

**REPORT OF THE
ARCTIC FISHERIES WORKING GROUP**

23 August–1 September 1999

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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 1998 Annual Meeting of ICES are as follows:

2:4:1 The **Arctic Fisheries Working Group** [AFWG] (Chair: Dr R. Bowering, Canada) will meet at ICES Headquarters from 23 August to 1 September 1999 to:

- a) assess the status and provide catch options for the year 2000 for the stocks of cod, haddock, saithe, Greenland halibut and redfish in Sub-areas I and II, taking into account interactions with other species and attempting alternative assessment methods where applicable;
- b) review progress in determining precautionary reference points.

AFWG will report to ACFM before its October/November 1999 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.

1.3 General Comments

The Working Group reviewed the comments from ACFM as detailed in the technical minutes from the October 1998 meeting and where practical addressed the suggestions as indicated.

Concern was expressed by ACFM in its minutes of the October 1998 meeting regarding the relationship between coastal cod and its offshore components. Therefore, the WG provided some additional information on the topic in this year's report. The coastline of the Norwegian and Barents Seas includes numerous fjords, permitting a complex system of sub-populations of cod. Cod sub-populations inhabiting different regions with variable environmental conditions will differ in their migration patterns, spawning locations, growth and maturation rates, otolith structure, set of parasites, genetic features, etc.

The degree of intermixing is largely unknown. Both coastal and North-east Arctic cod having running gonads can co-occur on spawning grounds. Both types also co-occur, in varying proportions, in catches all year-round. The migration pattern of coastal cod inhabiting fjords and inlets seems to be more limited than the highly migratory North-east Arctic

cod, which can be found in coastal areas at certain times of the year. Recent studies investigating the genetic structure of coastal and North-east Arctic cod using different markers have reached different conclusions (Mork *et al.* 1985; Fevolden and Pogson, 1995; Dahle *et al.*, 1995; Arnason and Pálsson, 1996; Mork and Giaever, 1999).

Thus, the status of this complex is presently uncertain. The search for parameters for proper biological stock delineation is ongoing. Further details can be found in Section 2.

A presentation was given at the beginning of the meeting on the new assessment model known as FLEKSIBEST, designed initially for NEA cod, being developed by the Institute of Marine Research in Bergen, Norway. The WG agreed that for the purpose of this meeting the assessment be conducted in the usual manner until the model is fully developed and adequately tested. In the meanwhile, the model was run parallel to the XSA during the course of the meeting to examine, among other things, the effects of varying the weightings of the respective data sources. See Section 9 for details.

An assessment for saithe conducted by Norway at the end of 1998, estimating the stock upon which the 1999 fishery was based, was reviewed by the WG. It indicated that an assessment including commercial CPUE indices likely biased the population size estimates downward in recent years. On the other hand, using a calibration index from the acoustic research survey alone probably results in an overestimation of the population size. It is likely that the true population size is somewhere between those estimated from the two options. Until the dilemma can be resolved it was agreed to present both options for consideration.

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. In last year's report it was indicated that as some of these year classes approach ages 5 and older they are beginning to appear in surveys much higher in abundance than expected. This trend continued in the current assessment of the stock. Nevertheless, the spawning stock still remains at a relatively low although stable level.

1.4 Biological reference Points

ACFM is now basing management advice largely on the fishing mortality reference points F_{pa} and F_{lim} and spawning stock biomass reference points B_{pa} and B_{lim} for stocks on which these values have been proposed. Based on the combined efforts of the WG and ACFM at the respective 1998 meetings, such reference points were developed for NEA cod, haddock and saithe. During the course of this meeting attempts were made to determine appropriate reference points for the Greenland halibut and redfish stocks. However, given the available data the WG did not feel confident in providing reliable estimates for these stocks at this time.

1.5 Discards and misreporting

Due to reduced abundance of larger cod in the North-east Arctic stock at present the fishery is catching smaller and smaller fish to fill the quota, including undersized fish (e.g., WD 4). Various sources suggest that unknown quantities of fish (mainly cod and saithe) probably have been discarded and therefore not reported. The fish are discarded either because of its small size or due to the bycatch regulations that only allow the catch to be composed of a certain percentage of a bycatch species.

Sorting grids are now mandatory for all groundfish fisheries in Sub-areas I and II north and east of straight lines through the following positions:

1. 70°58,5'N 23°00'E (at the 4 n. mile fishery border)
2. 71°30'N 23°00'E
3. 71°30'N 20°00'E
4. 72°00'N 17°00'E
5. 73°40,5'N 17°00'E (at the border of the NEZ)
6. 72°30'N 10°00'E
7. 76°00'N 03°00'E
8. 82°00'N 03°00'E

The relatively high saithe stock and low cod stock at present has often resulted in by-catches of saithe well above the legal percentage of the total catch. This has led to some unquantified discards. It might also have led to landings under wrong species name to avoid exceeding the allowable bycatch or quota.

According to WD 4 mandatory use of sorting grids on all the saithe grounds in the rest of the Norwegian Economic Zone south of the above mentioned lines may reduce this problem already during the trawl operation. If the skippers avoid clogging the grid this may reduce the bycatch of small saithe and hence the problem of undersized saithe and discards. An alternative would be closure of the most problematic areas and putting observers on board.

Regulations are now in effect in both the Norwegian and Russian zones prohibiting discards and catches of undersized cod, haddock and saithe. This is complemented by a new inspection program on Norwegian vessels to observe the performance of the fishery and to collect biological data.

1.6 Scientific Presentations

Results of several research projects were orally presented to the Working Group and the results are summarised as follows:

WD 1 (presented by T. Marshall) – summarises evidence supporting the hypothesis that juvenile cod are not fully available to the pelagic gear used in the international 0-group survey of the Norwegian and Barents Sea. Interannual variability in the proportion of juveniles, which have settled to the bottom at the time of the survey, would contribute to the lack of correlation between the 0-group abundance index and recruitment noted in WD 13. WD 1 highlights the need to undertake a comprehensive evaluation of objectives and timing of the 0-group survey be undertaken prior to the survey in 2000.

WD 2 (presented by T. Marshall) – presents the updated time series of the Russian liver condition index (LCI) and the total egg production (TEP) estimates. The 1999 values of LCI and TEP are intermediate and low, respectively, relative to other values in the time series. Both fecundity (individual-level) and TEP (stock-level) co-vary with condition of spawners which, in turn, is influenced by capelin stock biomass. VPA estimates of spawning stock biomass are biased and imprecise measure of TEP for this stock.

WD 13 (presented by B. Bogstad) - compares several survey-based estimates of the relative or absolute abundance at different early life history stages (egg, early pelagic juvenile, 0-group) with different recruitment indices for NEA cod. Based on regression analysis it was concluded that the early pelagic juvenile survey (1977–1991), conducted when juveniles are approximately 3 months old, gave the strongest correlation with recruitment. This analysis is part of a multi-year project to identify the life history stage at which year-class strength is established. The overall goal of this research is to develop a model predicting recruitment from survey-based estimates of abundance and possibly environmental information.

WD 18 (presented by K. Nedreaas) – presents an analysis showing that the XSA assessment for NEA cod has systematically underestimated fishing mortalities and overestimated spawning stock biomass. The WG should discuss possible ways to correct fishing mortality estimates for this systematic source of error.

WD 19 (presented by K. Nedreaas) – presents fecundity/length relationships for 1996, 1997 and 1998 for NEA Greenland halibut. The results show a reduction in individual fecundity from 1996 to 1998. Preliminary values of population fecundity (i.e., total egg production) were calculated using a constant sex ratio. In future, these will be adjusted to reflect variable sex ratio by age. It was proposed that future assessments could routinely estimate population fecundity as an index of reproductive potential of the stock.

WD 21 (presented by S. Mehl) – describes three methods for assessing the status of NEA cod stock putting more weight on survey data. Briefly, method 1 uses swept area indices for the Norwegian Winter survey calibrated to the converged part of the VPA; method 2 uses a time series model to predict the abundance in the upcoming Norwegian Winter survey based on the auto-correlation structure of survey series; and method 3 estimates spawning stock biomass from acoustic surveys of Lofoten region. Results of methods 1 and 3 were compared to the corresponding VPA estimates. It was concluded by the authors that these survey-based indices provide a more accurate assessment of stock status than VPA.

WD 24 (presented by K. Sunnanå) – describes temporal trends in the catch of shrimp in the Barents Sea in relation to cod abundance and cod consumption of shrimp. The study concludes that the CPUE index for the Barents Sea shrimp fishery is reflecting changes in gear technology and is consequently a poor index of abundance. This stock is not currently assessed, however, the possibility of conducting an annual assessment is under discussion. The WG discussed what the most appropriate avenue might be for a full evaluation of the status of this resource. It was considered that due to the lack of experience in assessing shellfish resources, the AFWG would not be the most appropriate. It was proposed that conducting the assessment at the November Scientific Council meeting of NAFO, where only cold-water shrimp stocks are evaluated annually by experienced international shellfish researchers, should be considered.

WD 28 (presented by V. Tretyak) – presents a method of estimating natural mortality (M) of NEA cod. The model links M to growth and maturation such that mean cod M at ages 3 to 15 decreases as growth increases and ages at maturity decreases. Recent estimates of M (~0.15) are lower than the assumed value of 0.2. If M is linked to growth then factors that influence the growth of cod (e.g., capelin and herring abundance) will affect M. The possibility of incorporating estimated values of M into the assessment was discussed. It was recommended that this research be pursued with the goal of having it published in the primary literature.

1.7 Chairman's Representative at ACFM Consultations

The WG was informed that the Chairman was unavailable to present the report to the ACFM Sub-Group meetings prior to the ACFM consultations in October 1999 due to a conflict in time with other commitments. The WG supported the nomination of Dr Bjarte Bogstad who agreed to act on behalf of the Chairman at these meetings.

2 NORWEGIAN COASTAL COD IN SUB-AREAS I AND II

2.1 Introduction

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 proposed by Rollefson (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.

During the last decades a lot of research has been carried out concerning the stock complex of cod in the Barents Sea and at the coast of Norway and Russia. Research on coastal cod, in Norway in particular, has been carried out on many topics including; migration patterns, population parameter studies and genetics.

2.1.1 Information from the Norwegian coastal surveys

Since 1992, the Norwegian Institute of Fisheries and Aquaculture Ltd. (Fiskerforsknig) has conducted coastal surveys from the Russian border in the north to 62°N on the coast. These surveys were specially designed to cover the distributional areas of the NCC and have covered several of the fjords and the main cod areas on the coast. The biomass of NCC found in the surveys in 1995 - 1998 ranges from 75 000 t to 145 000 t. In addition to cod, a number of other species are found to be abundant in the area.

2.1.2 Tagging experiments

Tagging experiment targeting NCC carried out in Norway indicates a highly stationary stock with mostly short range migration (Jakobsen, 1987). These tagging experiment were conducted basically in fjords. Migration patterns of NCC along the coastal zone outside fjords are not investigated intensively. The migration of NCC into the Murman area is not likely to occur in any large scale since there has not been any reported recaptures in the Murman area of cod tagged in Norwegian fjords. Furthermore, only a few recaptures have been reported from the Barents Sea of cod tagged in Norwegian fjords. It is likely that these "long distance" migrating cod were North-east Arctic cod, as North-east Arctic cod are found in some numbers at the coast and may therefore have been tagged. However, this in contrast to tagging experiments of cod at the Murman coast in 1937-1954 (Borisov *et al.*, 1999) where recaptured cod had mostly migrated far away from the tagging area.

2.1.3 Genetic experiments

Several attempts have been made to distinguish the stock of NCC from the NEA cod using genetic methods. Some of these investigations find hardly any differences (Mork and Giaever, 1999), while others find large differences using different methods (Fevolden and Pogson 1995;1996).

2.1.4 The catch statistics of NCC

In order to obtain an estimate of the catch of North-east Arctic cod, the catches of NCC is subtracted from the Norwegian catches of cod in the Norwegian statistics, based on information as to where and when the catches are taken and not based on biological sampling (1960 onwards).

Since 1997, the WG has been presented with data where the catches of NCC have been extracted from the Norwegian catches of cod taken within the 12 n.mile zone from the Russian border in north and south to the 62°N, based on biological sampling (Berg *et al.*, 1998; WD 3 1998). This has been done for the years from 1984 and onwards.

The calculation of NCC catches is based on:

- The catches within the 12 n.mile zone are aggregated to quarter of the year, fishing gear and Norwegian fisheries statistical areas.
- Based on traditional reading of the otoliths and the material collected for all Norwegian cod, the catches within the 12 n.mile zone have been allocated to Norwegian Coastal cod and North-east Arctic cod. The classification of the cod otoliths has been routinely done by Norwegian scientists for decades.

- The available age-length distributions are then allocated to the aggregated data of NCC using the same methods as for compiling the Norwegian catches of North-east Arctic cod.

The catches of NCC have been calculated back to 1984. In this period the catches have varied between 25 000 t and 75 000 t. In the catch statistics (Table 2.9) it is possible to follow strong and weak year classes through the catch matrix. This indicates consistency in the way in which the total cod catches have been separated.

2.2 Status of the fisheries

2.2.1 Historical development of the fisheries

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

2.2.2 Landings prior to 1999 (Table 2.8–2.9)

The estimated landings of NCC in 1997 is 63 319 t and the provisional figure for 1998 is 51 572 t (Table 2.8). The quotas for both these years were 40 000 t (which were an exclusive Norwegian quota).

2.2.3 Expected landings in 1999

Preliminary catch statistics for 1999 are not available for NCC. However, assuming that the catch of NCC is proportional to the catch of North-east Arctic cod (NEAC) and applying a linear regression over the eight last years (1991-1998) saying "Catch NCC=3,927 + 0.075* catch NEAC ($R^2 = 0.90$)" the expected landings of Norwegian Coastal cod in 1999 are 40 000t. This is about 12 000 t less than in 1998.

2.3 Status of research

2.3.1 Survey results (Tables 2.1-2.7)

A Norwegian standard trawl-acoustic survey was conducted along the coast from Varanger (Russian border) to Stadt (62°N) in October-November 1998 using RV *Jan Mayen*. The survey covered the same areas as the coastal surveys in 1995-1997.

The trawl-acoustic coastal survey in 1998 estimated a total biomass of NCC of about 75 000 t (104 million fish) for the coastal area from Varanger to Stadt at 62° N (Tables 2.1 and 2.2). The spawning biomass was estimated to 33 000 t (15 million fish, Tables 2.3 and 2.4). Thus, spawners make up about 44% of the total biomass. As much as 73% of the total coastal biomass was distributed north of 67° N (areas 03, 04 and 05) and 27% south of 67° N (areas 06 and 07). The bulk of the biomass was comprised of age classes 3-7 (Table 2.2).

The 1998 survey data indicated a higher proportion of NCC inside the fjords and in the south as compared to the northern and outer areas. In the Norwegian statistical areas 06 and 07 (south of 67° N) nearly all otoliths collected were of the NCC type, which is similar to the results of the 1993-1997 surveys (ICES 1994/Assess:2; 1996/Assess:4; ICES 1997/Assess:4; ICES 1998/Assess:2; ICES 1999/Assess:3).

The numbers of NCC at age from all the coastal surveys are given in Table 2.5. The total numbers decreased sharply in 1998 for all the age groups except for age 1. The survey indices for cod younger than 3 years are, however, uncertain because cod smaller than 30 cm often stay in shallow water and are therefore not available to the trawl.

A total of 2 500 cod otoliths were sampled during the 1998 survey. These were separated into NCC type (1 942) and NEAC type (558).

The Norwegian coastal survey in October-November 1999 will be conducted in a similar way as the 1995-1998 surveys to extend the time series for NCC over its distribution area.

2.3.2 Weight at age (Table 2.6)

Compared with the results from the 1997 survey, the weight at age (weighted average) from the trawl-acoustic survey has increased for cod younger than 8 years and slightly decreased for the older ones. Weight at age of NCC is well above the present level for NEAC. There is a general tendency for cod to be heavier at the same age when caught further south along the coast (Table 2.6). The same tendency was found for the surveys in 1995-1998. (ICES 1997/Assess:4; ICES 1998/Assess:2; ICES 1999/Assess:3).

2.3.3 Maturity at age (Table 2.7)

The maturity at age is estimated from the data collected during the Norwegian coastal survey. This is not optimal because the survey is conducted in the early autumn when the stage of maturity is difficult to define. Further improvement of maturity ogives is recommended. The age at 50% maturity (M_{50}) for the NCC was estimated to be about 5 years old on average for the surveyed area in 1998 (Table 2.7). There are some variations between the different areas. The 1998 data show that the average M_{50} is at about the same level to that found in the 1997 survey (5-years)(ICES 1999/Assess:3).

2.4 Preliminary VPA and tuning (Tables 2.8-2.10)

The tuning series for NCC now has the minimum recommended number of years for tuning (5 years). A preliminary VPA using Extended Survivors Analysis (XSA) with five years of tuning was made. The default settings were used with the following exceptions:

- The catchability was set to be dependent on stock size for ages < 6 years.
- The survivors estimates were shrunk to the mean of the final 2 years and the 4 oldest ages

2.5 Results of the assessment (Tables 2.8-2.10)

The average age 4-7 fishing mortalities in 1998 was estimated to 0.32 (Table 2.8). 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 202 000 t and 320 000 t. The spawning stock biomass has been between 117 000 t and 219 000 t (Table 2.8). The SSB in 1998 is at a historical low level.

2.6 Comments to the assessment

This assessment on NCC must be regarded as preliminary. Consequently only a few tables from the assessment are included in this report.

As for other stocks assessed by the AFWG, the surveys do not reflect the stock in a particularly good manner, especially for cod younger than 3 years. As more years of survey data become available, prospects for a meaningful analytical assessment will improve. Nevertheless, the assessment seems to reflect the NCC stock in a fairly good way compared with the results from the coastal surveys.

There is no explicit management for this stock. In accordance with 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 2.1 Estimated survey number (x1000) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1998.

Area	Age											Total
	0	1	2	3	4	5	6	7	8	9	10+	
03 East Finnmark	11428	9925	3089	3372	2397	1085	346	223	92	28	0	31985
04 West Finnmark/Troms	20538	3755	4309	3167	5320	3171	1621	557	58	57	32	42585
05 Lofoten/Vesterålen	3132	435	1903	3413	2309	1318	435	175	4	4	0	13130
00 Vestfjord	0	32	118	859	665	276	156	10	0	0	0	2117
06 Nordland	0	172	547	1617	1350	1250	362	120	151	22	86	5676
07 Møre	0	136	3693	2575	1198	315	216	492	11	58	11	8703
Total	35098	14455	13659	15003	13239	7415	3137	1578	315	169	128	104197

Table 2.2 Estimated survey biomass (tonnes) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1998.

