2]	223[2]	98[2]	14,535
1997[1]	8[2]	581[2]	438	18[2]	5[2]	-	11,280	61[2]	1,199	18[2]	162[2]	22[2]	13,792

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 7.4 *Sebastes marinus* in Sub-areas I and II. Nominal catch (t) by countries in Division IIb.

Year	Faroe Islands	Germany[5]	Greenland	Norway	Portugal	Russia[6]	Spain	UK England & Wales	UK Scotland	Total
1986	-									+
1987[4]	-	1,533	-	-	-	-	-	-	-	1,533
1988	No species specific data presently available									
1989	-	-	-	66	-	242	-	-	-	308
1990	-	-	1[2]	210	-	1,157	-	-	-	1,368
1991	-	303	-	44	-	426	-	-	-	773
1992	-	319	9[2]	2	5[2]	180	2	35[2]	-	552
1993	-	177	-	-	-	43	8[3]	10[2]	-	238
1994	-	282	-	18	-	60	4[3]	6[2]	1[2]	371
1995	-	187	-	115	7	33	-	-	-	342
1996	4	51[2]	-	32	5	136	76[2]	3[2]	-	307
1997[1]	-	20	-	34	-	225	-	-	-	279

Provisional figures.
Split on species according to reports to Norwegian authorities.
Split on species according to the 1992 catches.
Based on preliminary estimates of species breakdown by area.
Includes former GDR prior to 1991.
USSR prior to 1991.

1

Table 7.5.

Run title : Arctic S. marinus (run: XSAKHN01/X01)

At 26-Aug-98 21:27:36

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

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE									
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	1,	0,	0,
6,	0,	0,	0,	2,	0,	0,	4,	0,	0,
7,	0,	0,	0,	5,	0,	43,	58,	9,	9,
8,	232,	0,	142,	22,	24,	7,	82,	119,	97,
9,	445,	0,	88,	78,	196,	276,	223,	313,	147,
10,	739,	0,	520,	114,	364,	604,	651,	361,	313,
11,	1339,	266,	321,	394,	412,	770,	879,	879,	499,
12,	1948,	1488,	350,	549,	1051,	1821,	1559,	1234,	903,
13,	1591,	1708,	1387,	783,	1037,	1978,	1974,	1638,	1526,
14,	1527,	1854,	2062,	1718,	1545,	1916,	2223,	2134,	1934,
15,	2013,	1722,	1258,	3102,	2387,	1511,	1727,	1675,	2033,
16,	1331,	1571,	2497,	2495,	1431,	2572,	1362,	1614,	1704,
17,	1619,	1894,	1695,	2104,	1679,	2518,	760,	1390,	1516,
18,	1575,	1895,	2472,	1837,	1702,	1330,	545,	952,	810,
19,	1413,	1921,	1150,	998,	756,	582,	649,	679,	889,
20,	1457,	1808,	1026,	858,	726,	692,	574,	439,	641,
21,	976,	1935,	617,	688,	542,	485,	406,	560,	446,
22,	932,	1304,	425,	547,	536,	242,	356,	334,	178,
23,	1053,	908,	659,	268,	584,	167,	242,	490,	293,
+gp,	5625,	6346,	3991,	3110,	3533,	1423,	3130,	3135,	1968,
0 TOTALNUM,	25815,	26620,	20660,	19672,	18505,	18937,	17405,	17955,	15906,
TONSLAND,	23222,	28077,	19041,	16185,	16894,	17100,	15123,	17227,	16766,
SOPCOF %,	84,	102,	101,	97,	104,	100,	100,	100,	100,

1

Table 7.6.

Run title : Arctic S. marinus (run: XSAKHN01/X01)

At 26-Aug-98 21:27:36

Table 2 Catch weights at age (kg)

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE									
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0200,	.0200,	.0200,	.0200,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0300,	.0300,	.0300,	.0300,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0530,	.0530,	.0530,	.0530,	.0000,	.0000,	.1600,	.0000,	.0000,
6,	.0780,	.0780,	.0780,	.0800,	.0000,	.0000,	.2400,	.0000,	.0000,
7,	.1330,	.1330,	.1330,	.1800,	.0000,	.2500,	.3300,	.2200,	.2100,
8,	.3900,	.3900,	.3700,	.2900,	.3300,	.3700,	.4300,	.4900,	.4600,
9,	.4100,	.4100,	.5100,	.4800,	.3600,	.3800,	.6400,	.5600,	.5400,
10,	.5100,	.5100,	.4600,	.4200,	.4300,	.4900,	.6100,	.6500,	.7300,
11,	.6200,	.5500,	.5300,	.5000,	.5100,	.5100,	.5900,	.7100,	.7100,
12,	.6600,	.7100,	.6100,	.5900,	.5100,	.6400,	.6500,	.8100,	.8000,
13,	.7200,	.7200,	.6400,	.5800,	.6400,	.7400,	.7400,	.8400,	.8100,
14,	.8100,	.7800,	.7100,	.6500,	.6400,	.7600,	.7900,	.8800,	.8600,
15,	.8600,	.8500,	.7600,	.6500,	.7600,	.8600,	.8400,	.9600,	.9300,
16,	.8900,	.8300,	.8300,	.7100,	.8600,	.9500,	.9200,	1.0000,	1.0300,
17,	.9400,	.9100,	.8400,	.8200,	.8900,	1.0300,	1.1200,	1.0200,	1.2000,
18,	1.0400,	.9000,	1.0000,	.8400,	.9800,	1.0700,	1.0100,	1.0100,	1.2300,
19,	1.1000,	.9300,	.9600,	.9400,	1.0000,	1.1100,	1.0100,	1.0000,	1.3100,
20,	1.1300,	1.0400,	1.0400,	1.0200,	1.0300,	1.1600,	1.2100,	1.0300,	1.4500,
21,	1.2700,	1.1300,	1.0300,	1.0300,	1.2100,	1.1500,	1.1400,	1.0400,	1.3900,
22,	1.2800,	1.0600,	1.0800,	1.1500,	1.0300,	1.1300,	1.0900,	1.1400,	1.6300,
23,	1.2500,	1.2300,	1.0200,	1.2700,	1.2000,	1.0200,	1.3000,	1.0900,	1.1900,
+gp,	1.6840,	1.4450,	1.2160,	1.2700,	1.1400,	1.3600,	1.0100,	1.1600,	1.3300,
0 SOPCOFAC,	.8400,	1.0174,	1.0135,	.9702,	1.0377,	1.0037,	.9998,	1.0008,	1.0002,

1

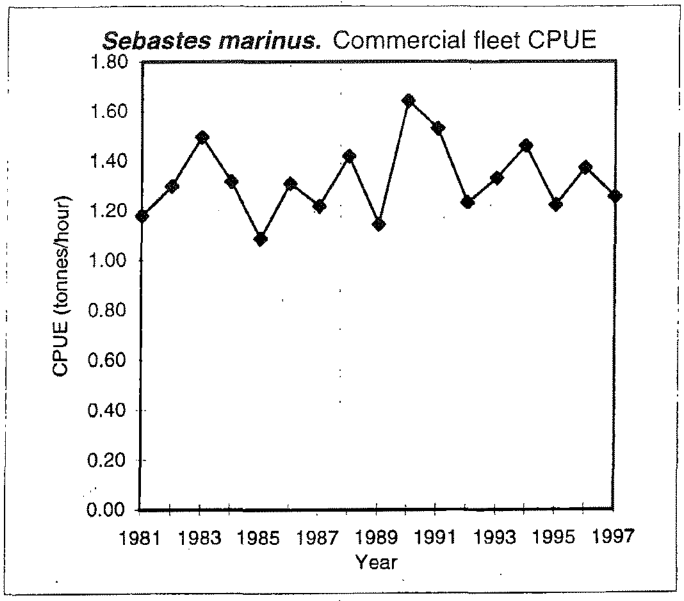
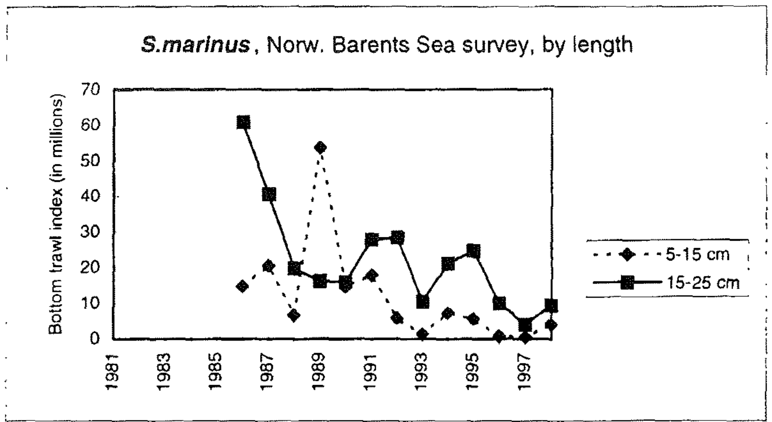


Figure 7.1. Plot of CPUE based on logbook information from freezer trawlers. Only days where *S.marinus* composed more than 50% of total catch were included in a GLM-analysis. The CPUEs have been standardized and scaled to a certain area (03) and month (2).



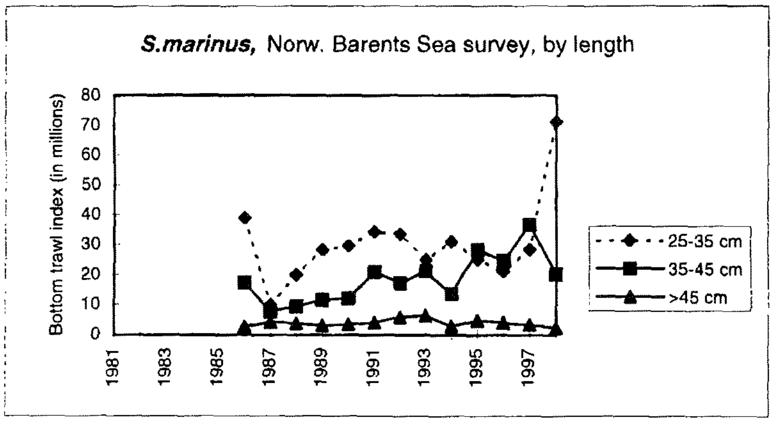
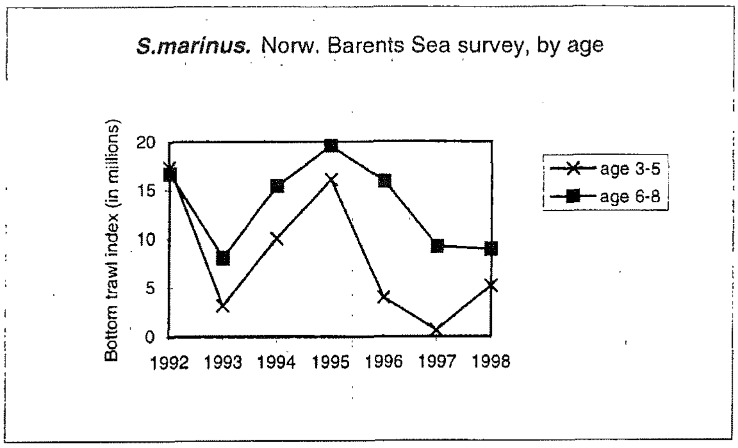


Figure 7.2a. *Sebastes marinus.* Abundance indices (by length) from the Norwegian bottom trawl survey in the Barents Sea in winter 1986-1998 (ref. Table D11a).



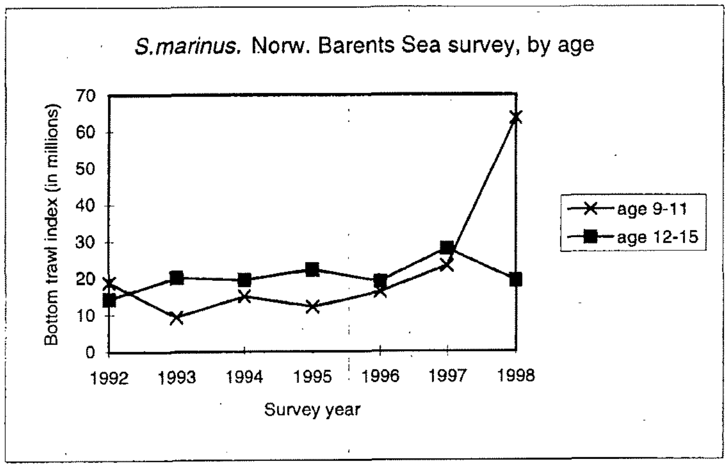
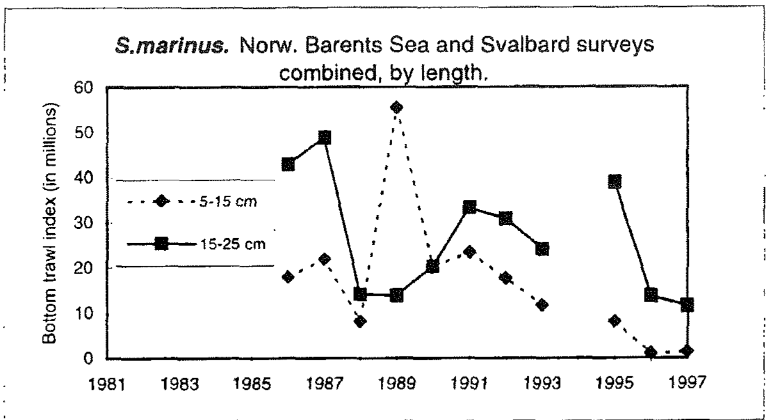


Figure 7.2b. *Sebastes marinus.* Abundance indices (by age) from the Norwegian bottom trawl surveys 1992-1998 in the Barents Sea (ref. Table D11b).



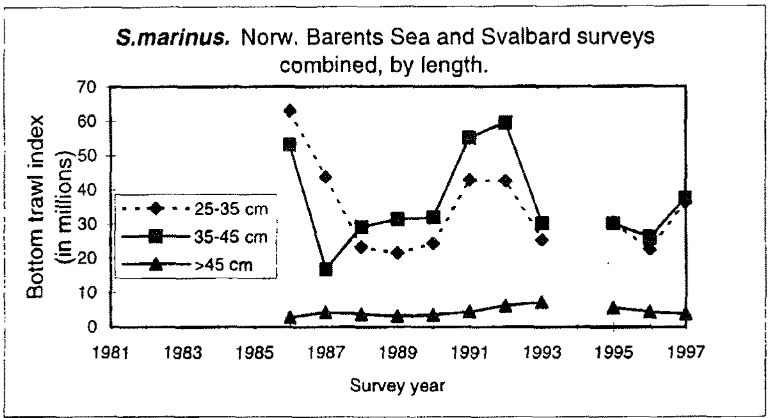
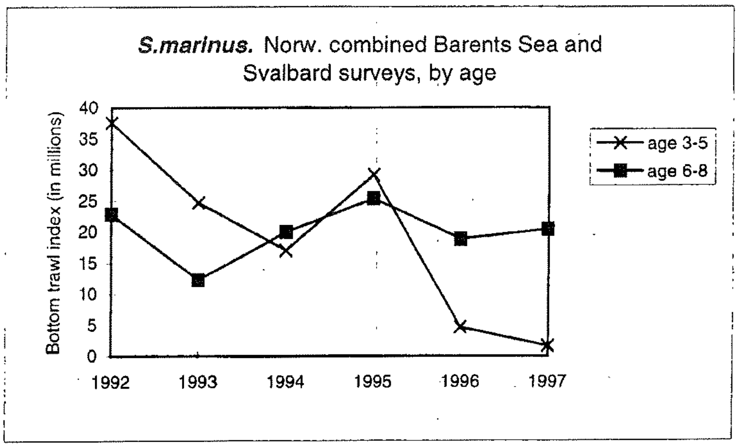


Figure 7.3a. *Sebastes marinus.* Abundance indices (by length) when combining the Norwegian bottom trawl surveys 1986-1997 in the Barents Sea (winter) and at Svalbard (summer/fall).



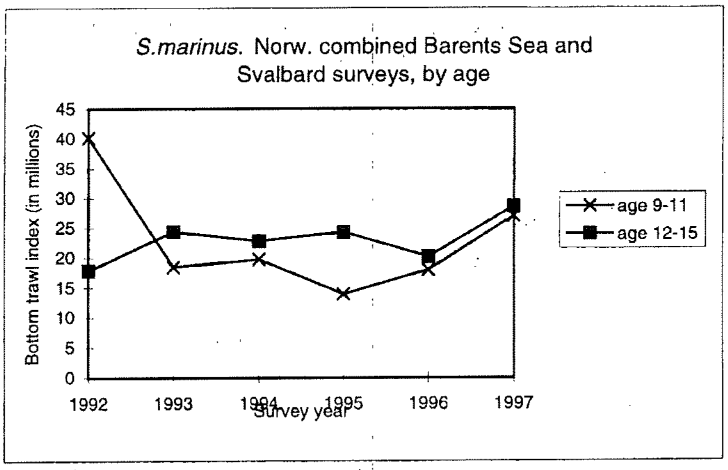


Figure 7.3b. *Sebastes marinus.* Abundance indices (by age) when combining the Norwegian bottom trawl surveys 1992-1997 in the Barents Sea (winter) and at Svalbard (summer/fall).

Table D1. REDFISH in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I, Divisions IIa and IIb combined as offically reported to ICES.

Year	Canada	Denmark	Faroe Islands	France	Germany[4]	Greenland	Iceland	Ireland	Netherlands	Norway	Poland	Portugal	Russia[5]	Spain	UK (E & W)	UK (Scotl)	Total
1984	-	-	-	2,970	7,457	-	-	-	-	18,650	-	1,806	69,689	25	716	-	101,313
1985	-	-	-	3,326	6,566	-	-	-	-	20,456	-	2,056	59,943	38	167	-	92,552
1986	-	-	29	2,719	4,884	-	-	-	-	23,255	-	1,591	20,694	-	129	14	53,315
1987	-	+	450[3]	1,611	5,829	-	-	-	-	18,051	-	1,175	7,215	25	230	9	34,595
1988	-	-	973	3,349	2,355	-	-	-	-	24,662	-	500	9,139	26	468	2	41,494
1989	-	-	338	1,849[1]	4,245	-	-	-	-	25,295	-	340	14,344	5[2]	271	1	46,688
1990	-	37[3]	386	1,821[1]	6,741	-	-	-	-	34,090	-	830	18,918	-	333	-	63,156
1991	-	23	639	791[1]	981	-	-	-	-	49,463	-	166	15,354	1	336	13	67,754
1992	-	9	58	1,301[1,6]	530	614	-	-	-	23,451	-	977	4,335	16	479	3	31,773
1993	8[3]	4	152	921[1,6]	685	15	-	-	-	18,226	-	1,040	7,573	65	734	1	29,389
1994	-	28	26	771[1,6]	1026	6	4	3	-	19,783	-	985	6,220	34	259	13	29,158
1995	-	-	30	748	692	7	1	5	1	15,620	-	936	6,985	67	252	13	25,357
1996	-	-	42[3]	746	618	37	-	2	-	20,533[2]	-	523	1,641	408	305	121	24,976
1997[1]	-	-	25[3]	616[3]	538[2]	39[2]	-	12[3]	-	18,213[2]	1	535	4,556	228[2]	235	29	25,027

[1] Provisional figures.
[2] Working Group figure.
[3] As reported to Norwegian authorities.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6] Possibly excluding landings abroad.

Table D2 REDFISH in Sub-area IV (North Sea). Nominal catch (t) by countries as officially reported to ICES. Not included in the assessment.

Year	Belgium	Denmark	Faroe Islands	France	Germany	Nether-lands	Norway	UK (England & Wales)	UK (Scotl)	Total
1986	-	24	-	578	183	-	1,048	35	1	1,869
1987	-	16	3	833	70	-	411	16	55	1,404
1988	-	32	90	915	188	-	696	125	9	2,055
1989	1	23	13	554[1]	111	-	500[2]	134	6	1,342
1990	+	41	25	554[1]	47	-	483[2]	369	6	1,525
1991	5	29	144	914[1]	213	2	415[2]	43	38	1,803
1992	4	22	23	1,960[1]	170	1	232[2]	65	122	2,599
1993	28	14	4	1,211[1]	33	1	281[2]	138	70	1,780
1994[1]	4	13	1	n.a.	324	8	306[2]	38	66	760
1995[1]	16	12	65	n.a.	80	16	268	46	241	744
1996[1]	20	16	n.a.	n.a.	74	41	390	37	146	724
1997[1]										

[1] Provisional figures.
[2] Working Group figure.
n.a. = not available.

Table D3. *Sebastes mentella* in Divisions IIa and IIb. Catch per unit effort and calculated total international effort.

Year	USSR/Russia catch/hour trawling (t/hr)		German Dem.Rep. catch/day (t/day)		Total effort (USSR units)	
	RT[1]	PST[2]	Freezer trawler	Factory trawler FVS IV (FAO code 090)	RT[1]	PST[2]
1965	0.38	-	-	-	41,216	-
1966	0.39	-	-	-	26,008	-
1967	0.37	-	-	-	16,862	-
1968	0.45	-	-	-	12,029	-
1969	0.48	-	-	-	14,242	-
1970	0.46	-	-	-	49,817	-
1971	0.38	-	-	-	118,587	-
1972	0.38	-	-	-	75,953	-
1973	0.45	-	-	-	85,289	-
1974	0.69	-	-	-	100,539	-
1975	0.95	1.01	-	-	251,653	-
1976	0.99	1.26	-	-	271,653	-
1977	0.77	1.00	-	-	190,084	-
1978	0.63	0.86	-	-	147,002	-
1979	0.56	0.93	-	-	155,616	-
1980	0.70	0.91	-	-	113,363	87,202
1981	0.63	0.95	8.71	-	129,438	85,338
1982	0.63	1.05	9.58	-	183,148	109,889
1983	0.80	1.09	17.12	-	131,591	96,581
1984	0.70	1.30	13.62	-	104,191	56,103
1985	0.60	1.00	9.89	-	105,113	63,068
1986	0.43	0.68	7.90	-	53,749	33,988
1987	-	0.70	-	7.30	-	15,026
1988	-	0.70	-	11.78	-	22,266
1989	-	0.90	-	12.96	-	26,104
1990	-	1.00	-	14.77	-	35,070
1991	-	0.80	-	-	-	60,909
1992	-	0.60	-	-	-	25,983
1993	-	1.00	-	-	-	12,623
1994	-	0.74	-	-	-	16,539
1995	-	0.80	-	-	-	12,715
1996[3]	-	0.80	-	-	-	10,108

[1]Side trawlers, 800-1000 HP.-

[2]Stern trawlers. Data from spring fishery only.

[3]Provisional figure set by the Working Group.

Table D4. *Sebastes mentella.* Average catch (numbers of specimens) per hour trawling of different ages of *Sebastes mentella* in the Russian groundfish survey in the Barents Sea and Svalbard areas (1976–1983 published in "Annales Biologiques").

Year class	0	1	2	3	4	5	6	7	8	9	10	11
1965	-	-	-	-	-	-	-	-	-	-	-	0.4
1966	-	-	-	-	-	-	-	-	-	-	3.0	-
1967	-	-	-	-	-	-	-	-	-	11.7	-	0.3
1968	-	-	-	-	-	-	-	-	16.2	-	1.5	0.3
1969	-	-	-	-	-	-	-	43.4	-	8.7	12.2	3.1
1970	-	-	-	-	-	-	85.8	-	19.8	34.9	11.9	-
1971	-	-	-	-	-	22.7	-	19.5	51.9	18.0	5.7	-
1972	-	-	-	-	9.4	-	6.7	57.6	12.3	6.7	-	-
1973	-	-	-	0.6	-	4.3	37.3	8.6	5.6	-	-	-
1974	-	-	4.8	-	4.9	22.8	4.8	4.8	-	-	-	3.0
1975	-	7.4	-	1.7	6.4	2.4	3.5	5.0	-	-	4.0	-
1976	7.0	-	8.1	1.2	2.5	6.8	4.9	5.0	1.0	13.0	-	-
1977	-	0.2	0.2	0.2	0.9	5.1	3.7	1.0	19.0	2.0	-	-
1978	0.8	0.02	0.9	1.0	5.0	3.8	2.0	20.0	6.0	-	-	-
1979	-	1.9	1.4	3.6	2.3	9.0	11.0	16.0	1.0	-	-	0.1
1980	0.3	0.4	2.0	2.5	16.0	6.0	11.0	25.0	2.0	-	1.5	2.0
1981	-	2.2	3.9	20.0	6.0	12.0	47.0	18.0	6.3	1.6	0.5	1.0
1982	19.8	13.2	13.0	15.0	34.0	44.0	39.0	32.6	4.3	3.1	4.9	+
1983	12.5	3.0	5.0	6.0	31.0	34.0	32.3	13.3	4.0	4.2	0.6	1.1
1984	-	10.0	2.0	-	5.0	18.3	19.0	2.2	2.4	0.2	1.7	2.4
1985	107.0	7.0	-	1.0	5.2	16.2	1.7	1.7	0.6	2.8	3.8	0.3
1986	2.0	-	1.0	1.8	8.4	3.6	2.1	1.2	5.6	8.2	0.9	0.4
1987	-	3.0	37.9	1.3	8.0	4.1	2.0	10.6	9.6	1.4	2.2	-
1988	4.0	58.1	4.3	13.3	25.8	3.9	8.6	11.2	2.8	4.1	-	-
1989	8.7	9.0	17.0	23.4	4.6	5.4	4.0	6.6	6.8	-	-	-
1990	2.5	6.3	6.1	1.0	4.3	1.7	11.5	12.8	-	-	-	-
1991	0.3	1.0	0.5	1.5	1.2	11.3	16.7	-	-	-	-	-
1992	0.6	+	0.2	0.1	4.3	14.7	-	-	-	-	-	-
1993[1]	-	+	1.5	1.8	11.6	-	-	-	-	-	-	-
1994	0.3	3.5	1.7	6.8	-	-	-	-	-	-	-	-
1995	2.8	1.0	6.3	-	-	-	-	-	-	-	-	-
1996[2]	+	9.7	-	-	-	-	-	-	-	-	-	-
1997[3]	1.0											

[1] - Not complete area coverage of Division IIb.
[2] - Area surveyed restricted to Subarea I and Division IIa only.
[3] - Data from the Nov-Dec survey only incl. Divisions IIa, IIb and the western part of Subarea I.

Table D5a. *Sebastes mentella*[1] in Division IIb. Abundance indices (**on length**) from the bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1986-1997 (numbers in millions).

	Length group (cm)									
Year	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0-34.9	35.0-39.9	40.0-44.9	>45.0	Total
1986[2]	6	101	192	17	10	5	2	4	+	338
1987[2]	20	14	140	19	6	2	1	2	+	208
1988[2]	33	23	82	77	7	3	2	2	+	228
1989	566	225	24	72	17	2	2	8	4	921
1990	184	820	59	65	111	23	15	7	3	1,287
1991	1,533	1,426	563	55	138	38	30	7	1	3,791
1992	149	446	268	43	22	15	4	7	4	958
1993	9	320	272	89	16	13	3	1	+	722
1994	No data presently available.									
1995	33	33	417	349	77	18	5	1	+	933
1996	56	69	139	310	97	8	4	1	1	685
1997	3	44	13	65	57	9	5	+	+	195

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.

[2] - Old trawl equipment (bobbins gear and 80 meter sweep length)

Table D5b. *Sebastes mentella*[1] in Division IIb. Preliminary Norwegian bottom trawl survey indices (**on age**) in the Svalbard area (Division IIb) in summer/fall 1992-1997 (numbers in millions).

	Age													
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1992	283	419	484	131	58	45	14	8	5	2	7	2	1	3	1,462
1993	2	527	117	202	142	8	23	6	13	1	7	1	1	+	1,050
1994	7	280	290	202	235	42	94	1	1	3	4	1	1	+	1,161
1995	4	50	365	237	132	61	19	17	11	+	1	3	0	0	900
1996	23	47	15	37	105	144	84	17	51	32	34	9	6	2	605
1997	8	43	6	6	40	20	30	25	7	3	1	2	2	1	194

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.

Table D6a. *Sebastes mentella*[1]. Abundance indices (**on length**) from the bottom trawl surveys in the Barents Sea in the winter 1986-1998 (numbers in millions). The area coverage was extended from 1993.

	Length group (cm)									
Year	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0-34.9	35.0-39.9	40.0-44.9	>45.0	Total
1986	81.3	151.9	205.4	87.7	169.2	129.8	87.5	23.6	13.8	950.2
1987	71.8	25.1	227.4	56.1	34.6	11.4	5.3	1.1	0.1	432.9
1988	587.0	25.2	132.6	182.1	39.6	50.1	47.9	3.6	0.1	1068.2
1989	622.9	55.0	28.4	177.1	58.0	9.4	8.0	1.9	0.3	961.0
1990	323.6	304.5	36.4	55.9	80.2	12.9	12.5	1.5	0.2	827.7
1991	395.2	448.8	86.2	38.9	95.6	34.8	24.3	2.5	0.2	1126.5
1992	139.0	366.5	227.1	34.6	55.2	34.4	7.5	1.8	0.5	866.6
1993	30.8	592.7	320.2	116.3	24.2	25.0	6.3	1.0	+	1116.5
1994	6.9	258.6	289.4	284.3	51.4	69.8	19.9	1.4	0.1	981.8
1995	263.7	71.4	637.8	505.8	90.8	68.8	31.3	3.9	0.5	1674.0
1996	213.1	100.2	191.2	337.6	134.3	41.9	16.6	1.4	0.3	1036.6
1997[2]	62.8	121.1	24.7	277.9	274.4	72.3	40.7	5.1	0.2	879.0
1998[2]	1.3	90.6	62.8	100.8	203.1	40.7	13.0	1.7	0.2	514.0

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.

[2] - Adjusted indices to account for not covering the Russian EEZ in Subarea I.

Table D6b. *Sebastes mentella*[1] in Sub-areas I and II. Preliminary Norwegian bottom trawl indices (**on age**) from the annual Barents Sea survey in February (numbers in millions). The area coverage was extended from 1993 onwards.

	Age													
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1992	351	252	132	56	14	11	3	9	18	16	12	11	2	5	892
1993	38	473	192	242	62	45	19	22	13	11	10	4	2	3	1,136
1994	7	85	332	189	370	228	73	42	3	30	8	14	25	7	1,413
1995	308	45	146	264	364	211	69	23	7	17	23	9	11	10	1,507
1996	173	119	109	114	128	122	106	64	24	19	12	7	8	4	1,009
1997[2]	43	101	19	54	96	43	44	171	76	74	39	29	10	9	808
1998[2]	1	73	49	27	13	52	107	104	41	18	7	4	3	3	502

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.

[2] - Adjusted indices to account for not covering the Russian EEZ in Subarea I.

Table D7. *Sebastes mentella* in Sub-areas I and II.
Results of the Russian trawl/acoustic redfish survey in the western Barents Sea in April-May 1992-1998. Abundance indices in millions.