Area	Age											Total
	0	1	2	3	4	5	6	7	8	9	10+	
03 East Finnmark	132	370	822	2693	2706	1810	793	737	511	200	0	10774
04 West Finnmark/Troms	166	291	1348	2903	8003	7001	4746	2253	274	450	418	27853
05 Lofoten/Vesterålen	46	42	830	2911	3214	2959	1518	927	24	24	0	12494
00 Vestfjord	0	3	41	813	1461	644	554	29	0	0	0	3546
06 Nordland	0	22	158	1426	1447	2218	855	510	748	161	1575	9120
07 Møre	0	25	1880	2502	2443	995	788	2219	90	494	90	11524
Total	345	752	5078	13247	19274	15627	9255	6675	1646	1329	2083	75310

Table 2.3 Estimated survey spawning stock number (x1000) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1998.

Area	Age											Total
	0	1	2	3	4	5	6	7	8	9	10+	
03 East Finnmark	0	298	93	742	743	792	246	223	74	28	0	3238
04 West Finnmark/Troms	0	0	215	412	1596	1934	1313	557	58	57	32	6175
05 Lofoten/Vesterålen	0	0	0	614	647	752	292	151	4	4	0	2463
00 Vestfjord	0	0	0	0	67	155	111	10	0	0	0	342
06 Nordland	0	0	0	65	135	250	217	90	136	22	86	1000
07 Møre	0	0	0	489	216	53	129	349	10	58	11	1315
Total	0	298	308	2322	3403	3936	2309	1381	281	169	128	14533

Table 2.4 Estimated survey spawning stock biomass (tonnes) of Norwegian coastal cod at age from the Norwegian coastal survey during the autumn 1998.

Area	Age											Total
	0	1	2	3	4	5	6	7	8	9	10+	
03 East Finnmark	0	11	25	592	839	1322	563	737	409	200	0	4697
04 West Finnmark/Troms	0	0	67	377	2401	4271	3844	2253	274	450	418	14356
05 Lofoten/Vesterålen	0	0	0	524	900	1687	1017	797	24	24	0	4972
00 Vestfjord	0	0	0	0	146	361	393	29	0	0	0	929
06 Nordland	0	0	0	57	145	444	513	383	673	161	1575	3950
07 Møre	0	0	0	475	440	169	473	1575	82	494	90	3798
Total	0	11	92	2026	4870	8252	6804	5774	1461	1329	2083	32702

Table 2.5 Estimated survey numbers at age (x1000) of Norwegian Coastal cod from the coastal surveys from 1995-1998.

YEAR	Age											TOTAL
	0	1	2	3	4	5	6	7	8	9	10+	
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
1998	35098	14455	13659	15003	13239	7415	3137	1578	315	169	128	104197

Table 2.6 Weight (gram) at age (year) for Norwegian Coastal cod from the Norwegian coastal survey during the autumn 1998.

Area	Age										
	0	1	2	3	4	5	6	7	8	9	10+
03 East Finnmark	12	37	266	799	1129	1668	2292	3300	5541	7086	
04 West Finnmark/Troms	8	77	313	916	1504	2208	2927	4043	4750	7843	14021
05 Lofoten/Vesterålen	15	96	436	853	1392	2244	3486	5284	5917	5917	
00 Vestfjord		103	348	946	2196	2330	3549	2861			
06-07 Nordland/Møre		151	480	937	1527	2054	2843	4461	5194	8262	15686
Weigthed average	10	52	372	883	1456	2107	2950	4230	5223	7868	15168

Table 2.7 Percent mature at age for Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 1998.

Area	Age										
	0	1	2	3	4	5	6	7	8	9	10+
03 East Finnmark	0	0	3	22	31	73	71	100	80	100	100
04 West Finnmark/Troms	0	0	5	13	30	61	81	100	100	100	100
05 Lofoten/Vesterålen	0	0	0	18	28	57	67	86	100	100	100
00 Vestfjord	0	0	0	0	10	56	71	100	100	100	100
06-07 Nordland/Møre	0	0	0	13	14	19	60	72	90	100	100
Weighted average	0	0	2	15	25	53	74	87	89	100	100

Table 2.8 Summary table from the preliminary VPA for Norwegian Coastal cod.

Run title : Coastal cod (run: XSANCC01/X01)

At 26/08/1999 10:13

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,	53855,	318125,	186688,	74824,	.4008,	1.0001,	.6220,	
1985,	53562,	298129,	164021,	75451,	.4600,	1.0000,	.5274,	
1986,	60944,	295111,	170822,	68905,	.4034,	1.0001,	.5804,	
1987,	63986,	259818,	159921,	60972,	.3813,	1.0000,	.4910,	
1988,	65373,	236149,	157253,	59294,	.3771,	1.0001,	.6175,	
1989,	90436,	201841,	117056,	40285,	.3442,	1.0000,	.3732,	
1990,	72044,	217786,	135146,	28127,	.2081,	1.0002,	.1816,	
1991,	53987,	252701,	157482,	24822,	.1576,	1.0002,	.1692,	
1992,	39697,	293374,	184899,	41690,	.2255,	1.0001,	.2350,	
1993,	66520,	307717,	192704,	52557,	.2727,	1.0000,	.2300,	
1994,	70494,	307626,	218789,	54562,	.2494,	1.0000,	.2389,	
1995,	55557,	301226,	172072,	57207,	.3325,	.9999,	.2916,	
1996,	68168,	265449,	176481,	61776,	.3500,	1.0000,	.3525,	
1997,	57599,	238799,	157201,	63319,	.4028,	1.0000,	.3591,	
1998,	65327,	220069,	119381,	51572,	.4320,	.9917,	.3119,	

Arith.

Mean , 62503, 267595, 164661, 54358, .3332 .3721,

Units, (Thousands), (Tonnes), (Tonnes), (Tonnes),

Table 2.9 Catch number table from the preliminary VPA for Norwegian Coastal cod.

Run title : Coastal cod (run: XSANCC01/X01)

At 26/08/1999 10:13

Catch numbers at age, Numbers*10**⁻³

YEAR,	1984,	1985,	1986,	1987,	1988,
AGE					
0,	0,	0,	0,	0,	0,
1,	160,	34,	2,	27,	0,
2,	829,	396,	4095,	170,	110,
3,	3478,	7848,	4095,	940,	1921,
4,	6954,	7367,	12662,	8236,	3343,
5,	7278,	8699,	8906,	12430,	6451,
6,	6004,	7085,	5750,	4427,	6626,
7,	4964,	3066,	3868,	2649,	4687,
8,	2161,	705,	1270,	1127,	1461,
9,	819,	433,	342,	313,	497,
+gp,	624,	264,	407,	149,	333,
TOTALNUM,	33271,	35897,	41397,	30468,	25429,
TONSLAND,	74824,	75451,	68905,	60972,	59294,
SOPCOF %,	100,	100,	100,	100,	100,

Catch numbers at age, Numbers*10**⁻³

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	1,	71,	22,	0,	21,	195,	99,	443,	179,
2,	41,	7,	125,	40,	4,	332,	810,	1193,	1326,	554,
3,	1159,	349,	607,	665,	369,	573,	896,	2376,	3438,	2819,
4,	1434,	1233,	1452,	3160,	1706,	1693,	2345,	2480,	3150,	4786,
5,	2299,	1330,	3114,	4422,	2343,	4302,	5188,	4930,	2258,	4023,
6,	5197,	1129,	1873,	2992,	2684,	2467,	5546,	4647,	2490,	2272,
7,	2720,	3456,	1297,	1945,	3072,	3337,	3270,	4160,	3935,	1546,
8,	949,	773,	873,	898,	1871,	1514,	1455,	2082,	3312,	1826,
9,	236,	141,	132,	837,	627,	777,	557,	898,	959,	975,
+gp,	86,	73,	94,	279,	690,	798,	433,	543,	684,	343,
TOTALNUM,	14121,	8492,	9638,	15260,	13366,	15814,	20695,	23408,	21995,	19323,
TONSLAND,	40285,	28127,	24822,	41690,	52557,	54562,	57207,	61776,	63319,	51572,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	99,

Table 2.10 Stock number table from the preliminary VPA for Norwegian Coastal cod.

Run title : Coastal cod (run: XSANCC01/X01)

At 26/08/1999 10:13

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR, 1984, 1985, 1986, 1987, 1988,

AGE

0, 53855, 53562, 60944, 63986, 65373,
 1, 91567, 44093, 43853, 49897, 52387,
 2, 87966, 74824, 36069, 35902, 40827,
 3, 53619, 71270, 60903, 25826, 29240,
 4, 39422, 40753, 51250, 46158, 20294,
 5, 28354, 25983, 26699, 30503, 30338,
 6, 14225, 16629, 13402, 13801, 13726,
 7, 7515, 6214, 7204, 5770, 7294,
 8, 3631, 1661, 2313, 2398, 2327,
 9, 1587, 1017, 722, 745, 944,
 +gp, 1191, 613, 847, 350, 622,
 TOTAL, 382931,336619,304206,275335,263374,

Stock number at age (start of year)

Numbers*10**-3

GMST

YEAR, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 84-96,

AGE

0, 90436, 72044, 53987, 39697, 66520, 70494, 55557, 68168, 57599, 65327, 0, 61560
 1, 53523, 74043, 58985, 44201, 32501, 54462, 57715, 45486, 55811, 47158, 53492, 52358
 2, 42891, 43821, 60620, 48228, 36169, 26610, 44570, 47077, 37151, 45294, 38482, 45764
 3, 33327, 35079, 35871, 49518, 39450, 29609, 21486, 35758, 37464, 29217, 36636, 37853
 4, 22202, 26237, 28405, 28820, 39941, 31965, 23723, 16780, 27126, 27562, 21397, 30369
 5, 13590, 16880, 20366, 21942, 20736, 31157, 24639, 17301, 11495, 19359, 18228, 23034
 6, 19002, 9046, 12616, 13856, 13963, 14857, 21617, 15478, 9704, 7368, 12177, 14500
 7, 5243, 10855, 6385, 8635, 8637, 9004, 9932, 12680, 8468, 5692, 3977, 7857
 8, 1731, 1831, 5760, 4054, 5310, 4292, 4352, 5173, 6617, 3372, 3261, 3146
 9, 583, 558, 800, 3926, 2507, 2654, 2144, 2247, 2351, 2421, 1107, 1288
 +gp, 210, 287, 567, 1301, 2739, 2704, 1655, 1343, 1658, 842, 1481,
 TOTAL,282738,290681,284362,264178,268472,277807,267390,267492,255445,253612,190239,

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, stabilised around 750,000 t in 1994-1997 but decreased to about 590,000 t in 1998. 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 1999 (Tables 3.1-3.3, Figure 3.1A)

Total landings for 1992 and 1996 were revised due to updated catch figures for France for those years. Final reported landings for 1997 amount to 762,403 t (Table 3.1), excluding 36,058 t of Norwegian coastal cod. The provisional figures for 1998 are 592,682 t, excluding 29,283 t of Norwegian coastal cod. This is about 61,000 t lower than the estimate of 654,000 t (equal to the TAC) used by the Working Group last year. The catch of North-east Arctic cod and Norwegian coastal cod combined is about 72,000 t lower than the agreed TAC of 694,000 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 1997 to 1998, catches decreased in all areas (Table 3.1). The catches by other non-quota countries than Iceland were set to zero.

3.1.3 Expected landings in 1999

The mixed Norwegian-Russian fisheries commission agreed on a TAC for North-east Arctic cod and Norwegian coastal cod combined for 1999 of 520,000 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 1999, 59,000 t was allocated to third countries and 6,000 t transferred from Russia to Norway, giving a Norwegian TAC of 236,500 t (coastal cod included) and a Russian TAC of 224,500 t. Of the Norwegian TAC, 67% was allocated to the fishery with conventional gears and 33% to the trawl fishery.

The Working Group has no information on the size of expected unreported landings in 1999 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 (1999). 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)

The results from the Norwegian survey on demersal fish in the Barents Sea in winter 1999 are described by Mehl (1999, WD 23).

The survey indices (bottom trawl and acoustic) from the Norwegian winter survey have been revised (WD 16, Tables A2-A3). The revision is carried out for the years 1983-1999, 1981 and 1982 will be revised later. The revised indices

are calculated from the basic survey data. The revisions were necessary because of changes in the strata system, revisions of the basic data and that the conversion between bobbins and rock-hopper gear is carried out by length group and not by age group. Furthermore, in the previous calculations of acoustic abundance of cod incorrect assumptions were made about the target strength used (1983-1985) or use of bobbins or rock-hopper gear, affecting the catchability (1989-1990). These errors have now been corrected.

The indices for 1997 and 1998, when the Russian EEZ was not covered, have been adjusted. The number of fish (age group by age group) in the Russian EEZ in 1997 and 1998 were interpolated assuming a linear development in the proportion found in the Russian EEZ from 1996 to 1999. These estimates were then added to the numbers of fish found in the Norwegian EEZ and the Svalbard area in 1997 and 1998. In the calculations of the proportion found in the Russian EEZ the numbers found in the Svalbard area are left out since the coverage of this area also varies from year to year due to variable ice coverage.

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

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 Korsbrette (1997).

The bottom trawl indices from the Svalbard survey (Table A5) have been revised in a similar way as the indices from the bottom trawl survey in the Barents Sea (WD 15). Table A17 gives the results of the Norwegian bottom trawl survey in the Barents Sea and Svalbard area (the Svalbard survey is a part of this survey) in August/September. The values for 1997 and 1998 are adjusted for the lack of coverage of the Russian EEZ in those years by assuming the same area distribution as in 1996.

Abundance estimates from the Russian autumn survey (November-December) are given in Table A10 (acoustic estimates) and Table A11 (bottom trawl estimates).

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

The Norwegian bottom trawl and acoustic surveys in the winter of 1999 both showed that the abundance of 1-group cod (the 1998 year class) is low. The results from the Russian surveys in late autumn 1998 and the International 0-group survey confirm this. Of the year classes 1997-1992, 1995 appears to be the strongest and is above average. The other year classes are average or below average. The 1991 and 1990 year classes still are above average. The 1989 and older year classes are now hardly detected in the surveys.

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 in the Barents Sea in winter are given in Tables A6 and A7, respectively. These values have been revised for the period 1983-1999 as part of the revision of the survey indices (Section 3.2.2). The lack of area coverage in 1997-1998 has been adjusted for in the same way as the adjustment of survey indices (Section 3.2.2). It should be noted that weight at age for this survey now is available also for 1983 and 1984, while data for 1987 are not available. The origin of the data reported for 1987 in previous Working Group reports is unknown.

The length at age and weight at age from the Lofoten survey are given in Tables A8 and A9, respectively. Length at age and weight at age from the Russian survey in October-December are given in Tables A12 and A13, respectively. No adjustment for incomplete coverage has been carried out for the Russian survey.

The data on weight at age from the autumn 1998 Russian survey and the winter 1999 Norwegian survey were in general agreement with each other, with the possible exception of fish at age 4.

The Norwegian winter survey shows similar values or a small increase in the weight at age in 1999 for ages 1 – 8 in comparison with 1998 (Table A7). The Russian autumn survey shows a small decrease or the same level of the weight of fish at age 3 – 8 and an increase in weight of fish at age 1-2 and older than 8 (Table A13). Both surveys show that the weight and length of fish at age in 1998/1999 differ little from the 1997/1998 values. Weight at age is at a low level especially for ages 1 – 4, while the values for ages 5 – 7 are at a bit higher level.

3.2.5 Maturity at age (Table 3.5)

Russian maturity ogives from the autumn survey are available from 1984 until present. Norwegian maturity at age ogives were obtained by combining the Barents Sea and Lofoten surveys (1985-1999) 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. This was the case in 1999 where the Norwegian maturity ogives for 1999 were higher than the Russian one. 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 the stock (described in Section 3.3.2). These ogives were used for 1985-1999. 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.

The proportion of mature fish decreased from 1998 to 1999, both in the Norwegian (ages 5 – 6) (Marshall, WD 3) and Russian (ages 6 – 8) data, which is likely connected with the low growth and poor condition of cod in the previous 1-2 years.

3.2.6 Condition (Figure 3.2A-B)

Annual mean values (1967-1998) of the Russian liver condition index ($LCI = \text{liver weight}/\text{total body weight} \times 100$) are shown for five 10-cm length classes in Figure 3.2A. All five length classes show a considerable degree of temporal synchrony such that variation among years is greater than the variation among length classes (Figure 3.2A). The covariance between cod LCI and capelin stock biomass (Figure 3.2B) indicates that capelin are an important determinant of condition in cod (Yaragina and Marshall in press). Values of LCI in 1999 were intermediate. The projected increase in capelin stock biomass (Figure 3.2B) might cause LCI to increase in the short term.

3.2.7 Reproductive potential (Figure 3.3)

Estimates of total egg production, calculated from the combined Norwegian winter and Lofoten surveys using the method described in Marshall *et al.* (1998), are shown in Figure 3.3. The 1999 value is similar in magnitude to the 1996 estimate (1997 and 1998 missing due to lack of spatial coverage of the Russian EEZ) and low relative to the values for 1992 and 1993. The quality of individual spawners in 1999 is intermediate, as evidenced by weight at age (Section 3.2.4) and LCI (Section 3.2.6). The reproductive potential of the stock is also constrained by reduced quantity of spawners; i.e. both the numbers of cod in older age classes and the percent mature in ages 5 and 6 were low. If total egg production in 1997 and 1998 is assumed to be similar to that in 1996 and 1999, then the reproductive potential of the stock has been low for the past four years. VPA estimates of spawner biomass from this years assessment may not be an accurate representation of the reduction in reproductive potential which has occurred since 1993 (Figure 3.3).

3.3 Data used in the assessment

3.3.1 Catch at age (Table 3.8)

The Norwegian and Russian catch at age data for 1983-1996 have been revised (WD 10, 11, 12). The catch at age for third countries and the catch at age added to account for unreported overfishing in the period 1990-1994 have not been changed. A complete revision of the catch at age, weight at age and catch in tonnes data for these and earlier years including an update of the catch at age by third countries should be carried out in the future. The main reason for the changes in the Norwegian data is the revision of the length-weight relationship for the years 1983-1989. For the Russian data, the main reason for the changes is the application of quarterly, instead of yearly, age-length distributions.

For 1997, revised age compositions in the Norwegian and Russian fishery together with final total landings for all countries were used to adjust the number at age in the 1997 landings. For 1998, 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. From Divisions IIa, age compositions were available for Germany, while from Division IIb, Spain and Germany provided age

compositions. Age compositions of the total landings were calculated separately in Sub-area I and Division IIa and IIb by using the age compositions that were available and raising the landings from other countries by Norwegian trawl (Sub-area I and Division IIa), and by Spanish trawl (Division IIb).

A SOP check gave a deviation of <1 % for 1997 and 1998. The number at age was adjusted to make the SOP fit exactly to the nominal catch for these years.

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

The weight at age in the catch for 1983-1996 has been revised in the same way as the number at age in the catch (Section 3.3.1). For 1997 and 1998, 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 last two countries only supplied data for 1997). The weight at age in the catch for these countries is given in Table 3.4. The weight at age in the catch in 1998 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 for 1983-1999 (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 same weights were used as for the period 1946-1981. The stock weights at age in 1999 are in good agreement with the prognosis made by the Working Group last year.

3.3.3 Effects of revisions of catch and survey data for the years 1983-1997

To test the effects of the revisions of survey data, catch at age and mean weights, the 1998 assessment was rerun by introducing the revisions singly and then with all revisions.

The overall effects of these changes were moderate. For the recruitment the survey revisions made more impact than the catch revisions, while for F_{5-10} and SSB the catch revisions had most impact. With full revision the change in recruitment (age 3) was less than 10 % in most years, with a maximum change in 1990 (14% increase). For F_{5-10} the changes were less than 5% in most years, the maximum being in 1985 (12% decrease). SSB changes were generally less than 5%, and had its maximum in 1990 (7% decrease). The recruitment was revised upward in the years prior to 1991 and downward for later years. For SSB and F upward and downward revisions were rather evenly distributed over the whole period.

A new RCT3 was made based on full revisions and compared to the 1998 run. This led to marginally reduced weights on the survey data and slightly reduced estimates (1-5%) of the year classes 1995-1997.

These revisions also had a slight impact on the log catchability residuals (see Section 3.9.2).

3.3.4 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.

3.3.5 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 1985-1999.

3.3.6 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	1981-1998
Norwegian bottom trawl	Svalbard	Autumn	1-8	1983-1998
Norwegian trawl fleet	Total area	All year	9-14	1985-1998
Russian trawl fleet	Total area	All year	9-14	1985-1998
Norwegian bottom trawl	Barents Sea	Winter	1-8	1980-1998
Norwegian acoustic	Barents Sea + Lofoten	Winter	1-11	1984-1998

Surveys that were conducted during winter were allocated to the end of the previous year. This was done so that data from the 1999 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. The Norwegian and Russian trawl fleet series have been updated with the revised catch at age data and some revisions also in the effort data.

3.3.7 Recruitment indices (Table 3.6)

There were four indices of recruitment available for the 1998 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.

3.3.8 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 7,500 cod stomachs from the Barents Sea are analysed annually. The stomachs are sampled throughout the year, although sampling is less frequent in the second quarter of the year.

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

The number of cod predators at age was taken from the VPA, and thus an iterative procedure has to be applied (Section 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, although some predation by cod on herring has been observed close to the spawning areas. The geographical distribution of the cod stock by season is based on Norwegian survey data.

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

Year	Age 0 cons.	Age 1 cons.	Age 2 cons.	Age 3 cons.	Age 4 cons.	Age 5 cons.	Age 6 cons.
1984	0	424	21	+	0	0	0
1985	1519	379	67	+	0	0	0
1986	53	420	394	99	0	0	0
1987	654	181	279	14	0	0	0
1988	29	405	22	2	0	0	0
1989	939	145	+	0	0	0	0
1990	0	62	28	0	0	0	0
1991	123	152	212	2	0	0	0
1992	4312	1029	154	4	0	0	0
1993	3890	20252	509	53	1	+	0
1994	8972	7250	677	134	54	9	+
1995	8395	15645	746	250	86	3	+
1996	10579	22645	1532	143	55	20	1
1997	3121	16786	2040	186	18	1	+
1998	182	4371	500	200	43	2	1

The consumption by cod of various prey species is shown in Table A16. The consumption of capelin increased from 1996 to 1998. This is consistent with the increase in capelin biomass from 1996 to 1998 (ICES C.M. 1999/Assess:18). The consumption of cod by cod decreased, but is still at a relatively high level.

3.3.9 Prediction data (Table 3.22, Figure 3.4)

The input data to the short-term prediction with management option table (1999-2001) are given in Table 3.22.

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 are positively correlated with capelin abundance (Yaragina and Marshall, 1999) and cod may switch to preying on cod when the abundance of capelin is low (Bogstad and Mehl, 1997). This year, the prognosis for the development of the capelin stock (Gjøsæter, WD 17) was used in the prediction of natural mortality and growth of cod. The predictions of capelin stock size are 4.0 million t in 1999 and 5.7 million t in 2000. Such predictions for 1998-1999 were also presented at last year's WG meeting (Gjøsæter, WD 1998), and turned out to be quite accurate (predicted value for 1998: 2.3 million t, observed value: 2.1 million t).

Weight at age in the stock for ages 3-9 in 2000-2001 was predicted (Ajiad, WD 14) assuming that the increase in capelin stock size will lead to an increase of 20% in the daily growth rate compared to the growth rate observed in 1998. For older age groups, weight at age in the stock was set equal to the values used for the period 1946-1981. The weight at age in the catch in 1999 for ages 3-8 was calculated assuming the same ratio between weight at age in the catch and in the stock as the average for 1996-1998. For 2000 and 2001, with higher stock weights, the catch weight/stock weight ratio for 1992 was applied, as this seemed more applicable in a situation with higher stock weights than the ratios for 1996-1999. For the older age groups, the weight at age in the catch was set equal to the weight at age in the stock.

The average maturity ogive for the years 1997-1999 was used for 2000 onwards.

The stock number at age in 1999 was taken from the final VPA (Table 3.18) for ages 4 and older. The number at age 3 was taken from the XSA (Table 3.14).

The fishing pattern for 1999 and later years was set equal to the 1998 fishing pattern, as the fishery seems to have shifted towards the younger age groups in 1998 and this situation is likely to continue with the current stock composition and minimum landing sizes.

The natural mortality due to cannibalism, $M_2(a,y)$ was predicted by the following model:

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

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

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

The following parameter values were obtained: $\alpha=0.0052$, $\beta=0.000011$, $\delta=0.20$, $\gamma=3.28$, $\kappa=0.57$.

These values were used to predict the natural mortality at age 2 and 3 due to cannibalism in 1999 and 2000. The biomass of cod by age was taken from the prediction, while the length at age in 2000 and 2001 was calculated from the weight at age used in the prediction assuming the same condition factor as in 1999. The natural mortality at age 4-6 due to cannibalism was predicted by assuming the ratio between M at these age groups and at age 3 was the same as in 1998.

Figure 3.4 shows the development in natural mortality due to cannibalism (XSA and predicted by the model above) for cod (prey) age groups 2 and 3 and the abundance of capelin in the period 1984-1998, as well as the predicted values for 1999 and 2000.

The recruitment at age 3 in year 2000 was calculated by applying the predicted natural mortality at age 2 in 1999 to the XSA estimate of age 2 fish in the beginning of 1999. The recruitment at age 3 in year 2001, i.e. the abundance of the 1998 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.

3.4.2 Recruitment (Table 3.7)

The only year class which needs to be estimated by the RCT3 program is the 1998 year class. Only the age 1 survey indices and the index from the international 0-group survey were included in the estimation, together with the VPA estimate at age 3. The results are given in Table 3.7.

3.4.3 Including cannibalism in the VPA (Tables 3.13-3.16, Figure 3.5 A-F)

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

The tuning diagnostics from VPA with cannibalism, are given in Table 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 discussed in last year's report.

Mortalities induced by cannibalism on age 1 in 1993-1998 are high (1.5-2.5). The mortalities induced by cannibalism in 1998 are lower than those predicted in last year's assessment.

In order to build a matrix of natural mortality which includes predation, the fishing mortality estimated in the final XSA analyses was split into the mortality caused by the fishing fleet (true F) and the mortality caused by cod cannibalism (M2 in MSVPA terminology) by using the number caught by fishing and by cannibalism. The new natural mortality data matrix was prepared by adding 0.2 (M1) to the predation mortality (M2). This new M matrix (Table 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.

3.5 Results of the assessment

3.5.1 Fishing mortalities and VPA (Tables 3.17-3.21, Figures 3.1A-B, 3.5A-F, 3.6)

The average age 5-10 fishing mortalities for the years 1981-1989 were in the range 0.70 to 0.95 (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. F_{5-10} then increased, reaching 1.01 in 1997 before dropping to 0.90 in 1998. F_{5-10} in 1994-1998 was higher than calculated in last year's assessment. The assumed fishing mortality in 1999 is also higher than predicted last year (0.91 vs. 0.71), and the spawning stock biomass in 1999 is estimated to be 304,000 t, compared to 576,000 t in last year's assessment. The reason for this is that the 1989-1992 year classes are much weaker than estimated in last year's assessment. Fig 3.6 shows the results of a retrospective analysis when cannibalism is taken into account. The number of cod consumed by cod was not recalculated year by year in the retrospective analysis, however. The fishing mortalities and stock numbers are given in Tables 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.

Figure 3.5A-F shows plots of the indices versus stock numbers from the VPA.

3.5.2 Recruitment (Table 3.7)

The results of the RCT3 analysis are given in Table 3.7. The 1998 year class estimate at age 3 is 525 million individuals.

3.6 Reference points and safe biological limits

3.6.1 Biomass reference points (Figure 3.7)

Jakobsen (1993) discusses past, present and future management of North-east Arctic cod. He suggested that to reduce the likelihood of poor year classes, the spawning stock biomass should be kept well above a level of 500,000 t (MBAL). This can also be seen from the stock/recruitment plot given in Figure 3.7. It was proposed at the ACFM meeting in 1998 to use 500,000 t as B_{pa} and 112,000 t as B_{lim} . The Working Group found no basis for changing these values

3.6.2 Fishing mortality reference points

At the 1998 WG meeting, the following values were estimated for the fishing mortality reference points $F_{0.1} = 0.13$, $F_{max} = 0.24$, $F_{low} = 0.27$, $F_{med} = 0.46$ and $F_{high} = 0.91$ (median values). This was done using the PASoft program package (MRAG 1997). Data input and analysis performed were described by Motos (WD 1998). Only $F_{0.1}$ (=0.12) and F_{max} (=0.22) were recalculated this year using the 1999 prediction parameters (Table 3.24), the other reference points were not recalculated this year. The present exploitation level is $F_{98} = 0.91$ (*status quo*) which is equal to F_{high} .

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

3.7 Catch options (Table 3.23)

The management option table (Table 3.23) shows that the expected catches in 1999 will give a decrease in F_{5-10} from 0.91 in 1998 ($F_{status quo}$) to 0.72 in 1999. Fishing at F_{pa} , F_{med} and $F_{status quo}$ in 2000 gives catches of 349,000, 378,000 and 652,000 t, respectively, compared to the expected catch in 1999 of 480,000 t.

In Figure 3.1D the catch level in 2000 and spawning stock biomass level in 2001 are plotted against the fishing mortality in 2000.

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 2001 as for 2001 (Table 3.22). The recruitment at age 3 of the 1999 and later year classes was set equal to the long-term average of 615 million, adjusted upwards to account for increased mortality at ages 3-6 due to cannibalism, i.e. 667 million individuals.

3.8.2 Methods

It was decided to limit the risk analysis for North-east Arctic cod to a single-species analysis, where only uncertainty in the initial stock estimate and the recruitment is taken into account. A formal harvest control rule (including reduction of F when the SSB falls below B_{pa}) has not been defined for this stock. As the spawning stock biomass now is between B_{pa} and B_{lim} , it is highly relevant to also consider harvest control rules which incorporate a reduction of F when the spawning stock biomass is below B_{pa} . The following F strategies were investigated: $F=0.42$ (F_{pa}) and $F=0.22$ (F_{max}) for all SSB levels, as well as a linear reduction of F from F_{pa} at B_{pa} to 0 at B_{lim} . In addition, the effect of fixed TACs of 300,000 t and 400,000 t was investigated. The simulation period was 1999-2004. For all these strategies, the average yield was computed together with the risk of falling below B_{lim} during the period as well as the probability that the SSB is above B_{pa} by the end of the period, and in which year $P(SSB > B_{pa})$ increases above 90%. 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 1999 and 2000 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 by 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 (Tables 3.25-3.26 and Figures 3.8A-L)

The results of the deterministic medium-term predictions for all the harvesting strategies mentioned are given in Table 3.25. A detailed output of these predictions for F_{pa} is given in Table 3.26. The text table below shows the results of the risk analysis.

Harvest control rule	Average yield 2000-2003	First year when $P(SSB > B_{pa}) > 0.9$	$P(SSB < B_{lim}$ during 2000-2004)	$P(SSB > B_{pa}$ in 2004)
$F=0.22$	335	2002	0.00	1.00
$F=0.42$	498	2003	0.00	0.98
$F=0.72$	621	Not within simulation period	0.00	0.38
$F=0.42$ above B_{pa} , reduce F linearly to 0 at B_{lim}	490	2002	0.00	0.99
TAC=300,000 tonnes, $F < 1.5$	300	2003	0.00	1.00
TAC=400,000 tonnes, $F < 1.5$	400	2004	0.00	0.93

Figures. 3.8A-L show the probability distribution of the spawning stock biomass and the yield in the period 1999-2004 for all the harvesting strategies studied.

3.8.4 Management considerations

The spawning stock in 1999 is well below B_{pa} , and not far from historical low levels, and a rebuilding plan is needed to bring the stock above B_{pa} . A fishing mortality of F_{pa} or less will almost certainly rebuild the stock in the medium term, while fishing at $F=0.72$ (F_{99}) is not likely to rebuild the stock to above B_{pa} in the medium term. To reach the management goal of having SSB above B_{pa} and F below 0.46 in 2001, a catch of less than 196,000 t in 2000 is required. The prediction of the weight at age in the stock and in the catch is quite uncertain, and is more likely to be an overestimate than an underestimate. This uncertainty is not taken into account in the projections. Also, the fishing pattern has in recent years changed towards smaller fish. If this continues, yield and biomass will be reduced compared to the forecast. In future projections, uncertainty in weight at age and fishing pattern, as well as in maturity and natural mortality, should be taken into account.

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 1998, updated by one year based on new catch and survey data from 1998/1999, as well as including a revision of the time series of catch and survey data. The XSA settings and other routines have not been changed. No attempts have been made in the current assessment to resolve the methodological problems with the use of XSA, 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 the reports from this Working Group in the past two years. The assessment represents yet another downward revision of the stock size.

3.9.2 Trends in catchability

The retrospective analysis shows consistent upward revisions of fishing mortality and downward revisions of SSB over the last 5 years (Figure 3.6). This tendency was commented in the 1998 ACFM report. The technical minutes to the WG says: *“The effect of capelin abundance on catchability appears to have a significant impact on the estimates for stock size for NEA cod. The WG should examine this at its next meeting and attempt to incorporate it into the assessment to counteract the bias in the retrospective pattern. In addition it should investigate whether changes in natural mortality/unrecorded landings (not covered by cannibalism) could be a likely source for some of the changes in catchability.”*

The catchability plots from the 1998 assessment (Figures 3.9.1-3.9.3) indicated that some fleets and age groups (mainly 2,3 and 4) had a cyclic pattern, which appeared to be in opposite phase with the development of the capelin stock.

Figures 3.9.1-3.9.3 also shows the catchability log residuals for the present assessment. For the young age groups the catchability variation does not in the present assessment show a clear relationship to the capelin stock (with the possible exception of ages 2 and 3 in the Norwegian winter bottom trawl survey). The change in this pattern compared to last year is mainly caused by changes for the unconverged years. In addition some points have changed due to the revisions of catch and survey data (Section 3.2).

For the age groups 6,7 and 8 in all the surveys there is a rather consistent pattern of higher catchabilities during the later period of the reasonably converged years (1991-1994) compared to earlier years. To evaluate how much this contributes to overestimating stock and underestimating F a retrospective XSA was made without the survey data for ages 6 and older for 1990 and earlier years. This increased the F_{98} by 13% and reduced the SSB_{98} by 8%. The retrospective pattern is in this case quite satisfactory for the last 6 years, but shows considerable over-estimation of F further back (Figure 3.9.4).

Thus the modified treatment of the survey data improved the retrospective pattern for the later years, while it got worse for earlier years. The WG could not, however, find biological reasons for treating the survey data for those oldest age groups differently from the younger ages. The fact that survey methodology has changed over the years was raised as a reason to be suspicious in general to the older part of the survey data. It was, however, argued that several revisions of the survey time series had attempted to take account of some of those changes. Until this issue is fully investigated, the WG agreed to utilize the full time series in the assessment.

Modelled values of residual natural mortality were presented and discussed (WD 28). According to this some important changes had occurred during the 80s and 90s. The magnitude of those changes is likely not sufficient to explain the whole apparent trend in survey catchabilities. Other effects like changes in predation by sea mammals and changes in unreported catches cannot be ruled out, but the information available to the WG was too scarce to allow for quantification.

3.9.3 A comparison of the assessment to results from survey-based assessment methods

It is shown by Nakken (WD 18-1999) that the previous assessment (ICES 1999) generated fishing mortalities which were systematically higher than those produced in the annual assessments in the period 1983-1996. It was concluded that the annual assessments of cod have chronically underestimated the fishing mortality and overestimated stock numbers available for the fishery. Hence fish have been removed from the stock at a higher rate than scientists thought at the time they gave their advice. The fishing mortalities were on average underestimated by 20%. The underestimation was more pronounced in time periods when fishing mortality was increasing. A similar systematic underestimation of the fishing mortality is seen from the retrospective analysis in the current assessment (Figure 3.6). The issue of underestimating fishing mortality was also addressed during a workshop held in Bergen, Norway, in December 1998. The workshop concluded that until we know the cause of the bias, managers should be made aware of the problem and base their decisions on the fact that current estimates of stock abundance have been over optimistic in the past (Pennington 1999).

Problems with the Northeast Arctic cod assessment result partly from changes in the surveys. At the above mentioned Workshop it was observed that the relationship between the Norwegian Barents Sea trawl survey (FLT04) and the VPA changed in 1993-1994 when the survey area was extended. The same was the case for the Norwegian acoustic survey (FLT05) in 1990 when new acoustic equipment (EK-500 and BEI-echo integrator) was introduced. It was recommended to take this into consideration when doing the assessment. Consequently a trial XSA-run was made to try to quantify the effect on the estimated fishing mortality and stock size if only the period 1993-1998 was used. The estimated fishing mortality (F5-10) was 4% higher in 1997 and 13% higher in 1998 compared to the adopted XSA for the current assessment.