Year	Period of survey	Age																		Total				Area of survey
		1-4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	Numbers 10^6	Biomass t 10^3	SSN 10^6	SSB t 10^3	in n.m.^{2}
1992	April	29	27	27	37	36	50	78	39	34	40	44	43	28	17	13	4	7	3	566	218	191	114	25300
1993	April	31	15	13	6	6	20	56	56	38	28	29	27	19	12	7	3	1	2	396	150	151	90	23500
1994												No	Data											
1995	May	+	32	51	83	90	41	31	31	41	94	73	48	30	10	9	4	1	+	669	202	211	102	23300
1996												No	Data											
1997	Apr-May	86	6	24	102	150	53	48	24	20	26	36	28	11	9	4	2	1	+	630	170	111	58	22400
1998	April	1	+	8	47	77	63	71	46	27	19	23	23	25	6	3	2	1	+	442	153	106	57	22931

Table D8. *Sebastes mentella.* Maturity ogives from Russian research vessels. Sexes combined. Data collected during April-June in the Kopytov area (western Barents Sea) and adjacent waters.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1995	1997	1998
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.021
8	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000	0.014
9	0.006	0.083	0.000	0.000	0.012	0.139	0.013	0.033	0.000	0.027	0.000
10	0.017	0.182	0.028	0.074	0.131	0.174	0.092	0.133	0.055	0.130	0.074
11	0.132	0.278	0.125	0.178	0.300	0.138	0.169	0.364	0.111	0.312	0.171
12	0.377	0.616	0.297	0.473	0.688	0.358	0.396	0.480	0.368	0.281	0.276
13	0.822	0.821	0.562	0.684	0.714	0.470	0.452	0.696	0.587	0.566	0.622
14	0.795	0.926	0.760	0.716	0.824	0.637	0.761	0.925	0.696	0.736	0.714
15	0.862	0.938	0.855	0.794	0.848	0.762	0.939	0.962	0.729	0.831	0.871
16	0.875	1.000	1.000	1.000	1.000	1.000	0.886	0.953	0.789	0.958	0.919
17	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.977	1.000	0.950	1.000
18	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table D9. Output statistics from the GLM-analysis of *S.marinus* CPUE.

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General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	17	1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
AREA	5	3 4 5 6 7
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12

Number of observations in data set = 590

Dependent Variable: CPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	31	41.31523422	1.33274949	2.75	0.0001
Error	558	270.72809459	0.48517580		
Corrected Total	589	312.04332881			

R-Square	C.V.	Root MSE	CPUE Mean
0.132402	94.04163	0.69654562	0.74067797

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	16	13.14467312	0.82154207	1.69	0.0439
AREA	4	17.56629555	4.39157389	9.05	0.0001
MONTH	11	10.60426556	0.96402414	1.99	0.0276

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	16	13.11973016	0.81998314	1.69	0.0445
AREA	4	20.51378421	5.12844605	10.57	0.0001
MONTH	11	10.60426556	0.96402414	1.99	0.0276

Parameter		Estimate		T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		0.5461424272	B	3.24	0.0013	0.16866112
YEAR	1981	-.0771548109	B	-0.45	0.6528	0.17141805
	1982	0.0428297518	B	0.22	0.8277	0.19672873
	1983	0.2415997516	B	1.35	0.1776	0.17897208
	1984	0.0609375728	B	0.39	0.6948	0.15521247
	1985	-.1682480631	B	-1.14	0.2530	0.14704740
	1986	0.0538855187	B	0.36	0.7159	0.14796759
	1987	-.0383112825	B	-0.25	0.8001	0.15124729
	1988	0.1645216550	B	0.49	0.6218	0.33336827
	1989	-.1115843979	B	-0.69	0.4909	0.16187701
	1990	0.3863178538	B	2.48	0.0134	0.15576484
	1991	0.2773112636	B	1.79	0.0736	0.15471235
	1992	-.0232883148	B	-0.14	0.8852	0.16128652

	1993	0.0762918884 B	0.45	0.6497	0.16789366
	1994	0.2071235981 B	1.24	0.2137	0.16638269
	1995	-.0326612214 B	-0.19	0.8515	0.17444047
	1996	0.1167871187 B	0.72	0.4709	0.16186799
	1997	0.0000000000 B	.	.	.
AREA	3	0.4289099174 B	4.24	0.0001	0.10104311
	4	0.1299646578 B	1.34	0.1814	0.09712891
	5	-.0159945705 B	-0.17	0.8643	0.09353642

Dependent Variable: CPUE

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
AREA	6	-.1693519244 B	-1.69	0.0920	0.10032889
	7	0.0000000000 B	.	.	.
MONTH	1	0.2120046440 B	1.30	0.1934	0.16281079
	2	0.2795454027 B	1.79	0.0738	0.15606197
	3	0.2547247041 B	1.67	0.0958	0.15266024
	4	0.1625528690 B	1.11	0.2693	0.14699428
	5	0.1846876158 B	1.25	0.2112	0.14753664
	6	0.0312991731 B	0.20	0.8383	0.15328484
	7	-.1803741100 B	-1.13	0.2607	0.16020777
	8	0.0005492199 B	0.00	0.9972	0.15782409
	9	0.0041772901 B	0.03	0.9772	0.14614885
	10	-.0533407561 B	-0.36	0.7179	0.14754727
	11	-.0801632986 B	-0.53	0.5974	0.15169232
	12	0.0000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

General Linear Models Procedure

Level of YEAR	N	CPUE Mean	CPUE SD
1981	29	0.57551724	0.46942660
1982	19	0.72631579	0.61012030
1983	25	0.91520000	1.30718247
1984	42	0.76785714	0.66636083
1985	52	0.50134615	0.22195238
1986	51	0.75254902	0.71328772
1987	46	0.67760870	0.59064629
1988	5	0.77200000	0.22208107
1989	36	0.58861111	0.55055376
1990	42	1.07857143	1.67442392
1991	42	0.91738095	0.74281291
1992	36	0.65222222	0.30266541
1993	31	0.75129032	0.44367963
1994	32	0.87250000	0.45409961
1995	27	0.66407407	0.40503807
1996	35	0.80371429	0.45678600
1997	40	0.65325000	0.45060863

Table D10. *Sebastes marinus*. Catch and catch per unit effort for Norwegian stern trawlers (ISSCFV - Code 07, 250-499,9 GRT), and total international effort (Norwegian trawl units).[1]

Year	Catch (t) as basis for the analysis	% of total international catch	CPUE (t/hour)	Effort hours trawling
1981	1,315	6.3	1.18	17,688
1982	2,014	12.3	1.30	12,615
1983	1,588	8.3	1.50	12,873
1984	3,960	14.0	1.32	21,574
1985	3,086	10.5	1.09	27,142
1986	4,502	14.9	1.31	23,084
1987	2,168	9.0	1.22	19,796
1988	4,349	16.8	1.42	18,257
1989	3,044	13.1	1.14	20,316
1990	3,589	12.8	1.64	17,111
1991	4,943	25.9	1.53	12,430
1992	2,265	14.0	1.23	13,144
1993	1,426	8.4	1.33	12,694
1994	1,241	7.3	1.46	11,699
1995	928	6.2	1.22	12,377
1996	1,831	10.6	1.37	12,562
1997[2]	1,295	7.7	1.25	13,363

[1] Only including days with more than 50% *S. marinus* in the catches, and analysed by a GLM-analysis.

[2] Provisional figures.

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 the coastal fishery was about 3,000 t. In recent years it has been 3,000–6,000 t although now gillnets are also used in the fishery. Following the introduction of international trawlers in the fishery in the mid 1960s, the total landings increased to a level of about 80,000 t in the early 1970s. The total 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 27.5 m to be directed for Greenland halibut. This fishery is also regulated by seasonal closure. Trawl catches are limited to bycatch only. From 1992 up to autumn 1994 bycatch in each haul should not exceed 10% in weight. In autumn 1994 this was changed to 5% bycatch of Greenland halibut onboard at any time. In autumn 1996 it was changed again to 5% bycatch in each haul.

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

8.1.2 Landings prior to 1997 (Tables 8.1 - 8.5, E8)

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

The revised total catch for 1996 is 14,205 t which is virtually unchanged from that used in the previous assessment. The preliminary estimate of total catch for 1997 is 9,259 t. This is considerably below the projected catch of 14,000 t estimated by the Working Group during its 1997 meeting. The discrepancy is mainly due to decreased Norwegian trawl catches in Division IIa (Table 8.3), but catches were also reduced in Sub-area I and Division IIb.

In recent years, some fishing for Greenland halibut has taken place in the northern part of Division IVa. In the period 1973–1990, the annual catch in Division IVa was usually well below 100 t, occasionally reaching 200 t. Since then, catches have increased sharply from 558 t in 1991 to 2,529 t in 1996 (Table E8). In 1997 landings were reduced to 1,194 t. The increase up to 1991 was mainly due to a gillnet fishery, but in the recent years most of it has been taken by trawl. This fishery is in another management area and is not restricted by any TAC regulations. Although there is a continuous distribution of this species from the southern part of Division IIa along the continental slope towards the Shetland area, little is known about the stock structure and the catch taken from this area has therefore not been added to the catch from Sub-areas I and II.

Also around Jan Mayen, small catches of Greenland halibut have been taken in some years. In the period 1992–97 reported annual catches were 56, 0, 140, 270, 59,51 t respectively. Jan Mayen is within Sub-area IIa, but little is known about the relationship with the stock assessed by the Arctic Fisheries Working Group. Catches from this area have therefore not been included in the catches given for Sub-area II.

8.1.3 Expected landings in 1998

The fishery for Greenland halibut is regulated by a TAC of 2,500 t that should be taken by gillnetters and longliners within a restricted time period and by restricting allowed bycatch in the trawl fishery to 5% of each trawl catch. When the gillnet and longline fishery was closed in 1997 the quotas had been overfished resulting in a catch of approximately 3,700 t. The bycatch in the trawl fishery has decreased and it is expected that a total of about 6,000 t will be caught by Norway. An additional 1,500 t is expected to be caught by Russian vessels, and 500 t by other countries.

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

8.2 Status of research

8.2.1 Survey results (Tables A14, E1-E6, Figures 8.1–8.4)

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

1. Norwegian Svalbard bottom trawl surveys (autumn) from 1984–97 in fishing depths of < 100–500 m. (Table E1, Figure 8.1).

2. Norwegian Barents Sea bottom trawl survey (winter) from 1989–98 in fishing depths of < 100–500 m. In order to utilise the 1998 values in VPA calibration, this series was adjusted back by 1 year and 1 age group to reflect sampling as if it occurred in the autumn of the previous year. (Table E2, Figure 8.2).

3. Russian bottom trawl surveys in the Barents Sea from 1990–97 in fishing depths of 100–900 m. This series had been revised substantially prior to its use in the 1996 assessment. The parameters of the 1996 and 97 survey, however, were considered too incompatible with previous years for direct comparison and covered only half the survey area. Therefore, this survey was not used in the current assessment (Table E3).

4. Norwegian Svalbard shrimp trawl surveys from 1988–97 in fishing depths of 200–600 m. (Table E4, Figure 8.3)

5. Norwegian Greenland halibut surveys in autumn 1994–98. The surveys cover the continental slope from 68 to 80°N, in depths of 500–1500 m north of 70°30'N, and 500–1000 m south of this latitude. (Table E5, Figure 8.4).

6. Norwegian bottom trawl surveys east and north of Svalbard in autumn 1996–97 (Table E6).

7. Norwegian pelagic 0-group surveys from 1970–97. (Table A14).

8. A Spanish survey along the continental slope between 73°30' and 80° N in 1997.

The Norwegian Svalbard bottom trawl survey caught Greenland halibut mainly in the range of ages 1–8, although in most years age 1 was poorly represented. The relative strength of the year classes varied considerably with age. For the 1983–87 year classes, which were all relatively abundant, there were no trend in this variation (Figure 8.1 top). The 1988 and 89 year classes were at some ages well below the previous year classes (Figure 8.1 middle), and from 1990 to 94 all year classes were consistently extremely poor up to and including age 5 (Figure 8.1 bottom). After that age, estimated abundance approached previous year classes. However, those age-groups are not considered to be well represented in this survey due to the limited depth range covered. In the last two years there were again high abundances of young fish in this survey. Both the 1995 and 96 year classes were more abundant than any other year class since 1988.

The Norwegian bottom trawl surveys during winter in the Barents Sea caught Greenland halibut up to 12 years and older, but was not particularly effective in catching fish older than 7 years. This is likely to be caused by the limited depth distribution of the survey area. Nevertheless, the survey appeared very effective at catching Greenland halibut up to age 6. The relative abundance of the year classes against age were comparable with the survey above: no clear pattern for the 83–87 year classes, an increasing trend for the 88–89 year classes, and a very sharp increase for the 90–92 year classes (Figure 8.2). From age 3–4 to age 6–8 the 90–92 year classes increased from only a few percentage to 100% or more of the mean for the 1983–87 year classes. Also in this survey were the 1995 and 1996 year classes were relatively abundant.

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. Also for this survey the relative abundance of the year classes against age were similar to the two surveys discussed above (Figure 8.3). The 1990 and 1991 year classes in particular increased from near zero values at age 1–4 to 50% of the mean for the 1983–87 year classes at age 6. The 1995 and 1996 year classes were relatively abundant in this survey also.

The Norwegian Greenland halibut surveys along the deep continental slope south and west of Spitsbergen were began in 1994. Although Greenland halibut older than 15 years were caught few fish were represented in the catch over age 12 or less than age 5. The scarcity of younger fish is probably a reflection of the minimum depth of 500 m. Most of the abundance indices were dominated by ages 5–8. Comparing the abundance at age for the different year classes it appears that there was no major variation among those year classes included (1985–1994). In most instances the between-year class differences were less than 50% and the differences were not consistent across ages. The relative strength of the 1991–92 year classes compared with the preceding ones increased from age 4 to age 7.

Data from the new survey north and east of Svalbard were only available for two years. Very high abundances were found for ages below 5 (Table E6). Although the time series is too short to compare year class abundance, it is noted that these data also indicate that the 1995 year class is comparatively large.

The Russian Barents Sea bottom trawl survey series from 1990–97 caught fish mainly in the range of 4–9 years old. In the last two years the survey covered only parts of the standard area and the trawl equipment was changed. Some calibration coefficients were used to make the data more compatible with previous years. Nevertheless, the abundance indices increased sharply for all major ages compared with the preceding years (Table E3). Such increase was not seen in any of the other surveys, and the survey series was therefore considered unreliable.

The strengths of the Greenland halibut year class of 1970–97 from the Norwegian pelagic 0-group surveys of the Barents Sea are shown in Table A14. The results are highly variable over the time period, however, most of the 1970's and 1980's year classes are represented in reasonably high numbers. In recent years the 1988–92 and the 1996 year classes have been well below the long term average. The 1993–95 and 97 year classes are closer to the average.

This year a working document describing a Spanish survey was presented to the Working Group (Paz and Duran, WD 1998). Sex-specific length-distributions from this survey were combined with the age-length-key from the Norwegian Greenland halibut survey along the continental slope in 1997. This showed that the catches were dominated by the 1990–92 year classes. Since data were only available for a single year and the selection pattern of the gear is unknown no further analyses were made on these data.

All in all the surveys seem to indicate that the catchability of the 1990–94 year classes increases considerably as the fish becomes five years and older. Based on extremely low catch rates in the surveys, these year classes were considered very poor in previous assessments by the Working Group. The new results indicate that the 1990–92 year classes may be at the same level as those prior to the previously assumed recruitment failure. Although similar results are not available yet for the 1993–94 year classes (still below 5 years in age), it is reasonable to assume that these year classes also may be severely underestimated in the surveys. The reason for this change in catchability is not clear. However, it seems clear that important areas for young Greenland halibut may be found north and east of Svalbard (Gundersen *et al.*,1997). Albert et al. (1997) showed that the south-western end of the distribution area of age 1 fish was gradually displaced northwards along west Spitsbergen in the period 1989–92 and southwards in the period 1994–96. These displacements corresponded to changes in hydrography and may be explained by increased migration of the 1990–94 year classes to areas outside the areas covered by the surveys.