Korsbrekke *et al.* (WD 21) presents survey-based assessments based on the Norwegian bottom trawl winter survey and Lofoten acoustic survey, respectively. The 1999 assessment is more in line with these survey-based assessments than the 1998 assessment. They also constructed a time series model of the abundance of age 3+ cod and haddock survey indices which predicts the subsequent value of the cod survey index (3+) fairly accurately. This model would be of more practical use in assessment if it predicted the abundance of individual age groups or the total stock biomass.

Three working documents by Sunnanå (WD 31,32 and 34) have addressed the problem of evaluating internal consistency of series of survey indices and catch at age numbers. The work presented an effort series calculated from the catch at age matrix and two corrected series of survey indices based on combining Norwegian surveys into a series of indices representing the whole stock, and the Russian trawl and acoustic survey.

The analysis is based on assuming that the year-classes maintain their relative strength, measured with respect to the average by age, from year to year throughout their life. This approach is chosen as a first linear approximation to a relation that is non-linear. The approach seems to give promising results.

The three series of indices were used in a trial VPA, summarising the established time series by combining them into an XSA tuning. The three series seem to be fairly consistent in the tuning. However, residuals are still showing some systematic variation.

The main feature of the tuning data used in this VPA is that the large variations indicating an increase in the stock in the early 90's and a decrease in the recent years, are almost removed. This gives a stock with no more than average recruitment to the fisheries, as the cannibalism removes a lot of the recruitment potential.

The overall level of F in this VPA is lower than in the agreed assessment. The effort index and the VPA also indicate a decreasing F in the final year. This may be attributed to the upgrading of the 1991, 1992 and 1993 year-classes, which is seen to be consistent both in the Norwegian and in the Russian corrected surveys, as well as the decreased catches of these year-classes.

The result of these preliminary investigations indicate that there are inconsistencies in the present survey indices that may be by far larger than any inconsistencies in the catch at age figures. The investigation further shows that such inconsistencies may be filtered out by using simple, first order assumptions (or models).

The AFWG do not believe that any assessment method will be able to compensate for large errors and inconsistencies in the input data and the AFWG will urge national research institutes to put effort into investigating the possibilities described above in the period before the next meeting in the working group. The AFWG will also urge the national research institutes to combine relevant, available survey indices into a combined series of numbers at age representing the whole stock, thus giving a catch independent stock assessment.

3.9.4 Comments to the predictions

Gjørseter (WD 17) has provided a short-term prediction of capelin biomass level. Significant changes in growth and cannibalism are predicted based on this prognosis. The changes predicted in growth are large compared to the changes observed in most recent years, but are comparable to the changes observed during the capelin stock increase in the years 1989-1992.

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 and cannibalism should be adjusted to account for this. The weight at age from the Norwegian autumn survey in 1999 will also be available before the ACFM meeting, and could possibly be utilized in the predictions of weight at age.

The recruitment prediction may be improved by taking into account ongoing work on relationship between survey indices at various life stages (Helle *et al.*, WD 13), as well as the work done using the Ricker model to estimate recruitment (Tretyak, WD 5).

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	172,532	86,483	130,000	513,234
1993	195,771	269,383	66,457	50,000	581,611
1994	353,425	306,417	86,244	25,000	771,086
1995	251,448	317,585	170,966		739,999
1996	278,364	297,237	156,627		732,228
1997	273,376	326,689	162,338		762,403
1998 ¹	247,949	261,474	83,259		592,682

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.

Year	Sub-area I		Division IIa		Division IIb	
	Trawl	Others	Trawl	Others	Trawl	Others
1967	238.0	84.8	38.7	90.0	121.1	-
1968	588.1	54.4	44.2	118.3	269.2	-
1969	633.5	45.9	119.7	135.9	262.3	-
1970	524.5	79.4	90.5	153.3	85.6	-
1971	253.1	59.4	74.5	245.1	56.9	-
1972	158.1	38.9	49.9	285.4	33.0	-
1973	459.0	33.7	39.4	172.4	88.2	-
1974	677.0	46.5	41.0	83.2	254.7	-
1975	526.3	35.4	33.7	86.6	147.4	-
1976	466.5	60.2	112.3	124.9	103.5	-
1977	471.5	66.7	100.9	156.2	110.0	-
1978	360.4	57.9	117.0	146.2	17.3	-
1979	161.5	33.7	114.9	120.5	8.1	-
1980	133.3	35.4	83.7	115.6	12.5	-
1981	91.5	45.1	77.2	167.9	17.2	-
1982	44.8	51.8	65.1	171.0	21.0	-
1983	36.6	28.2	56.6	143.7	24.9	-
1984	24.5	29.8	46.9	150.7	25.6	-
1985	72.4	40.2	60.7	112.8	21.5	-
1986	109.5	48.1	116.3	86.4	69.8	-
1987	126.3	19.8	167.9	77.5	129.9	1.7
1988	149.1	17.6	122.0	88.0	58.2	0.2
1989	144.4	19.5	68.9	81.2	19.1	0.1
1990	51.4	10.9	47.4	52.1	24.5	0.8
1991	58.9	12.1	73.0	84.0	40.0	1.2
1992	103.7	20.5	79.7	92.8	85.6	0.9
1993	165.1	30.7	155.5	113.9	66.3	0.2
1994	312.1	41.3	165.8	140.6	84.3	1.9
1995	218.1	33.3	174.3	143.3	160.3	10.7
1996	248.9	32.7	137.1	159.0	147.7	6.8
1997	235.6	37.7	150.5	176.2	154.7	7.6
1998 ¹	216.9	31.0	131.1	130.4	81.6	1.7

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	2	3,337	3,911	168,460	6,217	6,120	182,315	Iceland 1,209	383,234
1993	17,435	3,572	5,389	5,887	221,051	8,800	11,336	244,860	9,374 3,907	531,611
1994	22,826	1,962	6,882	8,283	318,395	14,929	15,579	291,925	36,737 28,568	746,086
1995	22,262	4,912	7,462	7,428	319,987	15,505	16,329	296,158	34,214 15,742	739,999
1996	17,758	5,352	6,529	8,326	319,158	15,871	16,061	305,317	23,005 14,851	732,228
1997	20,076	5,353	6,426	6,680	357,825	17,130	18,066	313,344	4,200 13,303	762,403
1998 ¹	15,527	1,197	6,388	3,841	284,647	14,212	13,089	244,115	1,489 8,177	592,682

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	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1983	0.41	0.82	1.32	2.05	2.82	3.94	5.53	7.70	9.17	11.46	16.59	16.42	16.96	24.46
1984	1.16	1.47	1.97	2.53	3.13	3.82	4.81	5.95	7.19	7.86	8.46	7.99	9.78	10.64
1985	0.34	0.99	1.43	2.14	3.27	4.68	6.05	7.73	9.86	11.87	14.16	14.17	13.52	15.33
1986	0.30	0.67	1.34	2.04	3.14	4.60	5.78	6.70	7.52	9.74	10.68	12.86	9.59	16.31
1987	0.24	0.48	0.88	1.66	2.72	4.35	6.21	8.78	9.78	12.50	13.75	15.12	10.43	19.95
1988	0.36	0.56	0.83	1.31	2.34	3.84	6.50	8.76	9.97	11.06	14.43	19.02	12.89	10.16
1989	0.53	0.75	0.90	1.17	1.95	3.20	4.88	7.82	9.40	11.52	11.47		19.47	14.68
1990	0.40	0.81	1.22	1.59	2.14	3.29	4.99	7.83	10.54	14.21	17.63	7.97	14.64	
1991	0.63	1.37	1.77	2.31	3.01	3.68	4.63	6.06	8.98	12.89	17.00		14.17	16.63
1992	0.41	1.10	1.79	2.45	3.22	4.33	5.27	6.21	8.10	10.51	11.59		15.81	6.52
1993	0.30	0.83	1.70	2.41	3.35	4.27	5.45	6.28	7.10	7.82	10.10	16.03	19.51	17.68
1994	0.30	0.82	1.37	2.23	3.35	4.27	5.56	6.86	7.45	7.98	9.53	12.16	11.45	19.79
1995	0.44	0.78	1.26	1.87	2.80	4.12	5.15	5.96	7.90	8.67	9.20	11.53	17.77	21.11
1996	0.29	0.90	1.15	1.67	2.58	4.08	6.04	6.62	7.96	9.36	10.55	11.41	9.51	24.24
1997	0.35	0.78	1.14	1.56	2.25	3.48	5.35	7.38	7.55	8.30	11.15	8.64	12.80	
1998	0.38	0.68	1.03	1.64	2.23	3.24	4.85	6.88	9.18	9.84	15.78	14.37	13.77	15.58
Russia (trawl only)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1983	0.65	1.05	1.58	2.31	3.39	4.87	6.86	8.72	10.40	12.07	14.43			
1984	0.53	0.88	1.45	2.22	3.21	4.73	6.05	8.43	10.34	12.61	14.95			
1985	0.33	0.77	1.31	1.84	2.96	4.17	5.94	6.38	8.58	10.28				
1986	0.29	0.61	1.14	1.75	2.45	4.17	6.18	8.04	9.48	11.33	12.35	14.13		
1987	0.24	0.52	0.88	1.42	2.07	2.96	5.07	7.56	8.93	10.80	13.05	18.16		
1988	0.27	0.49	0.88	1.32	2.06	3.02	4.40	6.91	9.15	11.65	12.53	14.68		
1989	0.50	0.73	1.00	1.39	1.88	2.67	4.06	6.09	7.76	9.88				
1990	0.45	0.83	1.21	1.70	2.27	3.16	4.35	6.25	8.73	10.85	13.52			
1991	0.36	0.64	1.05	2.03	2.85	3.77	4.92	6.13	8.36	10.44	15.84	19.33		
1992	0.55	1.20	1.44	2.07	3.04	4.24	5.14	5.97	7.25	9.28	11.36			
1993	0.48	0.78	1.39	2.06	2.62	4.07	5.72	6.79	7.59	11.26	14.79	17.71		
1994	0.41	0.81	1.24	1.80	2.55	2.88	4.96	6.91	8.12	10.28	12.42	16.93		
1995	0.37	0.77	1.21	1.74	2.37	3.40	4.71	6.73	8.47	9.58	12.03	16.99		
1996	0.30	0.64	1.09	1.60	2.37	3.42	5.30	7.86	8.86	10.87	11.80			
1997	0.30	0.57	1.00	1.52	2.18	3.30	4.94	7.15	10.08	11.87	13.54			
1998	0.33	0.68	1.06	1.60	2.34	3.39	5.03	6.89	10.76	12.39	13.61	14.72		
Germany (Division IIa and IIb)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994		0.68	1.04	2.24	3.49	4.51	5.79	6.93	8.16	8.46	8.74	9.48	15.25	
1995		0.44	0.84	1.50	2.72	3.81	4.46	4.81	7.37	7.69	8.25	9.47		
1996		0.84	1.15	1.64	2.53	3.58	4.13	3.90	4.68	6.98	6.43	11.32		
1997		0.43	0.92	1.42	2.01	3.15	4.04	5.16	4.82	3.96	7.04	8.80		
1998	0.23	0.73	1.17	1.89	2.72	3.25	4.13	5.63	6.5	8.57	8.42	11.45	8.79	
Spain (Division IIb)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994	0.43	1.08	1.38	2.32	2.47	2.68	3.46	5.20	7.04	6.79	7.20	8.04	10.46	15.35
1995	0.42	0.51	0.98	1.99	3.41	4.95	5.52	8.62	9.21	11.42	9.78	8.08		
1996		0.66	1.12	1.57	2.43	3.17	3.59	4.44	5.48	6.79	8.10			
1997 ¹	0.51	0.65	1.22	1.68	2.60	3.39	4.27	6.67	7.88	11.34	13.33	10.03	8.69	
1998	0.47	0.74	1.15	1.82	2.44	3.32	3.71	5.00	7.26					
¹ IIa and IIb combined														
Iceland (Sub-area I)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994	0.42	0.85	1.44	2.77	3.54	4.08	5.84	6.37	7.02	7.48	7.37			
1995		1.17	0.91	1.60	2.28	3.61	4.73	6.27			6.26			
1996		0.36	0.99	1.55	2.83	3.79	4.81	5.34	7.25	7.68	9.08	8.98	10.52	
1997	0.42	0.43	0.76	1.60	2.40	3.45	4.40	5.74	6.15		8.28	10.52	9.89	
1998														
UK (England & Wales)														
Year	Age													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1995 ¹			1.47	2.11	3.47	5.57	6.43	7.17	8.12	8.05	10.17	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			
1998														

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

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

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

Table 3.6

NORTHEAST ARCTIC COD : recruits as 3 year-olds (inc. data for ages 0,1),,,,
 5,33,2 (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	230	640	251	-11	-11
1971	525	70	90	77	-11	-11
1972	622	50	40	52	-11	-11
1973	615	160	50	148	-11	-11
1974	348	10	10	29	-11	-11
1975	639	600	10	90	-11	-11
1976	199	10	10	13	-11	-11
1977	138	10	10	49	-11	-11
1978	151	10	20	22	-11	-11
1979	152	10	10	40	-11	-11
1980	166	10	10	13	4.6	8.0
1981	397	10	10	10	0.8	4.0
1982	523	14	99	59	152.9	60.5
1983	1043	43	97	169	2755.0	745.4
1984	287	7	14	155	49.5	69.1
1985	205	33	91	246	665.8	353.6
1986	173	3	16	137	30.7	1.6
1987	243	1	1	17	3.2	2.0
1988	411	2	1	33	8.2	7.5
1989	720	4	6	38	207.2	81.1
1990	913	68	1	123	460.5	181.0
1991	825	31	64	230	126.6	241.4
1992	668	103	605	294	534.5	1074.0
1993	455	17	47	209	1035.9	858.3
1994	740	158	30	227	5253.1	2619.2
1995	-11	248	360	240	5768.5	2396.0
1996	-11	104	-11	287	4815.5	1623.5
1997	-11	-11	159	160	2418.5	3401.3
1998	-11	12	22	68	484.6	358.3
R-1-1	Russian Bottom trawl survey, area I, age 0, late autumn					
R-2B-1	Russian IIb, age 0, late autumn					
INT0GP	International 0-group survey, August/September					
N-BST1	Norwegian Barents Sea, Bottom trawl survey, age 1, February					
N-BSA1	Norwegian Barents Sea Acoustic survey age 1, February					

Table 3.7

Analysis by RCT3 ver3.1 of data from file :
codre.rct

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

Data for 5 surveys over 33 years : 1966 - 1998

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1996

I-----Regression-----I						I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	.71	4.10	.87	.350	25	4.65	7.41	1.073	.154
R-2B-1									
INT0GP	.02	2.96	2.16	.081	29	287.00	9.24	2.715	.024
N-BST1	.45	3.85	.91	.320	15	8.48	7.70	1.150	.134
N-BSA1	.40	4.30	.76	.403	15	7.39	7.24	.930	.205
VPA Mean =							6.16	.607	.482

Yearclass = 1997

I-----Regression-----I						I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1									
R-2B-1	1.92	.32	3.72	.028	25	5.08	10.08	4.610	.010
INT0GP	.02	2.79	2.25	.072	29	160.00	6.39	2.637	.030
N-BST1	.46	3.81	.91	.314	15	7.79	7.38	1.140	.158
N-BSA1	.39	4.31	.76	.400	15	8.13	7.50	.975	.216
VPA Mean =							6.19	.591	.587

Yearclass = 1998

I-----Regression-----I						I-----Prediction-----I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-1-1	.62	4.36	.80	.373	25	2.56	5.96	.955	.174
R-2B-1	1.90	.39	3.79	.026	25	3.14	6.35	4.521	.008
INT0GP	.02	2.70	2.28	.068	29	68.00	4.24	2.845	.020
N-BST1	.46	3.78	.92	.306	15	6.19	6.63	1.109	.129
N-BSA1	.39	4.32	.76	.396	15	5.88	6.60	.912	.191
VPA Mean =							6.23	.576	.479

Year	Weighted	Log	Int	Ext	Var	VPA	Log
Class	Average	WAP	Std	Std	Ratio		VPA
	Prediction		Error	Error			
1996	949	6.86	.42	.37	.77		
1997	818	6.71	.45	.35	.58		
1998	525	6.26	.40	.16	.17		

Table 3.8

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Table 1	Catch numbers at age			Numbers*10** ⁻³
	YEAR,	1946,	1947,	
AGE				
3,		4008,	710,	140,
4,		10387,	13192,	3872,
5,		18906,	43890,	31054,
6,		16596,	52017,	55983,
7,		13843,	45501,	77375,
8,		15370,	13075,	21482,
9,		59845,	19718,	15237,
10,		22618,	47678,	9815,
11,		10093,	31392,	30041,
12,		9573,	9348,	7945,
13,		5460,	9330,	4491,
14,		1927,	4622,	3899,
+sp,		750,	4103,	4205,
TOTALNUM,	189376,	294576,	265539,	
TONSLAND,	706000,	882017,	774295,	
SOPCOF %,	67,	57,	62,	

Table 1	Catch numbers at age					Numbers*10** ⁻³					
	YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
AGE											
3,		991,	1281,	24687,	24099,	47413,	11473,	3902,	10614,	17321,	31219,
4,		6808,	10954,	77924,	120704,	107659,	155171,	37652,	24172,	33931,	133576,
5,		35214,	29045,	64013,	113203,	112040,	146395,	201834,	129803,	27182,	71051,
6,		100497,	45233,	46867,	73827,	55500,	100751,	161336,	250472,	70702,	40737,
7,		83283,	62579,	37535,	49389,	22742,	40635,	84031,	86784,	87033,	38380,
8,		29727,	30037,	33673,	20562,	16863,	10713,	30451,	51091,	39213,	35786,
9,		13207,	19481,	23510,	24367,	10559,	11791,	13713,	14987,	17747,	13338,
10,		5606,	9172,	10589,	15651,	10553,	8557,	9481,	7465,	6219,	10475,
11,		8617,	6019,	4221,	8327,	5637,	6751,	4140,	3952,	3232,	3289,
12,		13154,	4133,	1288,	3565,	1752,	2370,	2406,	1655,	1220,	1070,
13,		3657,	6750,	1002,	647,	468,	896,	867,	1292,	347,	252,
14,		1895,	1662,	3322,	467,	173,	268,	355,	448,	299,	40,
+sp,		2167,	1450,	611,	1044,	156,	123,	128,	166,	173,	141,
TOTALNUM,	304823,	227796,	329242,	455852,	391515,	495894,	550296,	582901,	304619,	379354,	
TONSLAND,	800122,	731982,	827180,	876795,	695546,	826021,	1147841,	1343068,	792557,	769313,	
SOPCOF %,	68,	78,	88,	75,	84,	78,	82,	84,	83,	88,	