8.2.2 Fishing effort and catch-per-unit-effort (Table 8.6 and E7)

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 program using two trawlers in a limited commercial fishery (Tables 8.6 and E7). This comprises fishing during two weeks in May-June and October, representing an effort somewhat less than 20% of the 1991 level. Since 1994 the fishery has been restricted to May-June. This fishery was conducted, as much as possible, in the same way as the commercial fishery in the previous years.

The CPUE from this experimental fishery was found, however, to be considerably higher than in the traditional fishery and has exhibited an increasing trend from 1992–96. In 1997 this trend stopped and a clear reduction in catch was observed especially for age 6–7. The CPUE was higher in 1997 and 1998 than in the years before 1996.

8.2.3 Age readings

With respect to the current assessment of Greenland halibut in the NE Arctic, the problem of unusually low numbers of cohorts at age 9 in data sets from the 1990's continues into 1997 data. A preliminary analysis indicates that this may be related to sex-specific distribution of age groups. This should be further evaluated in view of the new indications of age-specific distribution of the sexes combined.

8.3 Data used in the assessment

Based on the arguments in Section 8.2.1 the Working Group no longer considers the survey indices for ages below age 5 appropriate for inclusion in the tuning data. Consequently, a standard XSA was run for age 5 and above. Due to the uncertainty in the tuning data the run should only be regarded as an experimental run for illustrative purposes. Assessment of the stock status is based on the new trends seen in the survey data. Catch, weight and maturation data are given for all ages although only age 5 and above were used in the VPA.

8.3.1 Catch at age (Table 8.7)

The catch-at-age data for 1996 were updated using revised catch figures and revised Norwegian age composition. Catch-at-age data for 1997 were available from both the Norwegian and Russian fisheries. Russian age data were only available from Sub-area II and the Norwegian age distribution was used to calculate Russian catch-at-age in Sub-area I. No age or length data were available from the Russian longline catches, thus Norwegian age compositions were used. A length distribution was available from the German catches in area IIb and this was combined with the appropriate Norwegian age-length key. The combined Norwegian and Russian catch-at-age was used to allocate catches from other countries by age groups. Total international catch-at-age is given in Table 8.7. Greenland halibut are usually caught in the range of 3–16 years old, but the catch is mainly dominated by ages 5–10. Generally, fish older than age 10 comprise a very low proportion of the catches. The Working Group observed that there is an apparent ageing discrepancy in the data, particularly related to age 9, which is 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 1997 (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 was set equal to the weight at age in the catch for all years.

The weights at ages 1 and 2 were set to 0 to indicate that in previous WG assessments these ages were only used for tuning and were not included in the stock biomass. In the present assessment only age 5 and above were used.

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 was used in previous years.

8.3.4 Maturity at age (Tables 8.9)

This year new maturity ogives were available (Smirnov, WD 1998). Annual ogives were given for the years 1984–90 and 1992–97. An average ogive derived from 1984–1987 was used for 1970–1983. For 1984 -97 a three-year running average was used.

8.3.5 Tuning data

The following abundance indices were used for tuning the VPA:

Fleet 9: Norwegian Svalbard bottom trawl surveys (autumn) from 1984–97 for ages 5–8.
Fleet 11: Norwegian Svalbard shrimp trawl surveys from 1988–97 for ages 5–8.
Fleet 12: Experimental commercial fishery CPUE from 1992–97 for ages 5–14.
Fleet 13: Norwegian bottom trawl surveys in the Barents Sea (conducted in winter and adjusted to the autumn the year before) from 1989–98 for ages 5–12.
Fleet 14: Norwegian Greenland halibut surveys using a commercial vessel along the continental slope from 94–97 for ages 5–14.

8.3.6 Recruitment indices (Tables A14, E1-E6)

In addition to the indices mentioned in Section 8.3.4, all the surveys in Section 8.2.1 may give information on recruitment. However, because the dynamics of migration and distribution patterns are not well understood for this stock, it is not known which age should be used for a reliable recruitment estimate. As outlined in Section 8.2.1 there is no longer evidence for a major recruitment failure in the early 1990's. The relative size of the individual year classes is poorly estimated though, and estimates would probably vary between sexes. Still, the 1995 year class was abundant in all surveys in the young fish areas. The recruitment estimates were considered to be too poor to make the basis for prediction.

8.4 Methods used in the assessment

8.4.1 VPA and tuning

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 still considers them to be appropriate for this stock.

The catchability was assumed to be independent on stock size for all ages and independent on age for ages above age 10. The diagnostics of the tuning are not given since this was only an illustrative run.

Table 8.1 GREENLAND HALIBUT in Sub-areas I and II.
Nominal catch (t) by countries (Subarea I,Divisions IIa and IIb combined) as officially reported to ICES.

Year	Denmark	Estonia	Faroe Isl.	France	Fed. Rep. Germany	Greenland	Iceland	Ireland	Lithuania	Norway	Poland	Portugal	Russia[4]	Spain	UK (England & Wales)	UK (Scotland)	Total
1984	0	0	0	138	2,165	3,746	0	0	0	4,376	0	0	15,181	0	23	0	25,629
1985	0	0	0	239	4,000	2,620	0	0	0	5,464	0	0	10,237	0	5	0	22,565
1986	0	0	42	13	2,718	1,947	0	0	0	7,890	0	0	12,200	0	10	2	24,822
1987	0	0	0	13	2,024	590	0	0	0	7,261	0	0	9,733	0	61	20	19,702
1988	0	0	186	67	744	496	0	0	0	9,076	0	0	9,430	0	82	2	20,083
1989	0	0	67	31	600	942	0	0	0	10,622	0	0	8,812	0	6	0	21,080
1990	0	0	163	49	954	80	0	0	0	17,243	0	0	4,764	0	10	0	23,263
1991	11	2564	314	119	101	12	0	0	0	27,587	0	0	2,490	132	0	2	33,332
1992	0	0	16	111	13	8	0	0	0	7,667	0	31	718	23	7	0	8,594
1993	2	0	61	80	22	46	56	0	30	10,380	0	43	1,235	0	16	0	11,971
1994	4	0	86	55	296	5	15	5	4	8,322	0	36	283	2	76	2	9,191
1995	0	0	12	174	35	47	25	2	0	9,200	0	84	794	757	115	7	11,252
1996	0	0	0	219	81	63	70	0	0	11,606	0	79	1,576	137	317	57	14,205
1997	0	0	0	0	56	1	62	0	0	7,894	12	50	1,038	54	67	25	9,259

TABLE 8.2 GREENLAND HALIBUT in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I as officially reported to ICES.

Year	Estonia	Faroe Islands	Fed. Rep. Germany	Green land	Iceland	Norway	Russia[3]	Spain	UK (England & Wales)	UK (Scot land)	Total
1984	-	-	-	-	-	593	81	-	17	-	691
1985	-	-	-	-	-	602	122	-	1	-	725
1986	-	-	1	-	-	557	615	-	5	1	1179
1987	-	-	2	-	-	984	259	-	10	+	1255
1988	-	9	4	-	-	978	420	-	7	-	1418
1989	-	-	-	-	-	2039	482	-	+	-	2521
1990	-	7	-	-	-	1304	321 [2]	-	-	-	1632
1991	164	-	-	-	-	2,029	522 [2]	-	-	-	2715
1992	-	-	+	-	-	2,349	467	-	-	-	2816
1993	-	32	-	-	56	1,754	867	-	-	-	2709
1994	-	17	217	-	15	1,157 [2]	175	-	+	-	1581
1995	-	12	-	-	25	1,321 [2]	270	57	-	-	1685
1996	-	-	+	30	70	792 [2]	198	-	+	-	1090
1997 [1]	-	-	-	1	62	573 [2]	170	-	+	-	806

[1] Provisional figures.
[2] Working Group figures.
[3] USSR prior to 1991.

Table 8.3 GREENLAND HALIBUT in Sub areas I and II.
Nominal catch (t) by countries in Division IIa as officially reported to ICES.

Year	Estonia	Faroe Islands	France	Fed. Rep. Germany	Greenland	Ireland	Norway	Portugal	Russia[5]	Spain	UK (England & Wales)	UK (Scotland)	Total
1984		-	138	265	-	-	3,703	-	5,459	-	1	-	9,566
1985		-	239	254	-	-	4,791	-	6,894	-	2	-	12,180
1986		6	13	97	-	-	6,389	-	5,553	-	5	1	12,064
1987		-	13	75	-	-	5,705	-	4,739	-	44	10	10,586
1988		177	67	150	-	-	7,859	-	4,002	-	56	2	12,313
1989		67	31 [1]	104	-	-	8,050	-	4,964	-	6	-	13,222
1990		133	49 [1]	12	-	-	8,233	-	1,246 [2]	-	1	-	9,674
1991	1,400	314	119 [1]	21	-	-	11,189	-	305 [2]	-	+	1	13,349
1992	-	16	108 [1]	1	13 [4]	-	3,586	15 [3]	58	-	1	-	3,798
1993	-	29	78 [1]	14	8 [4]	-	7,977	17	210	-	2	-	8,335
1994	-	68 [2]	47 [1]	33	3 [4]	4	6,390 [2]	26	67	+	14	-	6,652
1995	-	-	174	30	12 [4]	2	6,061 [2]	60	227	-	83	2	6,651
1996	-	-	219	34	123 [4]	-	9,565 [2]	55	466	3	278	57	10,800
1997 [1]	-	-	-	23 [2]	4 [4]	-	6,078 [2]	41	334	-	22	25	6,527

[1] Provisional figures.
[2] *Working Group figure.*
[3] As reported to Norwegian authorities.
[4] Includes Division IIb.
[5] USSR prior to 1991.

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Table 8.4 GREENLAND HALIBUT in Sub-areas I and II.
Nominal catch (t) by countries in Division IIb as officially reported to ICES.

Year	Den mark	Estonia	Faroe Islands	France	Fed. rep. Germany	Ireland	Lithua nia	Norway	Poland	Portugal	Russia[4]	Spain	UK (England & Wales)	UK (Scot land)	Total
1984	-		-	-	1,900	-		80	-	-	9,641	-	5	-	11,626
1985	-		-	-	3,746	-		71	-	-	3,221	-	2	-	7,040
1986	-		36	-	2,620	-		944	-	-	6,032	-	+	-	9,632
1987	+		-	-	1,947	-		572	-	-	4,735	-	7	10	7,271
1988	-		-	-	590	-		239	-	-	5,008	-	19	+	5,856
1989	-		-	-	496	-		533	-	-	3,366	-	-	-	4,395
1990	-		23 [2]	-	942	-		7,706	-	-	3,197 [2]	-	9	-	11,877
1991	11	1,000	-	-	80	-	-	14,369	-	-	1,663 [2]	132	+	1	17,256
1992	-	-	-	3 [2]	12	-	-	1,732	-	16 [2]	193	23	6	-	1,985
1993	2 [3]	-	-	2 [3]	8	-	30 [3]	649	-	26	158	-	14	-	889
1994	4	-	1 [3]	8 [3]	46	1	4 [3]	775 [2]	-	10	41	2 [2]	62	2	956
1995	-	-	-	-	5	-	-	1,818 [2]	-	24	297	700	32	5	2,881
1996	-	-	-	-	47	-	-	1,249 [2]	-	24	912	134	39	+	2,405
1997 [1]	-	-	-	-	33 [2]	-	-	1,243 [2]	12	9	534	54 [2]	45	+	1,932

[1] Provisional figures.
[2] Working Group figure.
[3] As reported to Norwegian authorities.
[4] USSR prior to 1991.

Table 8.5 GREENLAND HALIBUT in the Sub-areas I and II.
Landings by gear (tonnes).

Year	Gillnet	Longline	Trawl	Total
1980	1,189	336	11,759	13,284
1981	730	459	13,829	15,018
1982	748	679	15,362	16,789
1983	1,648	1,388	19,111	22,147
1984	1,200	1,453	19,230	21,883
1985	1,668	750	17,527	19,945
1986	1,677	497	20,701	22,875
1987	2,239	588	16,285	19,112
1988	2,815	838	15,934	19,587
1989	1,342	197	18,599	20,138
1990	1,372	1,491	20,325	23,188
1991	1,904	4,552	26,864	33,320
1992	1,679	1,787	5,787	9,253
1993	1,497	2,493	7,889	11,879
1994	1,403	2,392	5,353	9,148
1995	1,500	4,034	5,494	11,028
1996	1,480	4,616	7,977	14,073
1997	1,044	3,421	4,799	9,264

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Table 8.6 GREENLAND HALIBUT in Sub-areas I and II.
Catch per unit effort and total effort.

Year	USSR catch/hour trawling (t)		Norway[10] catch/hour trawling (t)		Average CPUE		Total effort (in '000 hrs trawling)[5]	CPUE 7+[6]	GDR[7] (catch/day tonnage (kg)
	RT[1]	PST[2]	A[8]	B[9]	A[3]	B[4]			
1965	0.80	-	-	-	0.80	-	-	-	-
1966	0.77	-	-	-	0.77	-	-	-	-
1967	0.70	-	-	-	0.70	-	-	-	-
1968	0.65	-	-	-	0.65	-	-	-	-
1969	0.53	-	-	-	0.53	-	-	-	-
1970	0.53	-	-	-	0.53	-	169	0.50	-
1971	0.46	-	-	-	0.46	-	172	0.43	-
1972	0.37	-	-	-	0.37	-	116	0.33	-
1973	0.37	-	0.34	-	0.36	-	83	0.36	-
1974	0.40	-	0.36	-	0.38	-	100	0.36	-
1975	0.39	0.51	0.38	-	0.39	0.45	99	0.37	-
1976	0.40	0.56	0.33	-	0.37	0.45	100	0.34	-
1977	0.27	0.41	0.33	-	0.30	0.37	96	0.26	-
1978	0.21	0.32	0.21	-	0.21	0.27	123	0.17	-
1979	0.23	0.35	0.28	-	0.26	0.32	67	0.19	-
1980	0.24	0.33	0.32	-	0.28	0.33	47	0.25	-
1981	0.30	0.36	0.36	-	0.33	0.36	42	0.28	-
1982	0.26	0.45	0.41	-	0.34	0.43	39	0.37	-
1983	0.26	0.40	0.35	-	0.31	0.38	58	0.32	-
1984	0.27	0.41	0.32	-	0.30	0.37	59	0.30	-
1985	0.28	0.52	0.37	-	0.33	0.45	44	0.37	-
1986	0.23	0.42	0.37	-	0.30	0.40	57	0.32	-
1987	0.25	0.50	0.35	-	0.30	0.43	44	0.35	-
1988	0.20	0.30	0.31	-	0.26	0.31	63	0.26	4.26
1989	0.20	0.30	0.26	-	0.23	0.28	73	0.19	2.95
1990	-	0.20	0.27	-	-	0.24	95	0.16	1.66
1991	-	-	0.24	-	-	-	134	0.18	-
1992	-	-	0.46	0.72	-	-	20	0.29	-
1993	-	-	0.79	1.22	-	-	15	0.65	-
1994	-	-	0.77	1.27	-	-	11	0.70	-
1995	-	-	1.03	1.48	-	-	-	-	-
1996	-	-	1.45	1.82	-	-	-	-	-
1997	-	-	1.23	1.60	-	-	-	-	-
1998	-	-	0.98	1.35	-	-	-	-	-

[1] Side trawlers, 800-1000 hp. From 1983 onwards, side trawlers (SRTM), 1,000 hp.
[2] Stern trawlers, up to 2,000 HP.
[3] Arithmetic average of CPUE from USSR RT (or SRTM trawlers) and Norwegian trawlers.
[4] Arithmetic average of CPUE from USSR PST and Norwegian trawlers.
[5] For the years 1981-1990, based on average CPUE type B. For 1991-1993, based on the Norwegian CPUE, type A.
[6] Total catch (t) of seven years and older fish divided by total effort.
[7] For the years 1988-1989, frost-trawlers 995 BRT (FAO Code 095). For 1990, factory trawlers FVS IV, 1943 BRT (FAO Code 090).
[8] *Norwegian trawlers, ISSCFV-code 07, 250-499.9 GRT.*
[9] Norwegian factory trawlers, ISSCFV-code 09, 1000-1999.9 GRT
[10] From 1992 based on research fishing. 1992-1993: two weeks in May/June and October; 1994-1995: 10 days in May/June

Table 8.7

Run title : Arctic Green.halibut (run: XSAOLE02/X02)
At 24-Aug-98 17:47:03

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE								
1,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,
3,	1,	1,	1,	1,	1,	22,	1,	62,
4,	34,	1,	461,	19,	276,	334,	98,	755,
5,	526,	80,	1109,	212,	917,	840,	830,	2037,
6,	2792,	4486,	3521,	1117,	2519,	2337,	2982,	3255,
7,	10464,	12712,	9605,	3923,	6204,	6520,	5824,	4200,
8,	18562,	12283,	6438,	3515,	3838,	4118,	5002,	2524,
9,	10034,	6130,	2775,	2551,	1834,	2265,	3000,	1610,
10,	6671,	4339,	1734,	1919,	1942,	1654,	1350,	1104,
11,	2517,	2703,	1368,	1536,	1622,	1857,	915,	1062,
12,	1250,	1660,	1234,	1127,	1338,	1536,	1212,	858,
13,	616,	1044,	675,	716,	734,	1122,	698,	595,
14,	1104,	300,	200,	251,	531,	600,	526,	384,
15,	266,	123,	40,	70,	137,	270,	254,	93,
+gp,	15,	20,	40,	56,	79,	98,	104,	87,
0 TOTALNUM,	54852,	45882,	29201,	17013,	21972,	23573,	22796,	18626,
TONSLAND,	89484,	79034,	43055,	29938,	37763,	38172,	36074,	28827,
SOPCOF %,	94,	104,	97,	92,	98,	88,	92,	100,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	78,	88,	64,	664,	48,	314,	0,	88,	141,	50,
4,	532,	887,	275,	1146,	551,	1212,	36,	461,	985,	435,
5,	1897,	2218,	731,	1896,	1304,	1543,	915,	1219,	1672,	1212,
6,	3589,	3155,	1138,	1917,	1494,	1864,	3698,	2874,	3335,	2972,
7,	4118,	2727,	1665,	1919,	1276,	1851,	3350,	2561,	2712,	3572,
8,	2365,	1234,	1341,	933,	1208,	2287,	1938,	1548,	1531,	1746,
9,	1509,	495,	944,	484,	1493,	1491,	1064,	972,	1128,	752,
10,	946,	319,	473,	448,	1258,	1228,	1191,	1037,	997,	828,
11,	934,	296,	511,	482,	838,	713,	602,	614,	530,	362,
12,	438,	243,	275,	380,	502,	488,	340,	363,	434,	202,
13,	349,	103,	242,	384,	324,	247,	171,	161,	314,	186,
14,	147,	45,	145,	150,	108,	201,	132,	120,	305,	63,
15,	83,	30,	62,	47,	43,	51,	41,	55,	232,	7,
+gp,	29,	21,	16,	15,	3,	13,	30,	8,	7,	0,
0 TOTALNUM,	17014,	11861,	7882,	10865,	10450,	13503,	13508,	12081,	14323,	12387,
TONSLAND,	24617,	17312,	13284,	15018,	16789,	22147,	25629,	22565,	24822,	19702,
SOPCOF %,	104,	100,	108,	102,	98,	95,	117,	110,	104,	103,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
1,	0,	0,	0,	7,	21,	0,	0,	0,	0,	0,
2,	0,	0,	0,	67,	21,	0,	0,	0,	3,	0,
3,	5,	214,	155,	389,	98,	10,	0,	0,	3,	1,
4,	233,	924,	793,	2084,	437,	224,	72,	72,	48,	30,
5,	907,	2080,	2139,	3312,	1098,	1140,	622,	814,	1034,	327,
6,	2540,	4453,	5163,	3889,	1195,	1088,	695,	953,	2083,	880,
7,	3141,	3655,	4642,	4716,	1069,	1608,	1231,	1637,	3795,	1687,
8,	2096,	1657,	1932,	2355,	778,	1118,	803,	934,	1426,	868,
9,	1182,	801,	1221,	1031,	360,	140,	305,	380,	262,	330,
10,	860,	318,	499,	1284,	600,	976,	630,	689,	655,	865,
11,	481,	228,	264,	774,	188,	444,	408,	437,	270,	229,
12,	313,	126,	314,	673,	150,	144,	324,	345,	132,	143,
13,	133,	120,	42,	177,	79,	36,	87,	142,	29,	18,
14,	140,	140,	96,	266,	89,	20,	38,	53,	22,	40,
15,	47,	28,	44,	517,	56,	4,	3,	7,	1,	1,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALNUM,	12078,	14744,	17304,	21541,	6239,	6952,	5218,	6463,	9763,	5419,
TONSLAND,	10083,	21080,	23263,	33332,	8594,	11971,	9191,	11252,	14205,	9259,
SOPCOF %,	51,	105,	100,	100,	93,	101,	100,	102,	100,	100,

Table 8.8

Table 2 Catch weights at age (kg)

	YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
	AGE								
	1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
	2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
	3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
	4,	.4410,	.4410,	.4410,	.4410,	.4410,	.4410,	.4410,	.4410,
	5,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,
	6,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,
	7,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,
	8,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,
	9,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,
	10,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,
	11,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,
	12,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,
	13,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,
	14,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,
	15,	5.7650,	5.7650,	5.7650,	5.7650,	5.7650,	5.7650,	5.7650,	5.7650,
	+gp,	6.3080,	6.3080,	6.3080,	6.3080,	6.3080,	6.3080,	6.3080,	6.3080,
0	SOPCOFAC,	.9435,	1.0434,	.9707,	.9229,	.9794,	.8774,	.9245,	.9974,

Table 2 Catch weights at age (kg)

	YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
	AGE										
	1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
	2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
	3,	.2000,	.3000,	.2000,	.2000,	.2700,	.3100,	.3000,	.3000,	.3400,	.3070,
	4,	.4410,	.6000,	.4820,	.5000,	.6200,	.4500,	.4800,	.3800,	.4700,	.5740,
	5,	.5670,	.9000,	.7020,	.6600,	.6900,	.7500,	.6300,	.6000,	.6200,	.7090,
	6,	.7370,	1.2000,	.8720,	.8400,	.8400,	1.0400,	.9600,	.8900,	.9200,	1.0030,
	7,	1.0790,	1.5000,	1.1410,	1.1500,	1.0300,	1.3400,	1.1800,	1.2000,	1.2800,	1.2660,
	8,	1.4210,	1.8000,	1.4680,	1.5600,	1.3100,	1.5700,	1.5300,	1.8500,	1.9000,	1.6830,
	9,	1.8480,	2.2000,	1.7780,	2.0400,	1.7400,	1.9700,	2.3100,	2.5900,	2.4800,	2.4820,
	10,	2.2810,	2.6000,	2.3020,	2.5700,	2.2400,	2.7300,	2.8700,	3.1800,	3.1100,	2.9820,
	11,	2.8870,	3.0000,	2.6640,	2.9800,	2.7700,	3.2900,	3.4600,	3.6200,	3.3500,	3.5470,
	12,	3.2470,	3.5000,	3.0460,	3.4300,	3.3700,	4.2200,	3.7700,	3.9500,	3.7200,	3.8000,
	13,	4.3030,	4.1000,	3.3680,	4.1300,	4.3200,	4.7100,	3.9900,	4.4800,	4.0000,	4.5600,
	14,	4.9310,	4.8000,	4.2850,	4.6800,	5.3500,	6.0800,	4.3500,	4.2500,	4.1800,	5.0020,
	15,	5.7650,	5.6000,	5.0250,	5.8100,	5.7800,	6.0000,	4.4700,	4.8000,	4.5000,	5.9530,
	+gp,	6.3080,	7.0000,	6.5890,	6.5900,	6.6000,	6.6000,	4.6000,	5.0000,	5.4000,	5.9530,
0	SOPCOFAC,	1.0375,	1.0029,	1.0766,	1.0169,	.9829,	.9513,	1.1713,	1.1042,	1.0387,	1.0284,

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Table 2 Catch weights at age (kg)

	YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
	AGE										
	1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
	2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.1000,
	3,	.4140,	.3100,	.2800,	.2900,	.2200,	.3400,	.2600,	.4400,	.1800,	.3000,
	4,	.5540,	.6300,	.5500,	.6000,	.4600,	.5400,	.5200,	.5600,	.4700,	.5000,
	5,	.7400,	.7600,	.7100,	.7700,	.6800,	.7900,	.7200,	.7300,	.7700,	.7700,
	6,	.9620,	1.0300,	1.0600,	1.0500,	.9700,	1.0200,	.9400,	.9400,	.9700,	.9400,
	7,	1.2490,	1.3200,	1.2900,	1.3800,	1.2700,	1.3500,	1.2700,	1.2500,	1.3100,	1.2800,
	8,	1.6260,	1.8000,	1.7000,	1.7500,	1.7600,	1.8800,	1.7200,	1.7400,	1.7400,	1.6400,
	9,	2.1640,	2.4200,	2.1000,	2.2000,	2.2100,	2.4600,	2.1900,	2.0900,	2.2400,	2.0700,
	10,	2.8970,	3.1300,	2.6100,	2.6000,	2.5600,	2.6700,	2.5200,	2.5100,	2.5900,	2.5900,
	11,	3.4060,	3.3700,	2.8700,	2.7900,	3.1100,	3.4300,	2.9700,	2.9500,	3.2900,	3.3000,
	12,	3.6610,	4.0500,	3.4500,	3.2800,	3.5900,	4.2900,	3.2900,	3.3400,	4.0200,	4.0100,
	13,	4.2470,	4.2900,	3.7200,	3.8900,	3.8300,	5.0800,	3.8400,	3.8300,	4.7500,	4.8300,
	14,	4.1870,	4.5000,	4.0900,	4.3800,	4.2500,	6.3300,	4.9500,	4.9800,	6.2400,	5.9500,
	15,	4.4630,	4.7200,	4.5200,	5.2900,	4.8000,	8.9100,	6.6800,	8.1500,	6.0900,	6.2700,
	+gp,	4.4630,	4.7200,	4.5200,	5.2900,	4.8000,	8.9100,	6.6800,	.0000,	8.0500,	6.2700,
0	SOPCOFAC,	.5100,	1.0481,	1.0028,	1.0043,	.9281,	1.0108,	1.0035,	1.0200,	.9950,	.9998,

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Table 8.9

Table 5 Proportion mature at age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE								
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,
5,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,
8,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,
9,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,
10,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,
12,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.2400,	.1700,	.1300,
5,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.4500,	.4300,	.3500,	.2100,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7700,	.7500,	.7200,	.6400,
7,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.7900,	.7900,	.8400,	.7900,
8,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8300,	.8400,	.8500,	.8300,
9,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.8600,	.8900,	.9300,	.9200,
10,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9200,	.9400,	.9800,	.9800,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	1.0000,	.9900,
12,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9800,	.9900,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0300,	.0300,	.0400,	.2600,	.2400,	.2700,	.0900,	.1400,	.1700,
5,	.0500,	.0700,	.0700,	.1200,	.2800,	.3200,	.3800,	.3800,	.4800,	.6500,
6,	.6600,	.6200,	.6000,	.2800,	.4600,	.4900,	.5200,	.4900,	.6000,	.7800,
7,	.7800,	.7400,	.7000,	.3900,	.5200,	.5700,	.6200,	.5900,	.6300,	.7000,
8,	.7900,	.7900,	.6800,	.4900,	.6100,	.6700,	.6700,	.6500,	.7000,	.7900,
9,	.9100,	.9000,	.8500,	.7100,	.8900,	.8900,	.8600,	.7900,	.7900,	.8100,
10,	.9700,	.9600,	.9000,	.9200,	.9500,	.9000,	.9100,	.9000,	.9400,	.9400,
11,	.9900,	.9800,	1.0000,	1.0000,	.9800,	.9800,	.9800,	1.0000,	.9800,	.9700,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 8.10

Run title : Arctic Green.halibut (run: XSAOLE03/X03)

At 26-Aug-98 14:47:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE								
5,	.0140,	.0029,	.0378,	.0075,	.0396,	.0422,	.0404,	.1070,
6,	.0664,	.1502,	.1598,	.0461,	.1094,	.1274,	.1960,	.2078,
7,	.2938,	.4512,	.5159,	.2540,	.3633,	.4269,	.4997,	.4373,
8,	.6956,	.6268,	.4088,	.3383,	.3985,	.4123,	.6437,	.3951,
9,	.5898,	.4870,	.2598,	.2646,	.2798,	.4091,	.5654,	.4124,
10,	.6002,	.5171,	.2309,	.2723,	.3118,	.4129,	.4308,	.3931,
11,	.4937,	.4897,	.2851,	.3111,	.3672,	.5217,	.3983,	.6775,
12,	.5181,	.6716,	.4082,	.3794,	.4610,	.6697,	.7326,	.7617,
13,	.7962,	1.0749,	.6019,	.4152,	.4294,	.8453,	.7002,	.9579,
14,	1.6522,	1.1669,	.5613,	.4412,	.5861,	.7121,	1.2865,	1.0449,
15,	.8182,	.7898,	.4196,	.3655,	.4333,	.6365,	.7146,	.7726,
+gp,	.8182,	.7898,	.4196,	.3655,	.4333,	.6365,	.7146,	.7726,
FBAR 6-10,	.4491,	.4465,	.3150,	.2351,	.2926,	.3577,	.4671,	.3691,

Table 8 Fishing mortality (F) at age

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
5,	.1053,	.1337,	.0466,	.1062,	.0780,	.0934,	.0574,	.0687,	.0958,	.0702,
6,	.2628,	.2415,	.0892,	.1571,	.1082,	.1447,	.3181,	.2426,	.2562,	.2328,
7,	.4148,	.3083,	.1833,	.2018,	.1411,	.1798,	.3931,	.3586,	.3581,	.4515,
8,	.4446,	.1972,	.2311,	.1404,	.1785,	.3791,	.2739,	.2991,	.3561;	.3888,
9,	.4104,	.1463,	.2153,	.1154,	.3287,	.3289,	.2866,	.2029,	.3498,	.2799,
10,	.4283,	.1331,	.1923,	.1421,	.4612,	.4650,	.4486,	.4713,	.3121,	.4418,
11,	.6411,	.2162,	.3078,	.2891,	.4033,	.4875,	.4113,	.4141,	.4424,	.1678,
12,	.6242,	.3169,	.3017,	.3732,	.5203,	.4096,	.4278,	.4407,	.5470,	.2829,
13,	.7758,	.2703,	.5647,	.8471,	.5944,	.4945,	.2308,	.3477,	.8133,	.4502,
14,	.6181,	.1931,	.7083,	.7908,	.5719,	.8799,	.5061,	.2378,	2.4672,	.3462,
15,	.6215,	.2267,	.4170,	.4912,	.5131,	.5506,	.4069,	.3841,	.9237,	.3393,
+gp,	.6215,	.2267,	.4170,	.4912,	.5131,	.5506,	.4069,	.3841,	.9237,	.3393,
FBAR 6-10,	.3922,	.2053,	.1822,	.1514,	.2435,	.2995,	.3441,	.3149,	.3264,	.3590,