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Table 1	Catch numbers at age					Numbers*10** ⁻³					
	YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE											
3,		32308,	37882,	45478,	42416,	13196,	5298,	15725,	55937,	34467,	3709,
4,		77942,	97865,	132655,	170566,	106984,	45912,	25999,	55644,	160048,	174585,
5,		148285,	64222,	123458,	167241,	205549,	97950,	78299,	34676,	69235,	267961,
6,		53480,	67425,	51167,	89460,	95498,	58575,	68511,	42539,	22061,	107051,
7,		18498,	23117,	38740,	28297,	35518,	19642,	25444,	37169,	26295,	26701,
8,		17735,	8429,	17376,	21996,	16221,	9162,	8438,	18500,	25139,	16399,
9,		23118,	7240,	5791,	7956,	11894,	6196,	3569,	5077,	11323,	11597,
10,		9483,	11675,	6778,	2728,	3884,	3553,	1467,	1495,	2329,	3657,
11,		3748,	4504,	5560,	2603,	1021,	783,	1161,	380,	687,	657,
12,		997,	1843,	1682,	1647,	1025,	172,	131,	403,	316,	122,
13,		254,	354,	910,	392,	498,	387,	67,	77,	225,	124,
14,		161,	102,	280,	280,	129,	264,	91,	9,	40,	70,
+sp,		98,	226,	108,	103,	157,	131,	179,	70,	14,	46,
TOTALNUM,	386107,	324884,	429983,	535685,	491574,	248025,	229081,	251976,	352179,	612679,	
TONSLAND,	744607,	622042,	783221,	909266,	776337,	437695,	444930,	483711,	572605,	1074084,	
SOPCOF %,	86,	88,	91,	92,	78,	82,	90,	94,	88,	96,	

Table 3.8 (continued)

Table 1	Catch numbers at age			Numbers*10** ⁻³						
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
3,	2307,	7164,	7754,	35536,	294262,	91855,	45282,	85337,	39594,	78822,
4,	24545,	10792,	13739,	45431,	131493,	437377,	59798,	114341,	168609,	45400,
5,	238511,	25813,	11831,	26832,	61000,	203772,	226646,	79993,	136335,	88495,
6,	181239,	137829,	9527,	12089,	20569,	47006,	118567,	118236,	52925,	56823,
7,	79363,	96420,	59290,	7918,	7248,	12630,	29522,	47872,	61821,	25407,
8,	26989,	31920,	52003,	34885,	8328,	4370,	9353,	13962,	23338,	31821,
9,	13463,	8933,	12093,	22315,	19130,	2523,	2617,	4051,	5659,	9408,
10,	5092,	3249,	2434,	4572,	4499,	5607,	1555,	936,	1521,	1227,
11,	1913,	1232,	762,	1215,	677,	2127,	1928,	558,	610,	913,
12,	414,	260,	418,	353,	195,	322,	575,	442,	271,	446,
13,	121,	106,	149,	315,	81,	151,	231,	139,	122,	748,
14,	23,	39,	42,	121,	59,	83,	15,	26,	92,	48,
+gp,	46,	35,	25,	40,	55,	62,	37,	53,	54,	51,
TOTALNUM,	574026,	323792,	170067,	191622,	547596,	807885,	496126,	465946,	490951,	339609,
TONSLAND,	1197226,	933246,	689048,	565254,	792685,	1102433,	829377,	867463,	905301,	698715,
SOPCOF %,	87,	97,	112,	108,	114,	103,	90,	102,	99,	100,

Table 1	Catch numbers at age			Numbers*10** ⁻³						
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	8600,	3911,	3407,	8948,	3108,	6942,	24634,	28968,	13648,	9828,
4,	77484,	17086,	9466,	20933,	19594,	14240,	45769,	70993,	137106,	22774,
5,	43677,	81986,	20803,	19345,	20473,	18807,	27806,	78672,	98210,	135347,
6,	31943,	40061,	63433,	28084,	17656,	20086,	19418,	25215,	61407,	54379,
7,	16815,	17664,	21788,	42496,	17004,	15145,	11369,	11711,	13707,	21015,
8,	8274,	7442,	9933,	8395,	18329,	8287,	3747,	4063,	3866,	3304,
9,	10974,	3508,	4267,	2878,	2545,	5988,	1557,	976,	910,	1236,
10,	1785,	3196,	1311,	708,	646,	783,	768,	726,	455,	519,
11,	427,	678,	882,	271,	229,	232,	137,	557,	187,	106,
12,	103,	79,	109,	260,	74,	153,	36,	136,	227,	69,
13,	59,	24,	37,	27,	58,	49,	31,	28,	21,	43,
14,	38,	26,	3,	5,	20,	12,	32,	34,	59,	14,
+gp,	45,	8,	1,	5,	5,	8,	8,	14,	20,	5,
TOTALNUM,	200224,	175669,	135440,	132355,	99741,	90732,	135312,	222093,	329823,	248639,
TONSLAND,	440538,	380434,	399038,	363730,	289992,	277651,	307920,	430113,	523071,	434939,
SOPCOF %,	107,	97,	110,	108,	90,	95,	102,	102,	102,	100,

Table 1	Catch numbers at age			Numbers*10** ⁻³						
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
3,	5085,	1911,	4963,	21835,	10094,	6531,	4879,	7655,	12827,	31830,
4,	17313,	7551,	10933,	36015,	46182,	59444,	42587,	28782,	36491,	88714,
5,	32165,	12999,	16467,	27494,	63578,	102548,	115329,	80711,	69633,	48939,
6,	81756,	17827,	20342,	23392,	33623,	59766,	98485,	100509,	83017,	40761,
7,	27854,	30007,	19479,	18351,	14866,	32504,	32036,	54590,	65768,	35083,
8,	5501,	6810,	25193,	13541,	9449,	10019,	7334,	10545,	28392,	26611,
9,	827,	828,	3888,	18321,	6571,	6163,	3014,	2023,	4651,	6607,
10,	290,	179,	428,	2529,	12593,	3671,	1725,	930,	1151,	971,
11,	41,	59,	48,	264,	1749,	7528,	1174,	462,	373,	199,
12,	13,	15,	12,	82,	377,	995,	1920,	230,	213,	70,
13,	1,	6,	1,	3,	63,	121,	222,	809,	144,	44,
14,	11,	5,	1,	9,	22,	19,	41,	84,	238,	24,
+gp,	16,	2,	2,	1,	1,	4,	1,	1,	1,	53,
TOTALNUM,	170873,	78199,	101757,	161837,	199168,	289313,	308747,	287331,	302899,	279906,
TONSLAND,	332481,	212000,	319158,	513234,	581611,	771086,	739999,	732228,	762403,	592682,
SOPCOF %,	99,	101,	95,	103,	101,	101,	100,	101,	100,	100,

Table 3.9

Run title : Arctic Cod (run: SVPBJA05/V05)
 At 30/08/1999 21:18

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

Table 2	Catch weights at age (kg)									
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,
SOPCOFAC,	.6799,	.7781,	.8813,	.7499,	.8396,	.7790,	.8170,	.8448,	.8346,	.8831,

Run title : Arctic Cod (run: SVPBJA05/V05)
 At 30/08/1999 21:18

Table 2	Catch weights at age (kg)									
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,
SOPCOFAC,	.8562,	.8819,	.9069,	.9175,	.7829,	.8184,	.8965,	.9415,	.8787,	.9561,

Table 3.9 (continued)

Table 2		Catch weights at age (kg)								
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,
SOPCOFAC,	.8743,	.9734,	1.1182,	1.0788,	1.1430,	1.0271,	.9007,	1.0236,	.9928,	1.0037,

Table 2		Catch weights at age (kg)								
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.8400,	1.4200,	.9400,	.6400,	.4900,	.5400,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.3700,	1.9300,	1.3700,	1.2700,	.8800,	.8500,
5,	1.5500,	1.5500,	1.5500,	1.5500,	2.0900,	2.4900,	2.0200,	1.8800,	1.5500,	1.3200,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.8600,	3.1400,	3.2200,	2.7900,	2.3300,	2.2400,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.9900,	3.9100,	4.6300,	4.4900,	3.4400,	3.5200,
8,	4.7000,	4.7000,	4.7000,	4.7000,	5.5800,	4.9100,	6.0400,	5.8400,	5.9200,	5.3500,
9,	6.1700,	6.1700,	6.1700,	6.1700,	7.7700,	6.0200,	7.6600,	6.8300,	8.6000,	8.0600,
10,	7.7000,	7.7000,	7.7000,	7.7000,	9.2900,	7.4000,	9.8100,	7.6900,	9.6000,	9.5100,
11,	9.2500,	9.2500,	9.2500,	9.2500,	11.5500,	8.1300,	11.8000,	9.8100,	12.1700,	11.3600,
12,	10.8500,	10.8500,	10.8500,	10.8500,	16.2000,	8.5700,	14.1600,	10.7100,	13.7200,	14.0900,
13,	12.5000,	12.5000,	12.5000,	12.5000,	16.4200,	7.9900,	14.1700,	12.9100,	15.4100,	18.7100,
14,	13.9000,	13.9000,	13.9000,	13.9000,	16.9600,	9.7800,	13.5200,	9.5900,	10.4300,	12.8900,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	24.4600,	10.6400,	15.3300,	16.3100,	19.9500,	10.1600,
SOPCOFAC,	1.0713,	.9731,	1.1050,	1.0767,	.8953,	.9483,	1.0182,	1.0160,	1.0224,	1.0001,

Table 2		Catch weights at age (kg)								
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
3,	.7400,	.8100,	1.0500,	1.1600,	.8100,	.8200,	.7700,	.7900,	.6700,	.6800,
4,	.9600,	1.2200,	1.4500,	1.5700,	1.5200,	1.3000,	1.2000,	1.1100,	1.0400,	1.0500,
5,	1.3100,	1.6400,	2.1500,	2.2100,	2.1600,	2.0600,	1.7800,	1.6100,	1.5300,	1.6200,
6,	1.9200,	2.2200,	2.8900,	3.1000,	2.7900,	2.8900,	2.5900,	2.4600,	2.2200,	2.3000,
7,	2.9300,	3.2400,	3.7500,	4.2700,	4.0700,	3.2100,	3.8100,	3.8200,	3.4200,	3.3000,
8,	4.6400,	4.6800,	4.7100,	5.1900,	5.5300,	5.2000,	4.9900,	5.7200,	5.2000,	4.8600,
9,	7.5200,	7.3000,	6.0800,	6.1400,	6.4700,	6.8000,	6.2300,	6.7400,	7.1900,	6.8700,
10,	9.1200,	9.8400,	8.8200,	7.7700,	7.1900,	7.5700,	8.0500,	8.0400,	7.7300,	9.3000,
11,	11.0800,	13.2500,	11.8000,	10.1200,	7.9800,	8.0100,	8.7400,	9.2800,	8.6100,	10.3000,
12,	11.4700,	16.8800,	16.5800,	11.5400,	10.1100,	9.4800,	9.2200,	10.4000,	11.0700,	15.0500,
13,	12.5000,	7.9700,	19.3300,	12.5000,	14.8000,	11.7600,	11.3100,	11.0800,	8.5900,	14.3500,
14,	19.4700,	14.6400,	14.1700,	15.8100,	12.5900,	11.7200,	17.5700,	9.7100,	12.6300,	13.7100,
+gp,	14.6800,	15.0000,	16.6300,	6.5200,	10.4000,	19.7900,	21.1100,	24.2400,	15.0000,	15.0000,
SOPCOFAC,	.9879,	1.0108,	.9521,	1.0270,	1.0127,	1.0090,	1.0030,	1.0147,	1.0004,	1.0008,

Table 3.10

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

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

Table 3	Stock weights at age (kg)									
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
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,

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Table 3	Stock weights at age (kg)									
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
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 (continued)

Table 3 Stock weights at age (kg)

YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
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,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.3720,	.4210,	.4130,	.3110,	.1910,	.2120,
4,	1.0000,	1.0000,	1.0000,	1.0000,	.9230,	1.1550,	.8750,	.8800,	.5060,	.4040,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5970,	1.8060,	1.6030,	1.4700,	1.2790,	.7900,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.4420,	2.7930,	2.8100,	2.4670,	1.9400,	1.9030,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.8210,	3.7770,	4.0590,	3.9150,	3.2800,	2.9770,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7580,	4.5660,	5.8330,	5.8100,	5.1710,	4.3920,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	7.6850,	6.5800,	6.5230,	7.8120,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	10.1170,	6.8330,	9.3000,	12.1120,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	14.2900,	11.0040,	13.1500,	13.1070,
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,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
3,	.2990,	.3980,	.5180,	.4400,	.3440,	.2250,	.2010,	.1950,	.2020,	.2170,
4,	.5200,	.7050,	1.1360,	.9310,	1.1720,	.7530,	.4850,	.4870,	.5210,	.5330,
5,	.8680,	1.1820,	1.7430,	1.8120,	1.8200,	1.4200,	1.1400,	.9710,	1.0790,	1.1610,
6,	1.4770,	1.7190,	2.4280,	2.7160,	2.8230,	2.4130,	2.1180,	2.0540,	1.8780,	1.9390,
7,	2.6860,	2.4580,	3.2140,	3.8950,	4.0310,	3.8250,	3.4700,	3.5270,	3.3690,	2.9450,
8,	4.6280,	3.5650,	4.5380,	5.1760,	5.4970,	5.4160,	4.9380,	5.5030,	5.2630,	4.5740,
9,	7.0480,	4.7100,	6.8800,	6.7740,	6.7650,	6.6310,	7.1600,	7.7670,	8.9270,	7.4230,
10,	9.9800,	7.8010,	10.7190,	9.5980,	8.5710,	7.6300,	9.1190,	10.1590,	12.1540,	10.3670,
11,	9.2500,	8.9560,	9.4450,	12.4270,	9.2500,	8.1120,	10.1010,	10.6690,	10.8980,	11.7380,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
13,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,	12.5000,
14,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,	13.9000,
+gp,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,	15.0000,

Table 3.11

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

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

Table 5	Proportion mature at age									
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
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,

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Table 5	Proportion mature at age									
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
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(continued)

Table 5		Proportion mature at age								
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
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,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	.0000,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0500,	.0800,	.0500,	.0100,	.0500,	.0100,	.0200,
5,	.0000,	.0000,	.0000,	.1000,	.1000,	.1800,	.0900,	.0800,	.0700,	.0500,
6,	.0000,	.0000,	.0000,	.3400,	.3000,	.3100,	.3600,	.1900,	.1800,	.3300,
7,	.0000,	.0000,	.0000,	.6500,	.7300,	.5600,	.5500,	.5300,	.2200,	.5300,
8,	1.0000,	1.0000,	1.0000,	.8200,	.8800,	.9000,	.8500,	.7100,	.4600,	.6200,
9,	1.0000,	1.0000,	1.0000,	.9200,	.9700,	.9900,	.9600,	.6200,	.5000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	.9000,	.7500,	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,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
3,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0100,	.0400,	.0100,	.0300,	.0100,	.0000,	.0000,	.0000,	.0100,
5,	.0500,	.0500,	.0600,	.1200,	.0900,	.1100,	.0700,	.0200,	.0200,	.0400,
6,	.1800,	.2100,	.2800,	.4300,	.3000,	.3300,	.3300,	.2600,	.1400,	.1900,
7,	.4100,	.5800,	.6500,	.7500,	.6100,	.6000,	.6200,	.6300,	.5600,	.4400,
8,	.6900,	.7700,	.8300,	.9300,	.9100,	.8100,	.7400,	.8300,	.8200,	.8200,
9,	.8500,	.8600,	.9700,	.9700,	.9700,	.9700,	.9500,	.9800,	.9500,	.9300,
10,	1.0000,	.9800,	1.0000,	1.0000,	.9900,	.9900,	.9800,	1.0000,	.9500,	.9800,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9900,	1.0000,	1.0000,	.9500,	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 3.12

North-East Arctic cod (Sub-areas I and II) (run name: XSABJA29)

106

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

1982 1998

1 1 0.90 1.00

1 8

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

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

1985 1998

1 1 0.00 1.00

9 14

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

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

1985 1998

1 1 0.00 1.00

9 14

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

Table 3.12 (continued)

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

1980 1998

1 1 0.99 1.00

1 8

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

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

1984 1998

1 1 0.99 1.00

1 11

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

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

1983 1998

1 1 0.60 0.85

1 8

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

Table 3.13

Lowestoft VPA Version 3.1

30/08/1999 21:06

Extended Survivors Analysis

Arctic Cod (run: XSABJA29/X29)

CPUE data from file fleet

Catch data for 53 years. 1946 to 1998. Ages 1 to 15.