Table 8 Fishing mortality (F) at age

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	FBAR 95-97
AGE											
5,	.0440,	.1161,	.1747,	.3203,	.1245,	.1122,	.0515,	.0651,	.0889,	.0359,	.0633,
6,	.1949,	.2962,	.4385,	.5161,	.1723,	.1657,	.0878,	.0989,	.2231,	.0964,	.1395,
7,	.3885,	.4461,	.5404,	.8773,	.2430,	.3481,	.2703,	.2892,	.6556,	.2681,	.4043,
8,	.4927,	.3438,	.4235,	.5490,	.3136,	.4068,	.2765,	.3197,	.4147,	.2826,	.3390,
9,	.4679,	.3323,	.4328,	.3959,	.1392,	.0801,	.1733,	.1925,	.1310,	.1487,	.1574,
10,	.5605,	.2064,	.3359,	1.0837,	.3981,	.6355,	.5731,	.6864,	.5538,	.7697,	.6699,
11,	.4700,	.2633,	.2499,	1.2710,	.4045,	.5454,	.5644,	.9771,	.5963,	.3574,	.6436,
12,	.2028,	.2016,	.6578,	1.8388,	.8614,	.5864,	.9542,	1.3666,	.8709,	.6966,	.9780,
13,	.2879,	.1055,	.0905,	.9402,	1.2777,	.4797,	.8205,	1.6769,	.3360,	.2486,	.7538,
14,	.6877,	.5241,	.1092,	1.1935,	2.4257,	1.4326,	1.4064,	2.3026,	1.5269,	1.0213,	1.6169,
15,	.4441,	.2612,	.2898,	1.2797,	.8260,	.7729,	.8117,	1.0771,	.2198,	.2111,	.5027,
+gp,	.4441,	.2612,	.2898,	1.2797,	.8260,	.7729,	.8117,	1.0771,	.2198,	.2111,	
FBAR 6-10,	.4209,	.3250,	.4342,	.6844,	.2532,	.3272,	.2762,	.3173,	.3956,	.3131,	

Table 8.11

Run title : Arctic Green.halibut (run: XSAOLE03/X03)

At 26-Aug-98 14:47:02

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE								
5,	40861,	29942,	32226,	30683,	25460,	21890,	22619,	21646,
6,	46847,	34632,	25697,	26708,	26212,	21063,	18062,	18699,
7,	44309,	37732,	25689,	18851,	21951,	20224,	15961,	12779,
8,	39919,	28429,	20682,	13200,	12586,	13138,	11358,	8335,
9,	24274,	17138,	13073,	11829,	8100,	7272,	7488,	5136,
10,	15933,	11584,	9063,	8678,	7814,	5270,	4158,	3661,
11,	6963,	7525,	5945,	6192,	5689,	4924,	3002,	2326,
12,	3332,	3658,	3969,	3848,	3905,	3392,	2515,	1735,
13,	1210,	1708,	1609,	2271,	2266,	2120,	1494,	1041,
14,	1472,	470,	502,	758,	1290,	1270,	783,	638,
15,	513,	243,	126,	246,	420,	618,	536,	186,
+gp,	29,	39,	125,	196,	241,	222,	217,	172,
TOTAL,	225662,	173149,	138706,	123461,	115935,	101403,	88194,	76354,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
5,	20463,	19097,	17298,	20280,	18737,	18659,	17695,	19795,	19722,	19265,
6,	16741,	15853,	14379,	14210,	15696,	14917,	14628,	14381,	15907,	15423,
7,	13074,	11079,	10718,	11321,	10452,	12124,	11110,	9160,	9712,	10597,
8,	7103,	7433,	7006,	7680,	7963,	7812,	8718,	6454,	5508,	5843,
9,	4832,	3919,	5253,	4786,	5745,	5733,	4602,	5706,	4119,	3321,
10,	2927,	2759,	2914,	3645,	3670,	3559,	3552,	2974,	4009,	2499,
11,	2127,	1641,	2079,	2069,	2722,	1992,	1924,	1952,	1598,	2526,
12,	1017,	964,	1138,	1315,	1334,	1565,	1053,	1098,	1110,	884,
13,	697,	469,	605,	724,	779,	682,	894,	591,	608,	553,
14,	344,	276,	308,	296,	267,	370,	358,	611,	359,	232,
15,	193,	159,	196,	131,	115,	130,	132,	186,	415,	26,
+gp,	67,	111,	50,	41,	8,	33,	96,	27,	12,	0,
TOTAL,	69584,	63761,	61943,	66498,	67489,	67577,	64763,	62935,	63079,	61169,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	GMST 70-95	AMST 70-95
AGE													
5,	22732,	20455,	14386,	13025,	10107,	11582,	13346,	13923,	13109,	9999,	0,	19604,	20611,
6,	15457,	18724,	15676,	10398,	8138,	7681,	8911,	10910,	11228,	10323,	8303,	16408,	17923,
7,	10518,	10948,	11984,	8703,	5342,	5896,	5602,	7025,	8506,	7732,	8069,	12374,	14341,
8,	5807,	6139,	6032,	6009,	3115,	3606,	3583,	3679,	4528,	3801,	5090,	7995,	9890,
9,	3409,	3054,	3746,	3399,	2987,	1959,	2066,	2339,	2300,	2574,	2466,	5141,	6357,
10,	2160,	1838,	1885,	2092,	1969,	2237,	1557,	1495,	1660,	1737,	1910,	3529,	4381,
11,	1383,	1062,	1287,	1160,	609,	1138,	1020,	755,	648,	821,	692,	2168,	2754,
12,	1838,	744,	702,	863,	280,	350,	568,	499,	245,	307,	495,	1297,	1680,
13,	573,	1292,	523,	313,	118,	102,	168,	188,	110,	88,	132,	674,	908,
14,	303,	370,	1000,	411,	105,	28,	54,	63,	30,	67,	59,	352,	498,
15,	141,	131,	189,	772,	107,	8,	6,	11,	5,	6,	21,	139,	228,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	4,		
TOTAL	64322,	64755,	57411,	47144,	32878,	34587,	36880,	40889,	42370,	37455,	27240,		

Table 8.12

Run title : Arctic Green.halibut (run: XSAOLE03/X03)

At 26-Aug-98 14:47:02

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,
AGE								
5,	8341,	6112,	6578,	6253,	5197,	4468,	4617,	4418,
6,	24859,	18403,	13636,	14172,	13909,	11177,	9584,	9922,
7,	38247,	32570,	22175,	16272,	18948,	17458,	13778,	11031,
8,	47649,	33934,	24687,	15756,	15023,	15682,	13558,	9949,
9,	40373,	28503,	21744,	19673,	13472,	12095,	12453,	8542,
10,	34526,	25102,	19640,	18805,	16933,	11420,	9009,	7934,
11,	19903,	21506,	16992,	17698,	16259,	14074,	8579,	6648,
12,	10712,	11760,	12758,	12369,	12552,	10902,	8086,	5576,
13,	5205,	7351,	6923,	9773,	9752,	9120,	6429,	4478,
14,	7259,	2315,	2475,	3740,	6363,	6261,	3863,	3148,
15,	2958,	1400,	725,	1421,	2421,	3563,	3091,	1074,
+gp,	181,	246,	789,	1237,	1518,	1403,	1371,	1088,
0 TOTSPBIO,	240211,	189204,	149121,	137179,	132348,	117624,	94419,	73808,

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

YEAR,	1978,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,
AGE										
5,	4177,	6187,	4371,	4819,	4654,	5038,	5017,	5107,	4280,	2868,
6,	8883,	13697,	9028,	8594,	9493,	11170,	10813,	9599,	10537,	9901,
7,	11286,	13295,	9783,	10415,	8613,	12997,	10357,	8684,	10442,	10598,
8,	8478,	11238,	8639,	10064,	8763,	10303,	11071,	10030,	8896,	8162,
9,	8037,	7760,	8405,	8787,	8996,	10165,	9143,	13152,	9500,	7582,
10,	6342,	6815,	6373,	8900,	7810,	9231,	9377,	8891,	12219,	7303,
11,	6080,	4875,	5482,	6105,	7464,	6488,	6591,	6995,	5353,	8869,
12,	3269,	3341,	3432,	4466,	4451,	6539,	3890,	4293,	4131,	3358,
13,	3000,	1922,	2036,	2992,	3367,	3214,	3569,	2647,	2432,	2522,
14,	1695,	1326,	1320,	1385,	1430,	2251,	1558,	2598,	1502,	1161,
15,	1114,	893,	985,	758,	667,	779,	591,	892,	1866,	156,
+gp,	422,	778,	331,	273,	53,	217,	442,	134,	67,	0,
0 TOTSPBIO,	62782,	72128,	60186,	67557,	65761,	78392,	72420,	73022,	71223,	62480,

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

YEAR,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,
AGE										
5,	841,	1088,	715,	1203,	1924,	2928,	3652,	3862,	4845,	5004,
6,	9814,	11957,	9970,	3057,	3631,	3839,	4356,	5025,	6535,	7569,
7,	10247,	10694,	10822,	4684,	3528,	4537,	4411,	5181,	7020,	6928,
8,	7459,	8729,	6973,	5152,	3344,	4542,	4129,	4161,	5515,	4924,
9,	6714,	6651,	6687,	5310,	5875,	4290,	3892,	3861,	4071,	4316,
10,	6071,	5522,	4428,	5003,	4790,	5375,	3570,	3378,	4042,	4228,
11,	4662,	3506,	3693,	3235,	1856,	3827,	2968,	2228,	2089,	2629,
12,	6729,	3012,	2422,	2829,	1005,	1501,	1869,	1667,	984,	1232,
13,	2434,	5541,	1947,	1218,	452,	517,	643,	721,	520,	426,
14,	1271,	1665,	4091,	1802,	447,	179,	269,	316,	189,	401,
15,	631,	620,	852,	4084,	515,	71,	39,	93,	33,	36,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTSPBIO,	56872,	58985,	52601,	37578,	27368,	31606,	29795,	30495,	35843,	37693,

Table 8.13

Run title : Arctic Green.halibut (run: XSAOLE03/X03)

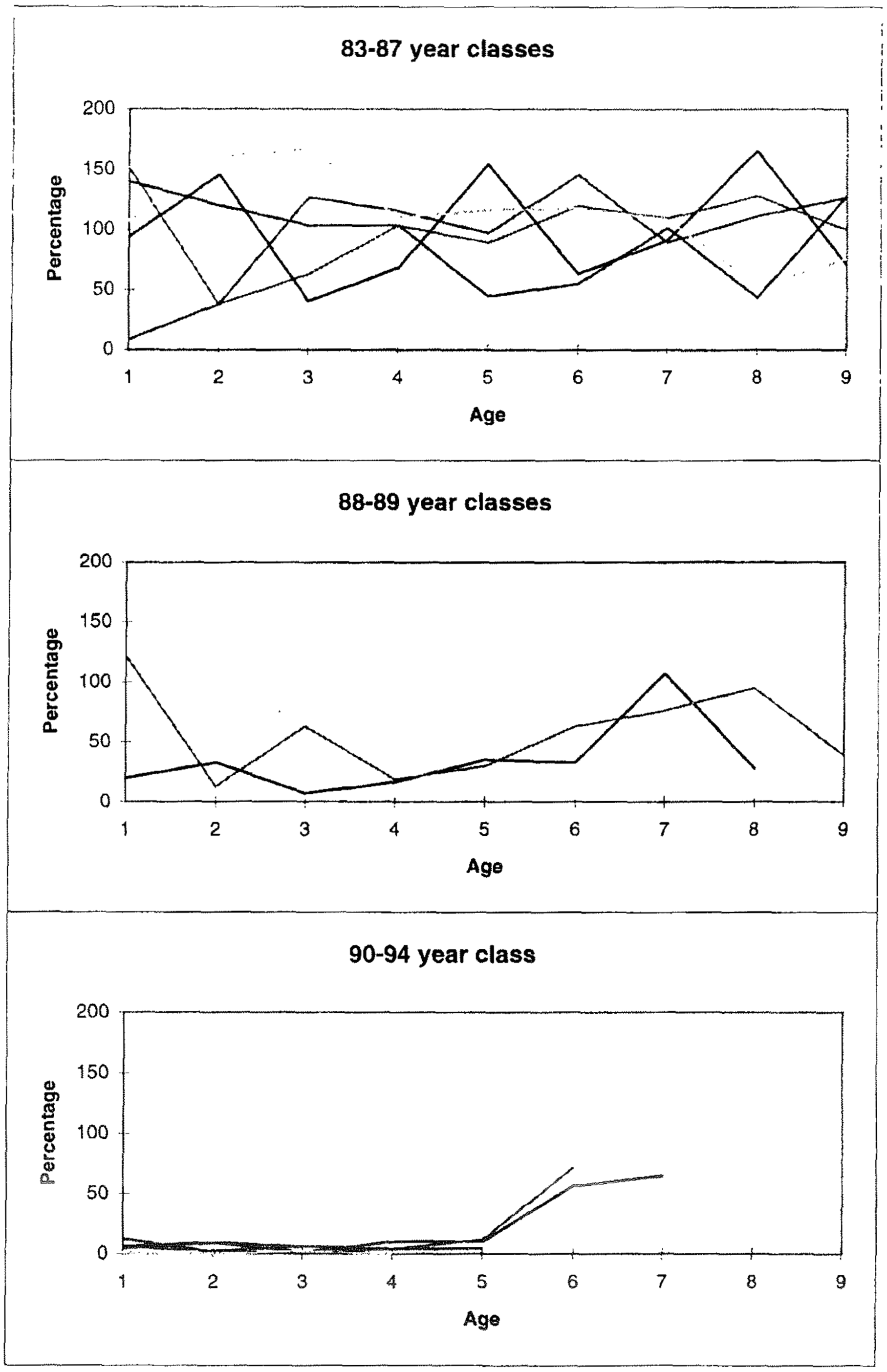
At 26-Aug-98 14:47:02

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 5	TOTALBIO,	TOTSPBIO,	Total SSB age 10+	LANDINGS,	YIELD/SSB,	FBAR 6-10,
1970,	40861,	289956,	240211,	80744	89484,	.3725,	.4491,
1971,	29942,	226656,	189204,	69680	79034,	.4177,	.4465,
1972,	32226,	180114,	149121,	60302	43055,	.2887,	.3150,
1973,	30683,	164373,	137179,	65043	29938,	.2182,	.2351,
1974,	25460,	157274,	132348,	65798	37763,	.2853,	.2926,
1975,	21890,	139462,	117624,	56743	38172,	.3245,	.3577,
1976,	22619,	114408,	94419,	40428	36074,	.3821,	.4671,
1977,	21646,	91664,	73808,	29946	28827,	.3906,	.3691,
1978,	20463,	79419,	62782,	21922	24617,	.3921,	.3922,
1979,	19097,	95222,	72128,	19950	17312,	.2400,	.2053,
1980,	17298,	76919,	60186,	19959	13284,	.2207,	.1822,
1981,	20280,	85537,	67557,	24879	15018,	.2223,	.1514,
1982,	18737,	83080,	65761,	25242	16789,	.2553,	.2435,
1983,	18659,	98651,	78392,	28719	22147,	.2825,	.2995,
1984,	17695,	89252,	72420,	26018	25629,	.3539,	.3441,
1985,	19795,	89518,	73022,	26450	22565,	.3090,	.3149,
1986,	19722,	87792,	71223,	27570	24822,	.3485,	.3264,
1987,	19265,	84227,	62480,	23369	19702,	.3153,	.3590,
1988,	22732,	83680,	56872,	21798	10083,	.1773,	.4209,
1989,	20455,	87889,	58985,	19866	21080,	.3574,	.3250,
1990,	14386,	78338,	52601,	17433	23263,	.4423,	.4342,
1991,	13025,	69557,	37578,	18171	33332,	.8870,	.6844,
1992,	10107,	42990,	27368,	9065	8594,	.3140,	.2532,
1993,	11582,	48688,	31606,	11470	11971,	.3788,	.3272,
1994,	13346,	45558,	29795,	9358	9191,	.3085,	.2762,
1995,	13923,	49270,	30495,	8403	11252,	.3690,	.3173,
1996,	13109,	53318,	35843,	7857	14205,	.3963,	.3956,
1997,	9999,	48164,	37693,	8952	9259,	.2456,	.3131,
Arith. Mean ,	19964,	101463,	79239,		26302,	.3391,	.3392,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),		(Tonnes),		

Figure 8.1. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each year class from Norwegian bottom-trawl survey in the Svalbard area (one line for each year class). Values as percentage of mean abundance at age for the 1983-87 year classes.