Fleet,	First,	Last,	First,	Last,	Alpha,	Beta
,	year,	year,	age,	age	,	
FLT01: Russian Trawl,	1982,	1998,	1,	8,	.900,	1.000
FLT02: Norwegian tra,	1985,	1998,	9,	14,	.000,	1.000
FLT03: Russian trawl,	1985,	1998,	9,	14,	.000,	1.000
FLT04: NorBarTrSur r,	1980,	1998,	1,	8,	.990,	1.000
FLT05: NorBarLofAcSu,	1984,	1998,	1,	11,	.990,	1.000
FLT06: NorSvaTrSur r,	1983,	1998,	1,	8,	.600,	.850

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 6

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

Catchability independent of age for ages >= 13

Terminal population estimation :

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

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

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

Prior weighting not applied

Tuning converged after 29 iterations

Regression weights

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

Fishing mortalities

Age,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1,	.217,	.049,	.101,	.463,	2.537,	1.747,	1.862,	1.984,	2.525,	1.626
2,	.002,	.060,	.235,	.142,	.440,	.646,	.906,	1.051,	1.173,	.544
3,	.033,	.009,	.018,	.041,	.078,	.206,	.538,	.449,	.350,	.371
4,	.128,	.062,	.062,	.127,	.097,	.198,	.295,	.339,	.288,	.413
5,	.265,	.134,	.187,	.220,	.347,	.341,	.326,	.396,	.538,	.483
6,	.398,	.230,	.321,	.442,	.459,	.647,	.579,	.519,	.679,	.710
7,	.717,	.247,	.424,	.539,	.566,	1.165,	.895,	.756,	.773,	.694
8,	.944,	.376,	.339,	.595,	.597,	.984,	.937,	.872,	1.266,	.859
9,	.820,	.340,	.383,	.444,	.658,	1.049,	.955,	.740,	1.387,	1.288
10,	.922,	.409,	.296,	.463,	.634,	1.008,	1.007,	.922,	1.436,	1.453
11,	.311,	.472,	.181,	.300,	.687,	1.040,	1.138,	.839,	1.354,	1.128
12,	.585,	.178,	.162,	.535,	.943,	1.158,	.843,	.708,	1.349,	1.075
13,	.039,	.594,	.016,	.055,	1.089,	.953,	.905,	1.141,	1.551,	1.272
14,	.395,	.279,	.180,	.195,	.711,	1.296,	1.076,	1.139,	1.452,	1.412

Table 3.13 (continued)

XSA population numbers (Thousands)

YEAR	AGE									
	2,	3,	4,	5,	6,	7,	8,	9,	10,	
1989	8.19E+05	3.01E+05	1.75E+05	1.59E+05	1.53E+05	2.75E+05	6.01E+04	9.95E+03	1.63E+03	5.32E+02
1990	1.44E+06	5.40E+05	2.46E+05	1.38E+05	1.14E+05	9.58E+04	1.51E+05	2.40E+04	3.17E+03	5.89E+02
1991	1.76E+06	1.12E+06	4.16E+05	2.00E+05	1.07E+05	8.19E+04	6.23E+04	9.68E+04	1.35E+04	1.85E+03
1992	3.07E+06	1.30E+06	7.28E+05	3.35E+05	1.54E+05	7.23E+04	4.87E+04	3.34E+04	5.64E+04	7.55E+03
1993	2.43E+07	1.58E+06	9.23E+05	5.72E+05	2.41E+05	1.01E+05	3.80E+04	2.32E+04	1.51E+04	2.96E+04
1994	9.70E+06	1.57E+06	8.35E+05	6.99E+05	4.26E+05	1.40E+05	5.22E+04	1.77E+04	1.05E+04	6.39E+03
1995	2.05E+07	1.38E+06	6.76E+05	5.56E+05	4.69E+05	2.48E+05	5.99E+04	1.33E+04	5.42E+03	3.00E+03
1996	2.90E+07	2.60E+06	4.58E+05	3.23E+05	3.39E+05	2.77E+05	1.14E+05	2.00E+04	4.27E+03	1.71E+03
1997	2.02E+07	3.27E+06	7.45E+05	2.39E+05	1.88E+05	1.87E+05	1.35E+05	4.37E+04	6.85E+03	1.67E+03
1998	6.01E+06	1.32E+06	8.27E+05	4.30E+05	1.47E+05	9.00E+04	7.75E+04	5.10E+04	1.01E+04	1.40E+03

Estimated population abundance at 1st Jan 1999

,	0.00E+00	9.68E+05	6.28E+05	4.67E+05	2.33E+05	7.42E+04	3.62E+04	3.17E+04	1.77E+04	2.28E+03
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Taper weighted geometric mean of the VPA populations:

,	4.34E+06	1.06E+06	4.99E+05	3.20E+05	2.07E+05	1.21E+05	5.78E+04	2.05E+04	6.41E+03	2.16E+03
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Standard error of the weighted Log(VPA populations) :

,	1.4598	.7734	.6017	.5763	.5778	.5651	.6081	.8168	.9810	1.1307
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YEAR	AGE			
	11,	12,	13,	14,

1989	1.70E+02	3.25E+01	2.88E+01	3.73E+01
1990	1.73E+02	1.02E+02	1.48E+01	2.27E+01
1991	3.20E+02	8.86E+01	6.98E+01	6.69E+00
1992	1.13E+03	2.19E+02	6.17E+01	5.62E+01
1993	3.89E+03	6.83E+02	1.05E+02	4.78E+01
1994	1.29E+04	1.60E+03	2.18E+02	2.89E+01
1995	1.91E+03	3.73E+03	4.12E+02	6.88E+01
1996	8.99E+02	5.01E+02	1.31E+03	1.37E+02
1997	5.56E+02	3.18E+02	2.02E+02	3.43E+02
1998	3.25E+02	1.17E+02	6.76E+01	3.51E+01

Estimated population abundance at 1st Jan 1999

,	2.68E+02	8.61E+01	3.28E+01	1.55E+01
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Taper weighted geometric mean of the VPA populations:

,	7.47E+02	2.95E+02	1.15E+02	4.78E+01
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Standard error of the weighted Log(VPA populations) :

,	1.2970	1.2635	1.1473	.9967
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Log catchability residuals.

Fleet : FLT01: Russian Trawl

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	99.99	99.99	-.22	1.72	.99	.98	.62	-.53	-.82
2	99.99	99.99	1.80	-.21	.46	.64	.51	.20	.17
3	99.99	99.99	1.03	.34	.13	.26	.02	-.12	.35
4	99.99	99.99	.18	.46	.38	.62	-.23	-.14	-.13
5	99.99	99.99	-1.13	.07	.14	1.20	-.05	-.85	-.41
6	99.99	99.99	-.37	-.29	.31	.76	.22	-.23	-.96
7	99.99	99.99	-1.76	-.75	.26	.75	-.09	-.21	-.77
8	99.99	99.99	99.99	-.15	-.12	.81	.10	-1.03	-.82
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 (continued)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-1.86	.31	.69	.65	-.63	-.20	-.30	.06	.00	.56
2	-1.27	.21	-.21	.68	-.17	-.08	-.51	-.43	-.07	.54
3	-.01	-.29	-.15	.23	.19	-.11	-.25	-.29	-.25	.38
4	.24	-.15	-.28	.00	.27	-.02	-.13	-.15	-.17	.22
5	.23	-.13	-.13	-.31	.79	.59	-.03	-.16	-.38	-.02
6	-.05	-.10	.39	.26	.48	1.02	.02	-.25	-.94	-.35
7	1.31	-.07	.28	.56	.41	1.25	.04	-.25	-1.55	-.87
8	1.78	-.01	-.50	.67	.84	.63	.30	.06	-1.04	-1.40
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	-6.8651	-6.7033	-6.6430
S.E(Log q)	.5599	.8357	.8857

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	.991	11.42	.78	17	.80	-10.66
2	.79	.927	9.78	.66	17	.57	-8.69
3	.62	2.609	9.73	.83	17	.28	-7.67
4	.70	2.364	8.88	.86	17	.24	-7.22
5	.91	.332	7.40	.60	17	.50	-6.94

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	1.46	-1.070	4.62	.35	17	.81	-6.87
7	2.01	-1.244	2.40	.13	17	1.64	-6.70
8	1.53	-1.072	4.89	.29	16	1.35	-6.64

Fleet : FLT02: Norwegian tra

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	
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	.89	-.04	.27	-.03	
10	99.99	99.99	99.99	99.99	99.99	.03	1.64	.92	-.74	
11	99.99	99.99	99.99	99.99	99.99	.11	.80	.56	-.80	
12	99.99	99.99	99.99	99.99	99.99	-2.59	1.42	.57	.22	
13	99.99	99.99	99.99	99.99	99.99	.47	-1.87	-.22	.71	
14	99.99	99.99	99.99	99.99	99.99	.55	-1.37	1.65	99.99	

Table 3.13 (continued)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	.44	-1.13	-1.85	-.35	.52	.25	.50	.31	.10	.44
10	.86	-.48	-2.91	-.46	.75	.23	-.71	.83	.00	.83
11	.59	-.75	-2.86	-.14	1.48	.41	-.75	.85	.68	.01
12	99.99	99.99	99.99	.14	.77	.12	-.17	-.15	-.06	-.78
13	99.99	99.99	99.99	99.99	-.40	-.52	99.99	.37	1.19	-.28
14	.01	99.99	99.99	99.99	-.86	-.86	99.99	-.64	.10	-1.37

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

Age	9	10	11	12	13	14
Mean Log q	-2.1510	-2.1617	-2.3115	-1.8258	-1.6895	-1.6895
S.E(Log q)	.7276	1.1193	1.1098	.7931	.8320	1.0140

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	1.17	-.630	1.03	.59	14	.88	-2.15
10	.98	.059	2.26	.53	14	1.16	-2.16
11	.76	1.229	3.33	.74	14	.83	-2.31
12	.91	.359	2.19	.72	11	.77	-1.83
13	.85	.522	2.22	.70	9	.75	-1.69
14	.68	1.182	2.81	.73	9	.59	-2.12

Fleet : FLT03: Russian trawl

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988
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	1.38	-.07	-.07	1.04
10	99.99	99.99	99.99	99.99	99.99	.36	.12	.93	1.37
11	99.99	99.99	99.99	99.99	99.99	1.49	-.36	.99	2.03
12	99.99	99.99	99.99	99.99	99.99	1.02	.03	.45	1.44
13	99.99	99.99	99.99	99.99	99.99	99.99	-.31	1.28	.88
14	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Table 3.13 (continued)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	.24	.39	-.03	-.32	.40	.32	.08	-.37	-.56	-1.17
10	.33	.70	-.46	.01	-.39	.09	.03	-.15	-.71	-.96
11	.20	1.14	.19	-.13	-1.16	-1.43	.11	-.67	-.26	-.13
12	99.99	.23	.72	.43	-.33	-.09	-1.98	-.73	-.29	.54
13	99.99	99.99	.32	99.99	.55	.56	-1.97	99.99	99.99	-.58
14	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

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

Age	9	10	11	12	13	14
Mean Log q	-2.9798	-3.0030	-3.4445	-4.0828	-4.9019	.0000
S.E(Log q)	.6048	.6269	.9419	.8788	1.0746	.0000

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e.	Mean Q
9	1.26	-1.110	1.50	.67	14	.75	-2.98
10	1.26	-1.247	1.80	.72	14	.77	-3.00
11	2.27	-3.997	-.60	.51	14	1.37	-3.44
12	2.55	-4.303	1.35	.47	13	1.34	-4.08
13	18.82	-1.781	6.74	.00	8	17.13	-4.90
14	.00	.000	.00	.00	0	.00	.00

Fleet : FLT04: NorBarTrSur r

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	
1	.10	-2.08	-1.66	.85	.57	.67	1.08	.41	-1.17	
2	-.36	.04	-.14	.00	.12	.60	.80	.77	.25	
3	-.06	-.02	.51	-.10	.20	.05	.22	.25	.50	
4	.34	.29	.71	.23	-.02	-.01	-.34	-.08	.00	
5	-.16	.07	.51	.27	-.02	-.13	-.40	-.40	.01	
6	-.45	.05	-.07	-.07	-.12	-.69	-.68	-.56	-.09	
7	-.68	-.21	-.15	-1.35	-1.34	-.99	-.46	-.28	-.26	
8	-.67	-.77	.92	-2.11	-1.05	99.99	99.99	99.99	-.37	
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 (continued)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.57	-.14	.51	.00	-.13	.14	-.29	-.20	.20	.12
2	-.43	-.61	-.29	-.10	-.01	.09	.05	-.22	.02	-.01
3	.03	-.36	-.45	-.30	.12	.12	.01	-.13	.12	.00
4	.22	.10	-.54	.02	-.03	.25	.09	.18	-.03	-.19
5	.01	.23	-.04	-.23	-.27	.00	.13	-.01	.16	-.11
6	.01	.10	-.12	-.09	.00	.55	.17	.16	.25	.01
7	-.57	.11	.09	.36	.15	.43	.21	.11	.36	.32
8	.35	-.69	-.62	.50	.54	.51	.05	.39	.11	-.27
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	-6.3345	-6.7519	-7.0313
S.E(Log q)	.3065	.4563	.5786

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	1.351	7.36	.88	19	.57	-5.87
2	.75	1.742	7.83	.82	19	.38	-5.76
3	.79	1.632	7.32	.85	19	.26	-5.74
4	.73	2.192	7.71	.87	19	.24	-5.85
5	.73	2.458	7.69	.89	19	.21	-6.04

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.76	2.183	7.60	.90	19	.20	-6.33
7	.71	2.124	7.99	.84	19	.28	-6.75
8	1.19	-6.09	6.46	.55	16	.71	-7.03

Fleet : FLT05: NorBarLofAcSu

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	
1	99.99	99.99	99.99	99.99	.62	.66	-.60	.05	-1.18	
2	99.99	99.99	99.99	99.99	.33	.35	.08	.29	.07	
3	99.99	99.99	99.99	99.99	.45	.16	-.18	-.11	.17	
4	99.99	99.99	99.99	99.99	.00	.14	-.31	-.78	-.40	
5	99.99	99.99	99.99	99.99	.14	-.26	-.58	-1.22	-.18	
6	99.99	99.99	99.99	99.99	.67	-.05	-1.73	-1.25	-.33	
7	99.99	99.99	99.99	99.99	.16	.04	.03	-2.50	-.30	
8	99.99	99.99	99.99	99.99	-.25	-1.53	-.30	99.99	-.45	
9	99.99	99.99	99.99	99.99	.18	99.99	99.99	-1.21	-.83	
10	99.99	99.99	99.99	99.99	.23	-.93	99.99	99.99	99.99	
11	99.99	99.99	99.99	99.99	99.99	-1.34	99.99	99.99	.54	
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 (continued)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.74	.29	.88	.50	.20	-.05	-.59	-.65	.45	.36
2	-.32	-.12	.01	.24	.21	-.11	-.18	-.29	.06	-.06
3	-.03	-.03	-.11	.07	.37	-.08	-.20	-.08	.23	-.30
4	.05	.22	-.39	.48	.44	.32	-.11	.02	.15	-.28
5	.00	.38	-.08	.22	.78	.36	.09	-.24	.27	-.51
6	.14	.43	.42	.56	.11	.24	.02	-.04	.13	-.21
7	-.37	.18	.57	.92	.45	-.29	-.30	.08	.11	.31
8	-.93	-.59	1.11	1.34	.63	.50	-.72	-.40	.01	.08
9	.46	-1.37	.31	1.25	.36	.88	-.60	-.36	.29	.02
10	99.99	-.43	.40	.27	.37	.35	.04	99.99	-.45	-.25
11	99.99	99.99	-.67	-.55	-.06	.19	.51	.34	99.99	.26
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	-5.5687	-5.4491	-5.3444	-5.4588	-4.6525	-4.0292
S.E(Log q)	.5546	.7095	.7758	.7807	.4119	.5488

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	.79	1.514	8.16	.85	15	.64	-6.30
2	.61	4.416	9.13	.93	15	.22	-6.06
3	.68	2.734	8.24	.89	15	.22	-5.96
4	.80	.968	7.28	.72	15	.37	-5.96
5	.97	.118	6.07	.59	15	.49	-5.87

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.93	.242	6.01	.54	15	.54	-5.57
7	.72	1.087	6.97	.62	15	.51	-5.45
8	.61	2.676	7.15	.84	14	.37	-5.34
9	.64	3.115	6.69	.89	13	.36	-5.46
10	.82	2.090	5.28	.95	10	.28	-4.65
11	.94	.368	4.19	.88	9	.55	-4.03

Fleet : FLT06: NorSvaTrSur r

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	99.99	99.99	99.99	1.42	1.63	1.46	.23	1.06	-1.85
2	99.99	99.99	99.99	-.32	.44	.57	.91	.99	.71
3	99.99	99.99	99.99	-.60	-1.23	.16	.26	1.17	.48
4	99.99	99.99	99.99	-.20	-.57	-.18	-.13	.23	.30
5	99.99	99.99	99.99	-1.05	-.30	.34	-.33	-.05	-.24
6	99.99	99.99	99.99	-1.24	-.95	.15	-.64	-.21	-.29
7	99.99	99.99	99.99	-1.60	-1.51	-.66	-.65	-.87	-.31
8	99.99	99.99	99.99	-.79	-.77	-.20	-.64	-.25	-1.14
9	No data for this fleet at this age								
10	No data for this fleet at this age								
11	No data for this fleet at this age								
12	No data for this fleet at this age								
13	No data for this fleet at this age								
14	No data for this fleet at this age								

Table 3.13 (continued)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-1.84	.27	.48	.28	-.54	-.47	.16	.04	.02	.45
2	-1.27	-.68	-.10	-.08	-.04	.04	-.19	-.14	-.28	.51
3	.03	-.67	-.45	-.17	-.16	-.08	.28	.29	-.30	.32
4	.08	.16	-.58	.13	-.31	-.41	.20	.27	.06	.35
5	-.21	.47	.12	-.32	-.17	-.08	.38	.09	-.19	.42
6	-.43	.25	.36	-.39	-.85	.66	.88	.43	-.21	.33
7	-.40	.09	.39	.07	-.28	.42	1.31	.77	-.34	-.05
8	-.39	-.30	.39	-.20	-.17	.45	1.39	.61	-.03	-.18
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	-6.6693	-6.5395	-6.5999
S.E(Log q)	.5666	.6740	.6289

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	.617	8.27	.72	16	.93	-7.30
2	.58	1.755	9.75	.63	16	.60	-6.68
3	.64	1.388	8.91	.60	16	.50	-6.56
4	.66	1.957	8.79	.77	16	.33	-6.76
5	.77	1.310	7.98	.77	16	.33	-6.70

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	.71	1.398	8.13	.70	16	.39	-6.67
7	.66	1.655	8.04	.71	16	.41	-6.54
8	.85	.773	7.11	.72	16	.54	-6.60

Fleet disaggregated estimates of survivors :

Age 1 Catchability dependent on age and year class strength

Year class = 1997

Table 3.13 (continued)

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F	
FLT01: Russian Trawl,	1700677.,	.838,	.000,	.00,	1,	.067,	1.202
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	1095498.,	.593,	.000,	.00,	1,	.135,	1.528
FLT05: NorBarLofAcSu,	1393112.,	.667,	.000,	.00,	1,	.106,	1.345
FLT06: NorSvaTrSur r,	1518474.,	.975,	.000,	.00,	1,	.050,	1.282
P shrinkage mean ,	1059136.,	.77,,,,				.402,	1.555
F shrinkage mean ,	514635.,	1.00,,,,				.240,	2.162
Weighted prediction :							
Survivors,	Int,	Ext,	N,	Var,	F		
at end of year,	s.e,	s.e,	,	Ratio,			
967973.,	.41,	.22,	6,	.542,	1.626		

Age 2 Catchability dependent on age and year class strength

Year class = 1996

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F	
FLT01: Russian Trawl,	1059405.,	.588,	.106,	.18,	2,	.094,	.357
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	628142.,	.381,	.036,	.10,	2,	.225,	.544
FLT05: NorBarLofAcSu,	596262.,	.296,	.060,	.20,	2,	.378,	.566
FLT06: NorSvaTrSur r,	1033720.,	.616,	.086,	.14,	2,	.086,	.364
P shrinkage mean ,	499040.,	.60,,,,				.160,	.647
F shrinkage mean ,	337727.,	1.00,,,,				.058,	.852
Weighted prediction :							
Survivors,	Int,	Ext,	N,	Var,	F		
at end of year,	s.e,	s.e,	,	Ratio,			
627795.,	.20,	.10,	10,	.513,	.544		

Age 3 Catchability dependent on age and year class strength

Year class = 1995

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F	
FLT01: Russian Trawl,	662043.,	.297,	.085,	.29,	3,	.222,	.275
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	467919.,	.263,	.015,	.06,	3,	.268,	.370
FLT05: NorBarLofAcSu,	375555.,	.238,	.109,	.46,	3,	.303,	.444
FLT06: NorSvaTrSur r,	578100.,	.455,	.165,	.36,	3,	.087,	.309
P shrinkage mean ,	320074.,	.58,,,,				.090,	.504
F shrinkage mean ,	543265.,	1.00,,,,				.030,	.326
Weighted prediction :							
Survivors,	Int,	Ext,	N,	Var,	F		
at end of year,	s.e,	s.e,	,	Ratio,			
467393.,	.14,	.08,	14,	.542,	.371		

Table 3.13 (continued)

Age 4 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Weights,	Scaled, Weights,	Estimated, F		
FLT01: Russian Trawl,	234510.,	.208,	.139,	.67,	4,	.262,	.410		
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000		
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000		
FLT04: NorBarTrSur r,	216617.,	.201,	.089,	.45,	4,	.274,	.438		
FLT05: NorBarLofAcSu,	220036.,	.206,	.148,	.72,	4,	.233,	.432		
FLT06: NorSvaTrSur r,	276806.,	.280,	.163,	.58,	4,	.151,	.357		
P shrinkage mean	207464.,	.58,,,,				.060,	.453		
F shrinkage mean	429106.,	1.00,,,,				.020,	.245		

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
232908.,	.11,	.06,	18,	.568,	.413

Age 5 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Weights,	Scaled, Weights,	Estimated, F		
FLT01: Russian Trawl,	61711.,	.198,	.055,	.28,	5,	.213,	.558		
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000		
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000		
FLT04: NorBarTrSur r,	68345.,	.172,	.026,	.15,	5,	.312,	.516		
FLT05: NorBarLofAcSu,	66395.,	.199,	.119,	.60,	5,	.191,	.527		
FLT06: NorSvaTrSur r,	95369.,	.220,	.092,	.42,	5,	.204,	.394		
P shrinkage mean	121471.,	.57,,,,				.061,	.322		
F shrinkage mean	95973.,	1.00,,,,				.019,	.392		

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
74200.,	.10,	.05,	22,	.557,	.483

Age 6 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, Weights,	Scaled, Weights,	Estimated, F		
FLT01: Russian Trawl,	28074.,	.205,	.043,	.21,	6,	.199,	.847		
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000		
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000		
FLT04: NorBarTrSur r,	39439.,	.165,	.036,	.22,	6,	.384,	.667		
FLT05: NorBarLofAcSu,	34392.,	.207,	.079,	.38,	6,	.190,	.736		
FLT06: NorSvaTrSur r,	40081.,	.220,	.105,	.48,	6,	.195,	.660		
F shrinkage mean	47439.,	1.00,,,,				.032,	.582		

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
36234.,	.10,	.04,	25,	.415,	.710

Table 3.13 (continued)

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

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F	
FLT01: Russian Trawl,	22317.,	.202,	.152,	.75,	7,	.190,	.885
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	37331.,	.160,	.051,	.32,	7,	.384,	.615
FLT05: NorBarLofAcSu,	33322.,	.201,	.080,	.40,	7,	.202,	.669
FLT06: NorSvaTrSur r,	32342.,	.226,	.056,	.25,	7,	.184,	.684
F shrinkage mean ,	24125.,	1.00,,,,				.040,	.840

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	, Ratio,		
31666.,	.10,	.05,	29,	.531,	.694

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

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F	
FLT01: Russian Trawl,	12798.,	.222,	.263,	1.18,	8,	.178,	1.05
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	19583.,	.167,	.081,	.49,	8,	.362,	.802
FLT05: NorBarLofAcSu,	21828.,	.214,	.067,	.31,	8,	.203,	.743
FLT06: NorSvaTrSur r,	16540.,	.249,	.118,	.47,	8,	.196,	.898
F shrinkage mean ,	15399.,	1.00,,,,				.061,	.941

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	, Ratio,		
17693.,	.11,	.07,	33,	.620,	.859

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

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F	
FLT01: Russian Trawl,	2209.,	.222,	.189,	.85,	8,	.100,	1.310
FLT02: Norwegian tra,	3529.,	.759,	.000,	.00,	1,	.088,	.991
FLT03: Russian trawl,	706.,	.631,	.000,	.00,	1,	.128,	2.248
FLT04: NorBarTrSur r,	2303.,	.168,	.059,	.35,	8,	.199,	1.280
FLT05: NorBarLofAcSu,	2466.,	.355,	.044,	.13,	9,	.189,	1.231
FLT06: NorSvaTrSur r,	2487.,	.244,	.151,	.62,	8,	.112,	1.225
F shrinkage mean ,	3658.,	1.00,,,,				.184,	.969

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	, Ratio,		
2278.,	.23,	.09,	36,	.405,	1.288

Table 3.13 (continued)

Age 10 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, Weights,	Scaled, Weights,	Estimated F
FLT01: Russian Trawl,	309.,	.243,	.167,	.69,	8,	.035,	1.347
FLT02: Norwegian tra,	470.,	.786,	.352,	.45,	2,	.068,	1.054
FLT03: Russian trawl,	112.,	.533,	.162,	.30,	2,	.172,	2.184
FLT04: NorBarTrSur r,	319.,	.185,	.132,	.71,	8,	.070,	1.323
FLT05: NorBarLofAcSu,	220.,	.366,	.062,	.17,	10,	.367,	1.609
FLT06: NorSvaTrSur r,	383.,	.267,	.212,	.79,	8,	.040,	1.192

F shrinkage mean , 501., 1.00,,,, .248, 1.013

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
268.,	.30,	.10,	39,	.327,	1.453

Age 11 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, Weights,	Scaled, Weights,	Estimated F
FLT01: Russian Trawl,	85.,	.252,	.196,	.78,	8,	.021,	1.136
FLT02: Norwegian tra,	92.,	.806,	.081,	.10,	3,	.095,	1.088
FLT03: Russian trawl,	61.,	.584,	.178,	.30,	3,	.160,	1.370
FLT04: NorBarTrSur r,	77.,	.188,	.115,	.61,	8,	.041,	1.207
FLT05: NorBarLofAcSu,	87.,	.388,	.106,	.27,	11,	.397,	1.120
FLT06: NorSvaTrSur r,	112.,	.286,	.361,	1.26,	8,	.023,	.958

F shrinkage mean , 101., 1.00,,,, .263, 1.023

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
86.,	.33,	.05,	42,	.163,	1.128

Age 12 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, Weights,	Scaled, Weights,	Estimated F
FLT01: Russian Trawl,	36.,	.215,	.105,	.49,	8,	.018,	1.018
FLT02: Norwegian tra,	20.,	.691,	.330,	.48,	4,	.245,	1.431
FLT03: Russian trawl,	44.,	.633,	.196,	.31,	4,	.248,	.886
FLT04: NorBarTrSur r,	37.,	.161,	.075,	.46,	8,	.035,	1.003
FLT05: NorBarLofAcSu,	32.,	.272,	.146,	.54,	9,	.029,	1.090
FLT06: NorSvaTrSur r,	38.,	.230,	.116,	.51,	8,	.019,	.987

F shrinkage mean , 36., 1.00,,,, .406, 1.012

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
33.,	.47,	.07,	42,	.154,	1.075

Table 3.13 (continued)

Age 13 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: Russian Trawl,	22.,	.218,	.096,	.44,	8,	.010,	1.037
FLT02: Norwegian tra,	13.,	.660,	.130,	.20,	5,	.234,	1.407
FLT03: Russian trawl,	10.,	.706,	.114,	.16,	5,	.172,	1.615
FLT04: NorBarTrSur r,	20.,	.165,	.094,	.57,	8,	.018,	1.081
FLT05: NorBarLofAcSu,	20.,	.337,	.065,	.19,	11,	.084,	1.091
FLT06: NorSvaTrSur r,	19.,	.230,	.104,	.45,	8,	.010,	1.131
F shrinkage mean ,	19.,	1.00,,,,				.471,	1.141
Weighted prediction :							
Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F		
16.,	.51,	.05,	46,	.104,	1.272		

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

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e.,	Ext, s.e.,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Russian Trawl,	8.,	.229,	.109,	.48,	8,	.005,	1.358
FLT02: Norwegian tra,	4.,	.733,	.462,	.63,	6,	.221,	1.955
FLT03: Russian trawl,	5.,	.599,	.253,	.42,	4,	.034,	1.716
FLT04: NorBarTrSur r,	8.,	.172,	.074,	.43,	8,	.010,	1.294
FLT05: NorBarLofAcSu,	11.,	.320,	.077,	.24,	11,	.034,	1.115
FLT06: NorSvaTrSur r,	8.,	.238,	.149,	.63,	8,	.006,	1.304
F shrinkage mean ,	9.,	1.00,,,,				.690,	1.259
Weighted prediction :							
Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F		
7.,	.71,	.12,	46,	.163,	1.412		

Table 3.14

Run title : Arctic Cod (run: XSABJA29/X29)

At 30/08/1999 21:07

Terminal Fs derived using XSA (With F shrinkage)

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

Table 8	Fishing mortality (F) at age									
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
AGE										
1,	.0000,	.0000,	.0007,	.0000,	.0000,	.0000,	.0000,	.0001,	.0011,	.0000,
2,	.0000,	.0001,	.0012,	.0007,	.0001,	.0000,	.0007,	.0017,	.0063,	.0034,
3,	.0023,	.0020,	.0252,	.0224,	.0331,	.0197,	.0158,	.0267,	.0238,	.0712,
4,	.0209,	.0320,	.1603,	.1656,	.1320,	.1447,	.0831,	.1282,	.1119,	.2577,
5,	.1497,	.1165,	.2638,	.3690,	.2283,	.2670,	.2841,	.4536,	.2080,	.3606,
6,	.3644,	.2921,	.2792,	.5538,	.3109,	.3309,	.5309,	.6892,	.4810,	.5504,
7,	.5105,	.4070,	.4213,	.5352,	.3262,	.3947,	.5101,	.6167,	.5466,	.5269,
8,	.3849,	.3473,	.4007,	.4316,	.3498,	.2509,	.5850,	.6816,	.6360,	.4546,
9,	.4044,	.4711,	.5058,	.5720,	.4133,	.4427,	.5905,	.6499,	.5354,	.4609,
10,	.4015,	.5495,	.5101,	.7665,	.5246,	.7064,	.7918,	.7661,	.6235,	.7143,
11,	.7328,	1.0438,	.5304,	1.0193,	.7069,	.7744,	.9332,	.9536,	.9388,	.8189,
12,	.5180,	1.0030,	.6557,	1.2790,	.6073,	.7502,	.7113,	1.3990,	.9198,	.9930,
13,	.6598,	.5540,	.7159,	.8405,	.5375,	.7378,	.6918,	1.1392,	1.5206,	.4791,
14,	.5478,	.7313,	.5886,	.9051,	.5626,	.6887,	.7510,	.9927,	.9175,	.6998,
+gp,	.5478,	.7313,	.5886,	.9051,	.5626,	.6887,	.7510,	.9927,	.9175,	.6998,
FBAR 5-10,	.3692,	.3639,	.3968,	.5380,	.3589,	.3988,	.5487,	.6429,	.5051,	.5113,

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Run title : Arctic Cod (run: XSABJA29/X29)

At 30/08/1999 21:07

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age									
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.0005,	.0005,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0029,	.0069,	.0021,	.0032,	.0000,	.0008,	.0014,	.0006,	.0008,	.0000,
3,	.0529,	.0538,	.0556,	.0658,	.0310,	.0172,	.0223,	.0394,	.0296,	.0242,
4,	.2551,	.2246,	.2695,	.3040,	.2350,	.1437,	.1101,	.1028,	.1515,	.2057,
5,	.5085,	.3459,	.4910,	.6469,	.7399,	.3514,	.3883,	.2103,	.1797,	.4073,
6,	.5094,	.4590,	.5144,	.8233,	1.0064,	.4803,	.4458,	.3781,	.2007,	.4649,
7,	.5227,	.4319,	.5255,	.6057,	.9669,	.5728,	.3962,	.4655,	.4261,	.3984,
8,	.4967,	.4814,	.6849,	.6528,	.8744,	.7204,	.5204,	.5652,	.6729,	.5186,
9,	.6053,	.3868,	.7317,	.7987,	.9372,	1.0555,	.6973,	.6965,	.8392,	.7784,
10,	.7103,	.7197,	.7765,	.9690,	1.3060,	.8360,	.7804,	.7255,	.8304,	.7309,
11,	.6082,	.9167,	.9493,	.7999,	1.3766,	1.0867,	.7376,	.4685,	.9118,	.5904,
12,	.6339,	.6988,	1.1541,	.8511,	.8899,	.9400,	.5132,	.6208,	.9341,	.3900,
13,	.6787,	.4842,	.9413,	.9624,	.6846,	1.0840,	1.3556,	.6567,	.8836,	1.3487,
14,	.6532,	.6470,	.9205,	.8856,	1.0509,	1.0118,	.8253,	.6393,	.8893,	.7754,
+gp,	.6532,	.6470,	.9205,	.8856,	1.0509,	1.0118,	.8253,	.6393,	.8893,	.7754,
FBAR 5-10,	.5588,	.4708,	.6207,	.7494,	.9718,	.6694,	.5381,	.5069,	.5248,	.5497,

Table 3.14 (continued)

Table 8		Fishing mortality (F) at age								
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0001,	.0000,	.0008,	.0000,	.0000,
2,	.0013,	.0013,	.0019,	.0023,	.0140,	.0302,	.0017,	.0049,	.0157,	.0036,
3,	.0228,	.0406,	.0212,	.0390,	.1949,	.2126,	.0829,	.1646,	.1330,	.1451,
4,	.2209,	.1416,	.1022,	.1661,	.1981,	.4952,	.2087,	.3099,	.5652,	.2221,
5,	.4798,	.3821,	.2277,	.2965,	.3516,	.5356,	.5202,	.4766,	.7531,	.6675,
6,	.5367,	.5703,	.2355,	.3844,	.3903,	.5050,	.7002,	.5706,	.6802,	.8486,
7,	.7676,	.6192,	.5174,	.3140,	.4205,	.4432,	.7011,	.6935,	.6759,	.8468,
8,	.9268,	.8375,	.8320,	.6674,	.6424,	.4861,	.7020,	.8841,	.9059,	.9344,
9,	1.1442,	.9598,	.9326,	1.1402,	1.0097,	.4055,	.6122,	.7731,	1.2154,	1.2942,
10,	.9990,	.9964,	.7684,	1.2436,	.7421,	.9799,	.4724,	.4603,	.7656,	.9891,
11,	1.1652,	.7073,	.6722,	1.2207,	.5912,	1.0088,	1.2006,	.3074,	.6260,	1.8535,
12,	.9659,	.4561,	.5555,	.7818,	.6319,	.6318,	.8564,	1.0504,	.2401,	1.5011,
13,	.8623,	.7110,	.5185,	1.1510,	.4038,	1.7923,	1.4780,	.5108,	.9852,	2.4654,
14,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,	.7741,	1.6427,
+gp,	1.0392,	.7738,	.6959,	1.1206,	.6821,	.9745,	.9341,	.6259,	.7741,	1.6427,
FBAR 5-10,	.8090,	.7276,	.5856,	.6743,	.5928,	.5592,	.6180,	.6430,	.8327,	.9301,

Table 8		Fishing mortality (F) at age								
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.0000,	.0001,	.0000,	.0000,	.0000,	.2485,	.3610,	.5173,	.5238,	.7960,
2,	.0015,	.0024,	.0012,	.0005,	.0002,	.0375,	.0575,	.8044,	.7981,	1.094,
3,	.0485,	.0315,	.0249,	.0666,	.0206,	.0199,	.0533,	.1449,	.1134,	.0629,
4,	.2077,	.1285,	.0993,	.2101,	.2035,	.1239,	.1706,	.2123,	.2274,	.1267,
5,	.3457,	.3542,	.2280,	.3020,	.3275,	.3072,	.3779,	.4952,	.5101,	.3681,
6,	.5423,	.6211,	.5137,	.5486,	.4993,	.6241,	.6043,	.7105,	.9440,	.5978,
7,	.6597,	.6660,	.8485,	.7971,	.7775,	1.1347,	.9141,	.9452,	1.1621,	1.0683,
8,	.7548,	.7032,	1.0498,	.9910,	1.0280,	1.2043,	1.0151,	1.0565,	1.0062,	1.0404,
9,	1.0530,	.8763,	1.2534,	1.0705,	.9867,	1.2603,	.7672,	.8206,	.7201,	1.1317,
10,	.9510,	1.0902,	1.0215,	.7074,	.7456,	1.0002,	.5039,	1.0703,	1.2881,	1.3266,
11,	1.2652,	1.3351,	1.0958,	.5956,	.5215,	.6653,	.4578,	.8682,	.9235,	1.3751,
12,	1.3534,	.8552,	.7982,	1.2624,	.3168,	.8180,	.1974,	1.2173,	1.1655,	1.1526,
13,	.8286,	1.6982,	1.4842,	.4614,	1.1725,	.3588,	.3758,	.2323,	.5951,	.7149,
14,	1.1031,	1.1853,	1.1442,	.8279,	.7560,	.8290,	.4220,	.9444,	1.1176,	1.0854,
+gp,	1.1031,	1.1853,	1.1442,	.8279,	.7560,	.8290,	.4220,	.9444,	1.1176,	1.0854,
FBAR 5-10,	.7177,	.7185,	.8191,	.7361,	.7274,	.9218,	.6971,	.8497,	.9384,	.9222,