F-8-1.XLS

Figure 8.2. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Norwegian bottom-trawl survey in the Barents Sea (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 year classes.

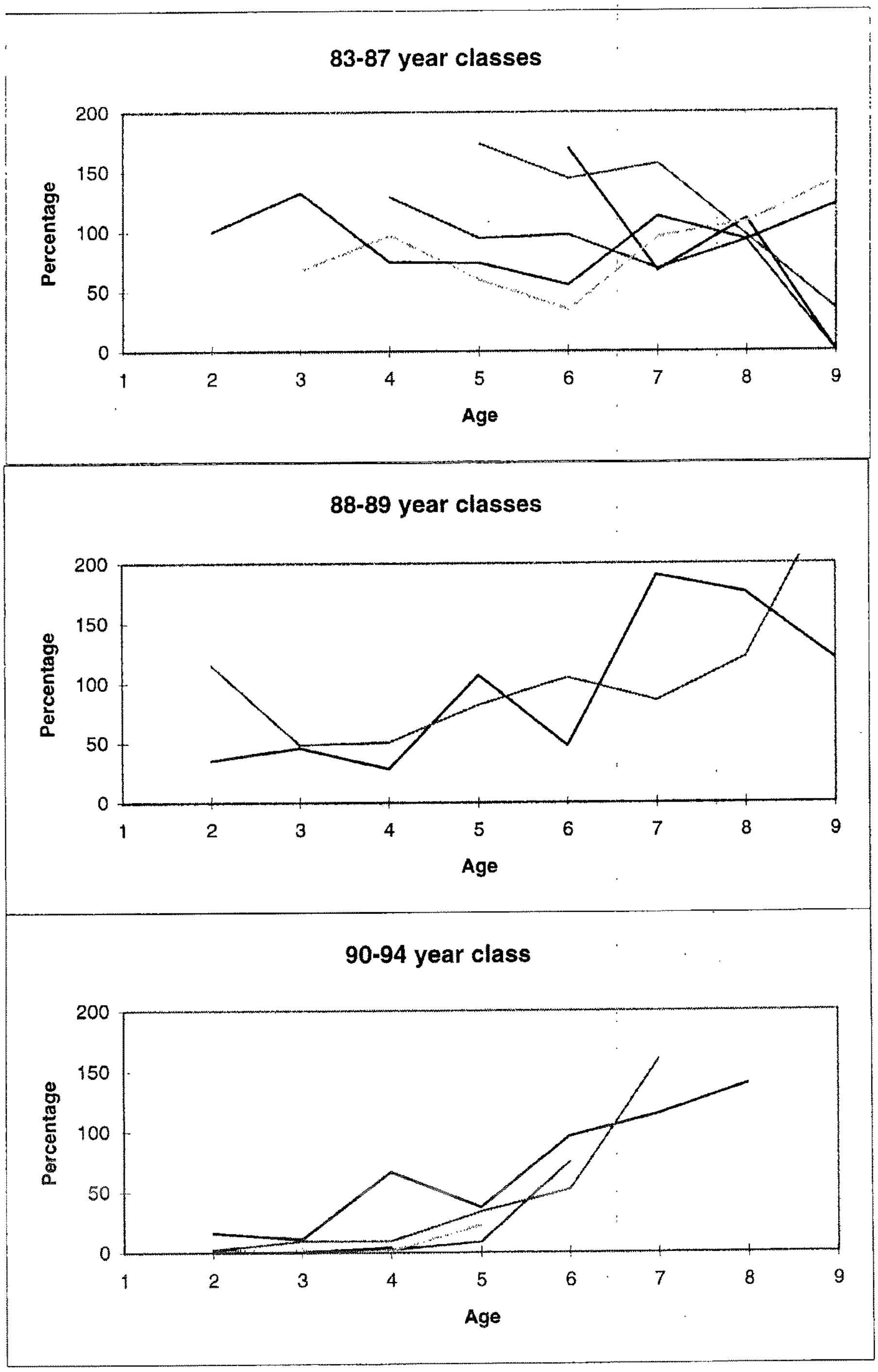


Figure 8.3. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Norwegian trawl survey for shrimp in the Svalbard area (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 year classes.

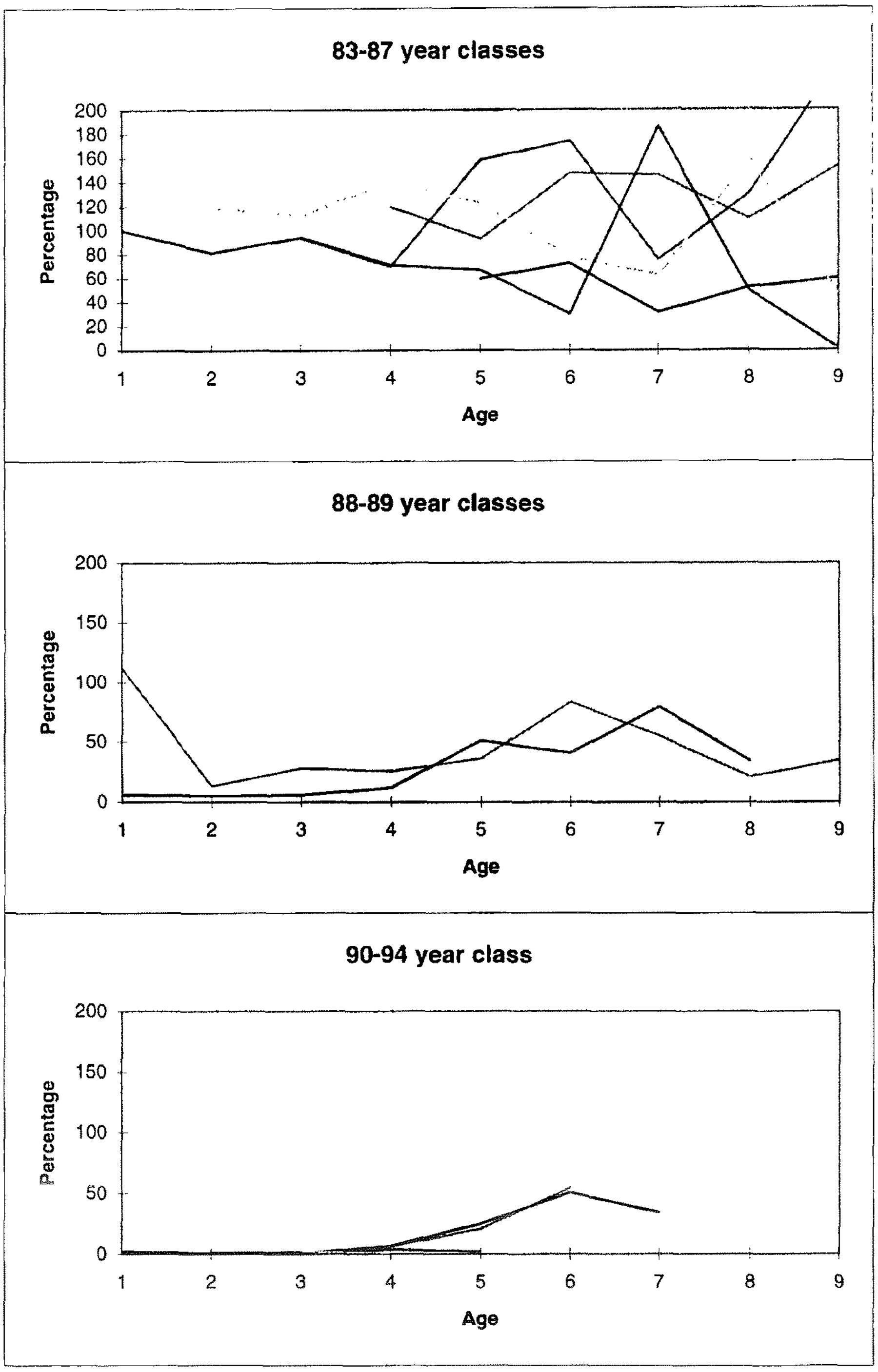
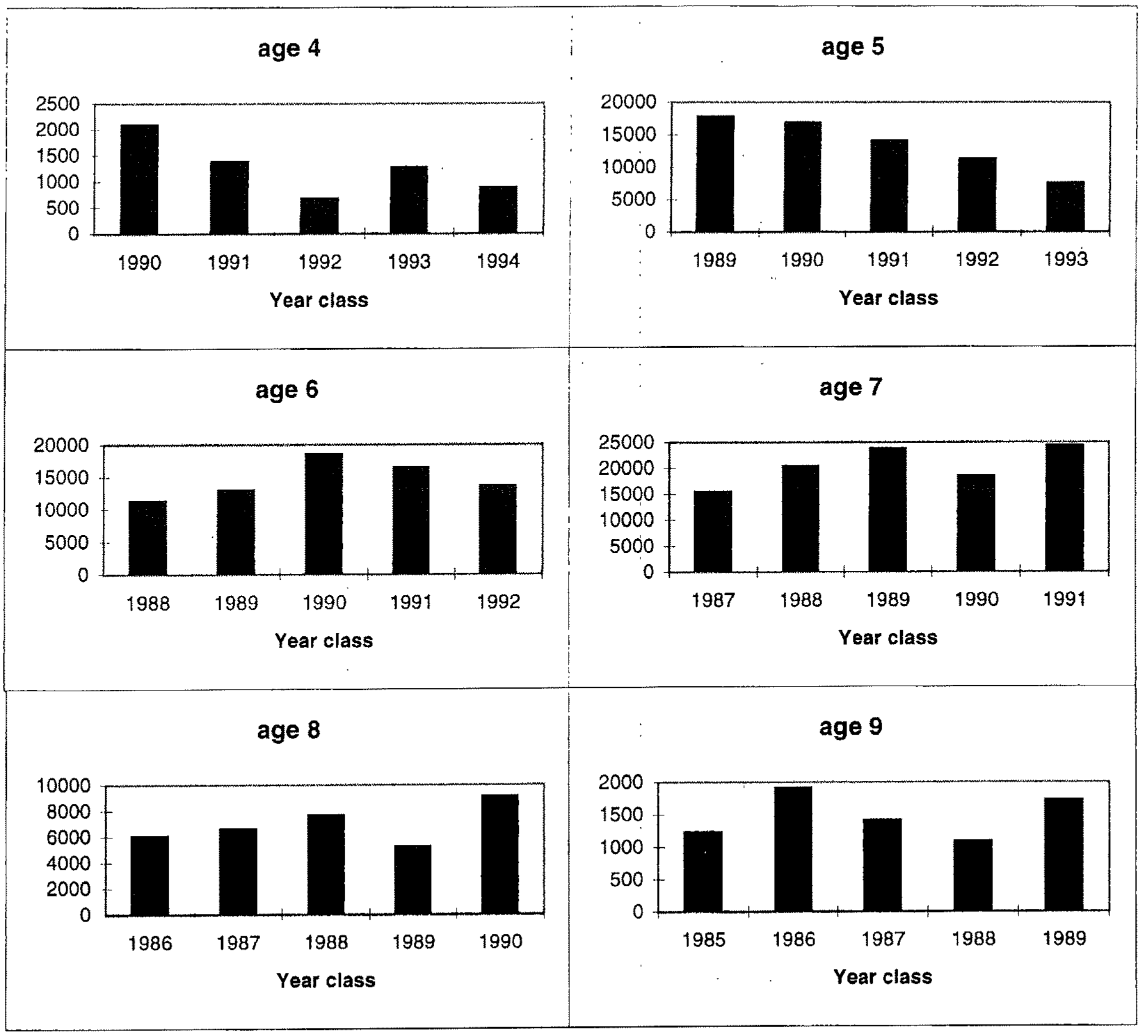


Figure 8.4. GREENLAND HALIBUT in Sub-area I and II:
Abundance at age from the Norwegian stratified Greenland halibut survey. Data for consecutive year classes at selected ages.



F-8-4.XLS

Table E1 GREENLAND HALIBUT in Sub-area I and II. Norwegian bottom-trawl survey indices (numbers in thousands) in the Svalbard area (Division IIb).

Year	Fish[2] <20 cm	Age									Total
		1	2	3	4	5	6	7	8	9+	
1981	2.1					No age data					20,100
1982	0.7										26,000
1983	5.9										26,690
1984	3.2	550	3,042	2,924	8,573	6,847	5,657	4,345	2,796	1,896	36,630
1985	1.6	884	3,921	4,294	6,674	8,793	8,622	3,920	1,817	525	39,450
1986	0.1	49	1,005	1,967	7,314	4,671	1,754	2,301	372	37	19,470
1987	1.0	630	1,014	3,076	4,409	4,786	3,141	964	364	116	18,500
1988	2.5	818	4,298	6,191	6,696	12,289	2,396	6,015	338	1,277	39,300
1989[1]	1.4	712	3,232	8,158	7,493	7,069	2,374	1,753	353	744	31,888
1990[1]	0.4	115	336	5,050	7,130	7,730	4,490	2,330	918	544	28,643
1991[1]	0.1	71	877	3,080	6,720	9,270	5,450	2,800	1,660	524	30,452
1992[1]	+	33	30	338	1,190	3,520	4,420	2,280	1,280	474	13,565
1993[1]	+	25	60	51	1,049	2,369	2,056	2,772	1,114	665	10,161
1994[1]	+	4	238	296	652	2,775	2,371	2,593	531	844	10,304
1995[1]	+	35	+	70	259	798	1,225	1,953	434	504	5,299
1996[1]	2.6	2520	250	90	250	930	2120	2740	950	850	10700
1997[1]	0.8	370	1500	280	+	350	2690	1650	280	260	7380

[1] New standard trawl equipment (rockhopper gear and 40 meter sweep length).
[2] In millions.

Table E2. GREENLAND HALIBUT in Sub-area I and II. Abundance indices from bottom trawl surveys in the Barents Sea in winter (in thousands). A: Restricted area surveyed every year; B: Enlarged area (includes the restricted one) surveyed since 1993.

A

Year	Age													
	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1989	1078	788	1056	2284	3655	2655	864	971	210	-	19	76	56	13712
1990	66	907	2071	1716	1996	2262	1046	365	175	-	30	119	165	10918
1991	-	279	755	1323	1257	1526	2440	906	450	457	-	55	127	9575
1992	63	128	719	897	1554	543	1069	791	-	648	135	40	53	6640
1993	-	17	168	502	1730	868	1490	758	88	655	382	31	35	6724
1994	-	16	142	1178	2259	1644	1750	885	-	506	38	25	-	8443
1995	-	-	-	168	786	749	1331	760	359	486	60	199	-	4898
1996	1816	-	28	40	709	1510	2964	1000	307	808	154	152	45	9533
1997	-	21	-	21	176	812	1788	1440	653	209	94	73	-	5287
1998	-	-	-	67	474	1172	2491	1144	302	401	89	19	4	6162

B

Year	Age													
	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total
1993	-	17	279	1002	3129	2818	3895	1632	309	1406	616	31	35	15169
1994	-	16	152	1482	3768	2698	3420	1615	-	1171	135	25	-	14482
1995	-	-	-	216	2824	6229	10624	2727	1250	1902	172	718	57	26761
1996	3149	-	28	102	1547	3043	4991	1599	472	1211	317	250	72	16782
1997[1]	-	163	-	203	624	2742	5759	4170	1653	562	240	181	66	16364
1998[1]	220	501	2797	1011	1847	3477	6539	3057	867	1179	301	96	57	21949

[1] Adjusted (according to the 1996 distribution) to include the Russian EEZ which was not covered by the survey.

Table E3. GREENLAND HALIBUT in Sub-area I and II. Russian autumn bottom trawl surveys: Abundance of males and females at different age (numbers in thousands).

Age	1990	1991*	1992	Males 1993**	1994	1995	1996***	1997***
≤3	2289	1078	451	78	38	0	0	248
4	4455	3799	4991	1488	841	284	1581	1670
5	7775	11236	20425	9832	6814	4556	10575	4709
6	9069	10821	15456	15040	12136	13743	27508	15311
7	5988	6067	9001	11759	7505	11483	28864	19157
8	1599	2107	4724	5827	3575	7297	17200	19203
9	529	415	808	1144	791	1359	10076	2492
10	331	174	139	393	325	428	87	2
11		38	45	154	79		2	24
12				127	63		3	
13								
14								
≥15								
Total	32035	35735	56040	45842	32167	39150	95895	62816
Mean age	5.64	5.73	5.82	6.37	6.33	6.68		

Age	1990	1991*	1992	Females 1993**	1994	1995	1996***	1997***
≤3	531	344	234	36	11	19	0	53
4	3905	4656	2470	678	763	183	1014	496
5	8476	14172	12916	3485	3054	1203	0	1214
6	6552	11021	10042	4711	5414	4479	2000	2512
7	5405	9167	8271	4768	4028	3813	5256	3392
8	2521	7312	5454	4478	4171	4242	3773	3257
9	1382	1954	1912	2226	2610	3034	3274	3364
10	827	1037	1123	1475	1551	985	638	1816
11	307	617	893	749	526	529	449	979
12	198	142	318	392	331	312	165	215
13	58	95	67	103	114	84	183	379
14	36	16		111	114	11	57	95
≥15		26		111	57	32	52	115
Total	30198	50559	43700	23323	22744	18926	16842	17887
Mean age	6.11	6.28	6.40	7.29	7.26	7.55		

* Age distribution based on length distribution from 1991 and length-at-age data from 1990 and 1992 combined.
** Age distribution based on length distribution from 1993 and length-at-age data from 1992 and 1994 combined.
*** Survey covered 60-90% of standard area. Non-standard trawl equipment used. Calibration coefficient used to make the data more comparable with previous years.

Table E4 GREENLAND HALIBUT in Sub-area I and II. Abundance indices on age from the Norwegian trawl survey for shrimp at Svalbard. July-August 1988-1992, June 1993-1996, May and July/August 1997. Numbers in thousands.
A: Only western area; B: Including areas east of Bear Island.

A	Age									Total
Year	1	2	3	4	5	6	7	8	9+	
1988[1]	4,163	14,278	8,259	8,354	2,594	144				37,792
1989[2]	4,653	9,777	9,943	4,855	4,057	1,054	542	83	372	35,336
1990	247	1,569	8,324	9,800	6,910	2,148	295	245	175	29,713
1991	25	577	2,465	4,969	5,362	2,541	1,380	158	278	17,755
1992	95	57	505	1,780	2,914	1,129	713	333	200	7,726
1993[3]	39	54	50	814	1,572	433	589	395	512	4,458
1994[3]	0	13	43	446	2,214	1,218	1,764	485	797	6,980
1995[3]	24	26	31	407	1,081	592	521	151	159	2,992
1996[3]	1267	67	162	250	882	741	753	63	5	4190
1997[3]	111	116	58	45	77	798	321	104	115	1745

[1]The length distribution was split on age according to Macdonald and Pitcher (1979).

[2]An age-length key from the bottom trawl survey for cod at Svalbard in September 1989 was used to convert the indices from length to age.

[3]An age-length key from the bottom trawl survey for cod at Svalbard in September the same year was used to convert the indices from length to age.

B	Age									Total
Year	1	2	3	4	5	6	7	8	9+	
1993	94	159	+	937	2389	1725	3296	2034	332	10966
1994	+	66	164	531	2699	1865	2510	887	284	9006
1995	69	78	237	640	2680	2168	3793	1501	379	11544
1996	911	77	194	324	1577	3323	5358	1920	452	14136
1997	6699	1121	178	558	644	7480	4953	841	445	22921

Table E5. GREENLAND HALIBUT in Sub-area I and II. Abundance indices on age from the Norwegian stratified bottom trawl survey using a hired commercial vessel. Trawls were made at 500-1500 m depth along the continental slope from 68-80°N

	AGE															
year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	total
1994	0	0	8	2087	17737	11249	15408	6051	1227	3554	1424	430	124	79	11	59389
1995	0	0	+	1376	16808	12967	20369	6552	1906	4092	1346	616	142	97	19	66290
1996	0	0	0	672	14000	18460	23776	7638	1408	3201	785	379	124	77	16	70536
1997	0	0	6	1274	11184	16442	18457	5231	1079	3105	892	580	81	159	16	58507
1998[1]	0	0	5	878	7508	13546	24331	9104	1717	4437	1297	870	109	207	62	64071

[1] Preliminary estimate using age-length key from 1997

Table E6. GREENLAND HALIBUT in Sub-area I and II. Abundance indices on age from the bottom trawl surveys north and east of Spitsbergen in September (numbers in thousands).

	AGE						
year	1	2	3	4	5	6+	Total
1996	14667	4241	3968	3060	2273	5239	33448
1997	3458	15375	14102	3296	427	672	37330

Table E7 GREENLAND HALIBUT in Sub-areas I and II
Results from a research program using trawlers in a limited commercial fishery 1992-1998.
All areas combined. Spring and autumn combined in 1992-1993, otherwise only spring-data.

Catch in numbers on age (%)							
Age	1992	1993	1994	1995	1996	1997	1998*
1							
2							
3	0.1			0.1		0.0	0.0
4	4.6	4.2	3.2	0.7	0.5	0.9	0.2
5	19.1	25.0	24.7	22.5	19.5	24.8	6.0
6	23.0	18.4	23.8	22.6	31.6	22.9	25.8
7	25.9	27.1	26.8	30.2	35.6	30.5	41.2
8	13.3	12.4	11.2	11.0	8.7	10.1	18.7
9	1.7	0.7	1.0	2.7	1.3	2.6	5.0
10	6.8	7.4	5.9	6.6	2.0	5.0	2.0
11	2.9	3.1	2.4	2.0	0.5	1.9	0.8
12	1.7	1.0	0.6	1.1	0.2	0.8	0.4
13	0.5	0.4	0.2	0.3	0.0	0.3	
14	0.2	0.2	0.1	0.2	0.1	0.2	
15	0.1					0.0	

Mean individual weight (kg)							
Age	1992	1993	1994	1995	1996	1997	1998*
1							
2							
3	0.26			0.40		0.39	
4	0.50	0.53	0.52	0.47	0.48	0.45	0.42
5	0.71	0.76	0.73	0.70	0.74	0.69	0.76
6	0.96	0.98	0.95	0.94	0.94	0.88	0.95
7	1.29	1.33	1.28	1.24	1.23	1.15	1.21
8	1.77	1.85	1.79	1.71	1.66	1.55	1.67
9	2.00	2.28	2.23	2.03	2.00	1.87	2.25
10	2.46	2.65	2.55	2.50	2.50	2.34	2.58
11	3.10	3.43	3.37	3.28	3.16	2.95	3.50
12	3.86	4.32	4.22	3.71	3.70	3.46	4.15
13	4.44	5.18	5.01	4.62		4.52	
14	6.00	6.44	6.29	5.59		5.47	
15	5.22						

CPUE (N) on age							
	1992	1993	1994	1995	1996	1997	1998*
1							
2							
3	0			1	0	0	0
4	19	30	26	7	7	11	2
5	80	176	198	218	286	299	53
6	97	130	191	218	463	276	228
7	109	191	215	292	521	368	364
8	56	87	90	106	127	122	165
9	7	5	8	26	19	31	44
10	29	52	47	64	29	60	18
11	12	22	19	19	7	23	7
12	7	7	5	11	3	10	4
13	2	3	2	3	0	4	0
14	1	1	1	2	1	2	0
15	0					0	0

CPUE (kg) on age							
	1992	1993	1994	1995	1996	1997	1998*
1							
2							
3	0			0	0	0	
4	10	16	13	3	4	5	1
5	57	134	145	152	211	207	40
6	93	127	182	205	435	243	216
7	140	254	276	362	641	423	440
8	99	162	161	182	211	189	276
9	14	11	18	53	38	59	99
10	70	138	121	160	73	141	46
11	38	75	65	63	23	68	25
12	28	30	20	39	11	33	15
13	9	15	8	13	0	16	
14	5	9	5	11	0	13	
15	2					0	

	1992	1993	1994	1995	1996	1997	1998*
Overall mean individual weight (kg)	1.35	1.38	1.27	1.29	1.12	1.16	1.31
CPUE (kg round weight per trawlhour)**	567	973	1020	1247	1640	1398	1157
CPUE (Number fish per trawlhour)**	420	705	803	967	1464	1207	883
Catch (in tonnes)	695	862	811	368	436	274	274

*) Preliminary
* *) Average for freezer- and factorytrawler

T-E7.XLS

Table E8 GREENLAND HALIBUT in ICES Sub-area IV (North Sea. Nominal catch (t) by countries as officially reported to ICES. Not included in the assessment .

Year	Denmark	Faroe Islands	France	Germany	Norway	Russia	UK England & Wales	UK Scotland	Total
1973	-	-	-	4	9	8	28	-	49
1974	-	-	-	2	2	-	30	-	34
1975	-	-	-	1	4	-	12	-	17
1976	-	-	-	1	2	-	18	-	21
1977	-	-	-	2	2	-	8	-	12
1978	-	-	2	30	-	-	1	-	33
1979	-	-	2	16	2	-	1	-	27
1980	-	177	-	34	5	-	-	-	216
1981	-	-	-	-	7	-	-	-	7
1982	-	-	2	26	17	-	-	-	45
1983	-	-	1	64	89	-	-	-	154
1984	-	-	3	50	32	-	-	-	85
1985	-	1	2	49	12	-	-	-	64
1986	-	-	30	2	34	-	-	-	66
1987	-	28	16	1	35	-	-	-	80
1988	-	71	62	3	19	-	1	-	156
1989	-	21	14[1]	1	197	-	5	-	238
1990	-	10	30[1]	3	29	-	4	-	79
1991	-	48	291[1]	1	216	-	2	-	558
1992	1	15	416[1]	3	626	-	+	1	1062
1993	1	-	78[1]	1	858	-	10	+	948
1994	+	103	84[1]	4	724[1]	-	6	-	921
1995	+	706	165	2	460[1]	-	52	283	1668
1996	+	-	249	1	2015[1]	-	105	159	2529
1997[1]	+			3[1]	1028[1]	-	1	162	1194

[1] Provisional figures

9 REFERENCES

Albert, O.T., Nilssen, E.M., Nedreaas, K.H., and Gundersen, A.C. 1997. Recent variations in recruitment of Northeast Atlantic Greenland Halibut (*Reinhardtius hippoglossoides*) in relation to physical factors. ICES CM 1997/EE:06. 22pp.

Anonymous 1998. Report to ACFM from a group of experts meeting in Bergen, Norway 21–23 April 1998.

Anon, 1998. Preliminary report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1997. Internal Report.Inst. Mar. Res.Bergen.

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

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

Gundersen, A.C., Nedreaas, K.H., Smirnov, O.V., Albert, O.T., and Nilssen, E.M., 1997. Extension of recruitment and nursery areas of Greenland Halibut (*Reinhardtius hippoglossoides*) into the arctic. In submission.

Hylen, A. 1997. Acoustic abundance estimate of 0-group of Northeast Arctic cod and haddock. ICES C. M. 1997/BB:15.

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

ICES, 1994. Report of the Arctic Fisheries Working Group. ICES CM 1994 Assess: 2. 240 pp.

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

ICES, 1997. Report of the Arctic Fisheries Working Group. ICES CM 1997/Assess: 4. 326 pp

ICES. 1997. Report of the Study Group on the Precautionary Approach to Fisheries Management. ICES CM 1997/Assess: 7. 41 pp.

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

ICES, 1998. Report of the Arctic Fisheries Working Group. ICES CM 1997/Assess: 2. 366 pp

ICES. 1998. Report of the Study Group on the Precautionary Approach to Fisheries Management. ICES CM 1998/ACFM: 10. 39 pp.

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

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

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

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

Marshall, C.T., Kjesbu, O.S., Yaragina, N.A., Solemdal, P., and Ulltang, Ø. 1998. Is spawner biomass a sensitive measure of the reproductive and recruitment potential of Northeast Arctic cod. Can. J. Fish. Aquat. Sci. 55.

Mehl, S. 1998. Botnfiskundersokingar i Barentshavet vinteren 1998. [Bottom trawl investigations in the Barents Sea (reduced area) winter 1998]. Fisken og Havet 7 (1998) [In Norwegian with table and figure text also in English].

Mehl, S., and Yaragina, N.A. 1992. Methods and results in the joint PINRO-IMR stomach sampling program. p. 5–16. In: Interrelations between fish populations in the Barents Sea. Proceedings of the fifth PINRO-IMR symposium. Murmansk, 12–16 Augst 1991. Edited by B. Bogstad and S. Tjelmeland.

MRAG. 1997. Core program development for the modelling of fishery management strategies. Final Report of EC Study Project 94/110.

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

Ottersen, G., Michalsen, K. and Nakken, O. 1999. Ambient temperature and distribution of Northeast Arctic cod. ICES J. mar. Sci., In press.

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

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

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

Yaragina, N.A.. 1996. Change of liver condition index of North-east Arctic cod in the 1970–90's. ICES CM 1996/G:41.

Anon. 1998. Inter-sessional assessment Northeast Arctic saithe. Institute of Marine Research, Bergen, Norway, 21–23 April 1998.

Aglen, A.. Preliminary report on demersal fish surveys in the Barents Sea and Svalbard area during summer 1996 and 1997.

Berg, E. and Eriksen, I. A. Catch statistics for Norwegian coastal cod - data and methods.

Bogstad, B. Predicting cod cannibalism in cod assessment.

Bogstad, B., Frøysa, Hiis Hauge, K., and Skagen, D.W. Status for the development of new assessment software - the Flexsibest project.

Dolgov, A.. Commercial prey consumption by cod and other fish predators.

Dolgov, A. The use of prey otoliths to check reliability of estimates of the Barents Sea cod's consumption of commercial species.

Drevetnyak, K. Russian investigations of redfish (*Sebastes mentella* Travin) from the Norwegian-Barents Sea stock in 1998.

Gjøsæter, H. Prognosis for development of the capelin stock.

Jakobsen, T. Biological reference points in North-East Arctic stocks.

Motos, L. Estimation of PA reference points and Arctic cod case example.

Motos, L. Estimation of PA reference points for Northeast Arctic cod, haddock and saithe.

Ozhigan, V., Yaragina, N.A., and Tretyak, V. Predicted weight at age of North-East Arctic cod in 1998 and 1999 (ICES area I).

Paz, X. and Duran, P. Summary results for a 1997 Greenland halibut survey in ICES Division IIb.

Smirnov, O.V. Russian investigations on Greenland halibut during 1996–1997.

Yaragina, N.A., Nedreaas, K.H., Mjanger, H., Koloskova, V. and Ågotnes, P. Differences in age determination of North-East Arctic cod.

Yaragina, N.A., and Marshall, C.T. Trophic influences on seasonal and interannual variation in the hepatosomatic index of Northeast Arctic cod (*Gadus morhua*).