Table 8		Fishing mortality (F) at age									
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
1,	.2170,	.0487,	.1011,	.4631,	2.5370,	1.7470,	1.8621,	1.9844,	2.5253,	1.6264,	2.0454,
2,	.0020,	.0597,	.2348,	.1422,	.4398,	.6459,	.9057,	1.0514,	1.1734,	.5442,	.9230,
3,	.0327,	.0086,	.0183,	.0406,	.0782,	.2063,	.5382,	.4494,	.3500,	.3706,	.3900,
4,	.1283,	.0622,	.0624,	.1266,	.0965,	.1979,	.2953,	.3394,	.2880,	.4126,	.3467,
5,	.2654,	.1341,	.1874,	.2204,	.3471,	.3410,	.3263,	.3963,	.5383,	.4834,	.4727,
6,	.3979,	.2303,	.3208,	.4425,	.4592,	.6472,	.5788,	.5194,	.6793,	.7096,	.6361,
7,	.7172,	.2473,	.4241,	.5390,	.5656,	1.1653,	.8952,	.7563,	.7730,	.6944,	.7413,
8,	.9436,	.3756,	.3392,	.5951,	.5965,	.9836,	.9371,	.8724,	1.2663,	.8590,	.9992,
9,	.8200,	.3404,	.3826,	.4443,	.6578,	1.0495,	.9548,	.7403,	1.3874,	1.2877,	1.1385,
10,	.9216,	.4093,	.2957,	.4626,	.6341,	1.0079,	1.0066,	.9220,	1.4359,	1.4527,	1.2702,
11,	.3107,	.4717,	.1811,	.3001,	.6867,	1.0396,	1.1381,	.8394,	1.3543,	1.1284,	1.1074,
12,	.5847,	.1778,	.1622,	.5348,	.9427,	1.1583,	.8427,	.7082,	1.3488,	1.0751,	1.0440,
13,	.0391,	.5939,	.0160,	.0553,	1.0893,	.9526,	.9045,	1.1415,	1.5509,	1.2721,	1.3215,
14,	.3948,	.2791,	.1804,	.1947,	.7112,	1.2963,	1.0761,	1.1386,	1.4518,	1.4124,	1.3342,
+gp,	.3948,	.2791,	.1804,	.1947,	.7112,	1.2963,	1.0761,	1.1386,	1.4518,	1.4124,	1.3342,
FBAR 5-10	.6776,	.2895,	.3250,	.4506,	.5434,	.8657,	.7831,	.7011,	1.0134,	.9145,	

Table 3.15

Run title : Arctic Cod (run: XSABJA29/X29)

At 30/08/1999 21:07

Terminal Fs derived using XSA (With F shrinkage)

Run title : Arctic Cod (run: XSABJA29/X29)

At 30/08/1999 21:07

Terminal Fs derived using XSA (With F shrinkage)

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

Table 10	Stock number at age (start of year)					Numbers*10** ⁻⁴				
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
AGE										
1,	163378,	179535,	240135,	97038,	41110,	66355,	121461,	75345,	103765,	119663,
2,	86903,	133763,	146991,	196460,	79448,	33658,	54327,	99444,	61680,	84866,
3,	47104,	71150,	109508,	120199,	160739,	65039,	27556,	44450,	81282,	50183,
4,	36396,	38476,	58137,	87424,	96230,	127312,	52211,	22208,	35432,	64981,
5,	27998,	29183,	30510,	40547,	60655,	69045,	90194,	39340,	15995,	25939,
6,	36371,	19737,	21265,	19187,	22954,	39522,	43283,	55582,	20464,	10636,
7,	23022,	20684,	12066,	13169,	9029,	13772,	23242,	20839,	22843,	10357,
8,	10284,	11313,	11273,	6483,	6313,	5335,	7598,	11425,	9209,	10827,
9,	4388,	5730,	6545,	6182,	3447,	3643,	3398,	3466,	4731,	3991,
10,	1874,	2398,	2929,	3231,	2857,	1867,	1916,	1542,	1481,	2268,
11,	1833,	1027,	1133,	1440,	1229,	1384,	754,	711,	587,	650,
12,	3596,	721,	296,	546,	425,	496,	522,	243,	224,	188,
13,	837,	1754,	217,	126,	124,	190,	192,	210,	49,	73,
14,	497,	354,	825,	87,	44,	60,	74,	79,	55,	9,
+gp,	562,	305,	150,	191,	40,	27,	26,	29,	31,	31,
TOTAL,	445043,	516130,	641979,	592310,	484646,	427704,	426755,	374910,	357829,	384663,

Run title : Arctic Cod (run: XSABJA29/X29)

At 30/08/1999 21:07

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)					Numbers*10** ⁻⁴				
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	139570,	110133,	71502,	51084,	117419,	238801,	194890,	25566,	16842,	29709,
2,	97971,	114217,	90127,	58540,	41824,	96135,	195505,	159562,	20932,	13789,
3,	69247,	79977,	92866,	73636,	47774,	34242,	78647,	159838,	130560,	17124,
4,	38262,	53772,	62052,	71918,	56450,	37920,	27556,	62968,	125803,	103775,
5,	41115,	24274,	35169,	38801,	43448,	36537,	26892,	20208,	46519,	88517,
6,	14808,	20245,	14063,	17623,	16635,	16973,	21051,	14932,	13407,	31822,
7,	5022,	7285,	10474,	6884,	6334,	4978,	8596,	11036,	8377,	8981,
8,	5007,	2438,	3873,	5070,	3075,	1972,	2299,	4736,	5673,	4479,
9,	5626,	2494,	1233,	1598,	2161,	1050,	786,	1118,	2203,	2370,
10,	2061,	2515,	1387,	486,	589,	693,	299,	320,	456,	779,
11,	909,	829,	1002,	522,	151,	131,	246,	112,	127,	163,
12,	235,	405,	272,	318,	192,	31,	36,	96,	58,	42,
13,	57,	102,	165,	70,	111,	65,	10,	18,	42,	19,
14,	37,	24,	51,	53,	22,	46,	18,	2,	8,	14,
+gp,	22,	52,	20,	19,	26,	22,	35,	16,	3,	9,
TOTAL,	419951,	418762,	384256,	326622,	336211,	469597,	556865,	460530,	371009,	301591,

Table 3.15 (continued)

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10 ^{**} -4				
	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	61126,	153496,	274668,	80199,	96751,	92889,	52684,	97805,	30065,	20835,
2,	24323,	50045,	125672,	224876,	65661,	79213,	76040,	43134,	80012,	24615,
3,	11290,	19889,	40920,	102691,	183687,	53010,	62922,	62150,	35142,	64487,
4,	13684,	9034,	15636,	32801,	80861,	123765,	35089,	47419,	43162,	25190,
5,	69167,	8983,	6420,	11558,	22744,	54305,	61754,	23318,	28478,	20082,
6,	48225,	35047,	5019,	4186,	7035,	13102,	26024,	30052,	11853,	10979,
7,	16367,	23084,	16223,	3247,	2333,	3899,	6474,	10578,	13906,	4916,
8,	4937,	6219,	10175,	7918,	1942,	1255,	2049,	2629,	4329,	5792,
9,	2183,	1600,	2204,	3625,	3326,	836,	632,	832,	889,	1432,
10,	891,	569,	502,	710,	949,	992,	456,	280,	314,	216,
11,	307,	269,	172,	190,	168,	370,	305,	233,	145,	120,
12,	74,	78,	108,	72,	46,	76,	110,	75,	140,	63,
13,	23,	23,	41,	51,	27,	20,	33,	38,	22,	90,
14,	4,	8,	9,	20,	13,	15,	3,	6,	19,	7,
+gp,	8,	7,	5,	6,	12,	11,	7,	12,	11,	7,
TOTAL,	252608,	308353,	497775,	472151,	465556,	423757,	324583,	318562,	248487,	178830,

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10 ^{**} -4				
	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	22864,	22941,	25126,	59956,	81859,	213069,	138419,	114889,	49092,	81533,
2,	17058,	18720,	18779,	20572,	49087,	67020,	136057,	78991,	56075,	23805,
3,	20080,	13945,	15290,	15356,	16834,	40182,	52853,	105166,	28931,	20668,
4,	45665,	15662,	11064,	12210,	11763,	13501,	32249,	41026,	74485,	21146,
5,	16516,	30377,	11277,	8202,	8103,	7858,	9765,	22262,	27166,	48577,
6,	8434,	9570,	17452,	7351,	4965,	4781,	4732,	5479,	11108,	13355,
7,	3848,	4015,	4210,	8549,	3477,	2467,	2097,	2117,	2205,	3538,
8,	1726,	1629,	1689,	1476,	3154,	1308,	649,	688,	674,	565,
9,	1863,	664,	660,	484,	448,	924,	321,	193,	196,	202,
10,	321,	532,	226,	154,	136,	137,	214,	122,	69,	78,
11,	66,	102,	146,	67,	62,	53,	41,	106,	34,	16,
12,	15,	15,	22,	40,	30,	30,	22,	21,	36,	11,
13,	12,	3,	5,	8,	9,	18,	11,	15,	5,	9,
14,	6,	4,	0,	1,	4,	2,	10,	6,	10,	2,
+gp,	7,	1,	0,	1,	1,	2,	3,	2,	3,	1,
TOTAL,	138481,	118180,	105948,	134425,	179933,	351351,	377446,	371086,	250089,	213507,

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10 ^{**} -4							
	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,GMST46-96	AMST 46-96	
AGE													
1,	81890,	144229,	175544,	307107,	2430475,	970354,	2047009,	2901562,	2016581,	601267,	0,	105976,	260284,
2,	30116,	53967,	112469,	129898,	158232,	157408,	138472,	260357,	326547,	132141,	96797,	66910,	85302,
3,	17471,	24608,	41624,	72812,	92259,	83453,	67556,	45833,	74486,	82698,	62780,	49262,	61425,
4,	15890,	13844,	19974,	33461,	57241,	69851,	55587,	32289,	23942,	42976,	46739,	38201,	47365,
5,	15252,	11443,	10651,	15364,	24137,	42553,	46921,	33874,	18827,	14696,	23291,	26644,	32612,
6,	27525,	9577,	8193,	7231,	10092,	13966,	24774,	27720,	18659,	8998,	7420,	15422,	18897,
7,	6014,	15138,	6228,	4867,	3803,	5220,	5986,	11370,	13500,	7745,	3623,	7618,	9568,
8,	995,	2403,	9679,	3337,	2324,	1769,	1333,	2002,	4369,	5102,	3167,	3412,	4641,
9,	163,	317,	1352,	5645,	1507,	1048,	542,	427,	685,	1008,	1769,	1513,	2656,
10,	53,	59,	185,	755,	2964,	639,	300,	171,	167,	140,	228,	628,	1422,
11,	17,	17,	32,	113,	389,	1287,	191,	90,	56,	33,	27,	257,	737,
12,	3,	10,	9,	22,	68,	160,	373,	50,	32,	12,	9,	101,	369,
13,	3,	1,	7,	6,	10,	22,	41,	131,	20,	7,	3,	41,	206,
14,	4,	2,	1,	6,	5,	3,	7,	14,	34,	4,	2,	16,	107,
+gp,	5,	1,	1,	1,	0,	1,	0,	0,	0,	8,	2,		
TOTAL,	195402,	275617,	385949,	580623,	2783505,	1347733,	2389092,	3315889,	2497906,	896834,	245856,		

Table 3.16

Run title : Arctic Cod (run: SVPBJA05/V05)

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Table 4 Natural Mortality (M) at age
YEAR, 1946, 1947, 1948,

AGE	1946,	1947,	1948,
3,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,
14,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age
YEAR, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958,

AGE	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
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,

Run title : Arctic Cod (run: SVPBJA05/V05)

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Table 4 Natural Mortality (M) at age
YEAR, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968,

AGE	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
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 (continued)

Table 4		Natural Mortality (M) at age								
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
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,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2006,	.2004,	.3122,	.2583,	.2087,
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,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
3,	.2000,	.2000,	.2050,	.2068,	.2656,	.3967,	.7281,	.6271,	.5287,	.5186,
4,	.2000,	.2000,	.2000,	.2000,	.2030,	.2942,	.3975,	.4235,	.2943,	.3339,
5,	.2000,	.2000,	.2000,	.2000,	.2026,	.2266,	.2080,	.2774,	.2097,	.2193,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2048,	.2001,	.2056,	.2018,	.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,
14,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 3.17

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

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

Table 8 Fishing mortality (F) at age										
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
AGE										
3,	.0023,	.0020,	.0254,	.0226,	.0334,	.0198,	.0159,	.0269,	.0240,	.0717,
4,	.0210,	.0322,	.1610,	.1663,	.1328,	.1456,	.0836,	.1290,	.1126,	.2588,
5,	.1504,	.1172,	.2649,	.3696,	.2293,	.2683,	.2855,	.4541,	.2093,	.3618,
6,	.3651,	.2932,	.2803,	.5537,	.3120,	.3322,	.5317,	.6884,	.4816,	.5511,
7,	.5109,	.4079,	.4224,	.5356,	.3276,	.3960,	.5111,	.6171,	.5471,	.5274,
8,	.3862,	.3488,	.4020,	.4333,	.3515,	.2527,	.5857,	.6813,	.6365,	.4561,
9,	.4061,	.4728,	.5075,	.5729,	.4160,	.4450,	.5923,	.6503,	.5366,	.4632,
10,	.4043,	.5515,	.5125,	.7663,	.5266,	.7096,	.7926,	.7674,	.6246,	.7143,
11,	.7344,	1.0403,	.5341,	1.0159,	.7076,	.7754,	.9373,	.9519,	.9381,	.8179,
12,	.5184,	1.0011,	.6563,	1.2718,	.6083,	.7511,	.7142,	1.3983,	.9166,	.9897,
13,	.6603,	.5544,	.7174,	.8383,	.5386,	.7379,	.6943,	1.1371,	1.5109,	.4801,
14,	.5480,	.7310,	.5890,	.9050,	.5630,	.6890,	.7510,	.9930,	.9180,	.7000,
+gp,	.5480,	.7310,	.5890,	.9050,	.5630,	.6890,	.7510,	.9930,	.9180,	.7000,
FBAR 5-10,	.3705,	.3652,	.3983,	.5386,	.3605,	.4006,	.5498,	.6431,	.5059,	.5123,

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age										
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
3,	.0534,	.0543,	.0561,	.0662,	.0312,	.0174,	.0225,	.0398,	.0298,	.0244,
4,	.2562,	.2262,	.2714,	.3055,	.2360,	.1445,	.1109,	.1036,	.1525,	.2069,
5,	.5090,	.3474,	.4932,	.6486,	.7385,	.3525,	.3894,	.2117,	.1811,	.4088,
6,	.5106,	.4602,	.5160,	.8237,	1.0025,	.4812,	.4470,	.3797,	.2024,	.4671,
7,	.5241,	.4341,	.5271,	.6079,	.9645,	.5734,	.3980,	.4673,	.4284,	.4012,
8,	.4979,	.4840,	.6873,	.6546,	.8753,	.7205,	.5218,	.5672,	.6742,	.5221,
9,	.6068,	.3890,	.7346,	.8022,	.9358,	1.0530,	.6979,	.6973,	.8395,	.7795,
10,	.7125,	.7213,	.7772,	.9720,	1.3019,	.8351,	.7809,	.7263,	.8296,	.7333,
11,	.6097,	.9184,	.9483,	.8010,	1.3726,	1.0823,	.7375,	.4721,	.9097,	.5924,
12,	.6349,	.7006,	1.1525,	.8511,	.8909,	.9420,	.5148,	.6223,	.9372,	.3923,
13,	.6784,	.4870,	.9410,	.9633,	.6872,	1.0812,	1.3471,	.6584,	.8824,	1.3452,
14,	.6530,	.6470,	.9210,	.8860,	1.0510,	1.0120,	.8250,	.6390,	.8890,	.7750,
+gp,	.6530,	.6470,	.9210,	.8860,	1.0510,	1.0120,	.8250,	.6390,	.8890,	.7750,
FBAR 5-10,	.5602,	.4727,	.6226,	.7515,	.9697,	.6693,	.5392,	.5082,	.5259,	.5520,

Table 3.17 (continued)

Table 8		Fishing mortality (F) at age								
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
3,	.0230,	.0409,	.0213,	.0393,	.1960,	.2137,	.0836,	.1658,	.1339,	.1460,
4,	.2218,	.1422,	.1028,	.1672,	.1995,	.4961,	.2100,	.3120,	.5660,	.2235,
5,	.4809,	.3829,	.2286,	.2977,	.3533,	.5373,	.5215,	.4783,	.7537,	.6679,
6,	.5384,	.5713,	.2368,	.3854,	.3919,	.5072,	.7015,	.5724,	.6813,	.8479,
7,	.7688,	.6214,	.5195,	.3159,	.4217,	.4455,	.7036,	.6962,	.6783,	.8464,
8,	.9271,	.8390,	.8338,	.6701,	.6437,	.4875,	.7042,	.8867,	.9088,	.9357,
9,	1.1416,	.9599,	.9343,	1.1369,	1.0102,	.4089,	.6137,	.7769,	1.2138,	1.2913,
10,	.9966,	.9938,	.7720,	1.2387,	.7436,	.9818,	.4778,	.4636,	.7738,	.9911,
11,	1.1604,	.7081,	.6731,	1.2199,	.5939,	1.0065,	1.1997,	.3136,	.6315,	1.8483,
12,	.9634,	.4587,	.5585,	.7819,	.6391,	.6365,	.8546,	1.0522,	.2469,	1.4950,
13,	.8615,	.7109,	.5224,	1.1459,	.4069,	1.7817,	1.4679,	.5124,	.9914,	2.4481,
14,	1.0390,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,	.6260,	.7740,	1.6430,
+gp,	1.0390,	.7740,	.6960,	1.1210,	.6820,	.9750,	.9340,	.6260,	.7740,	1.6430,
FBAR 5-10,	.8089,	.7281,	.5875,	.6741,	.5941,	.5614,	.6204,	.6457,	.8350,	.9301,

Table 8		Fishing mortality (F) at age								
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	.0489,	.0318,	.0252,	.0671,	.0208,	.0195,	.0533,	.0328,	.0554,	.0546,
4,	.2090,	.1295,	.1003,	.2115,	.2049,	.1251,	.1722,	.2134,	.2282,	.1274,
5,	.3477,	.3562,	.2298,	.3044,	.3296,	.3094,	.3805,	.4981,	.5108,	.3686,
6,	.5443,	.6232,	.5163,	.5512,	.5030,	.6265,	.6070,	.7135,	.9443,	.5981,
7,	.6615,	.6686,	.8497,	.7994,	.7803,	1.1334,	.9148,	.9458,	1.1596,	1.0655,
8,	.7556,	.7062,	1.0488,	.9908,	1.0288,	1.2008,	1.0150,	1.0546,	1.0062,	1.0374,
9,	1.0535,	.8758,	1.2471,	1.0671,	.9863,	1.2547,	.7693,	.8242,	.7225,	1.1279,
10,	.9531,	1.0907,	1.0160,	.7072,	.7455,	.9989,	.5064,	1.0685,	1.2862,	1.3144,
11,	1.2628,	1.3282,	1.0969,	.5941,	.5233,	.6663,	.4616,	.8691,	.9228,	1.3639,
12,	1.3559,	.8594,	.7969,	1.2602,	.3172,	.8174,	.1995,	1.2134,	1.1591,	1.1428,
13,	.8316,	1.6914,	1.4765,	.4632,	1.1688,	.3591,	.3786,	.2353,	.5985,	.7125,
14,	1.1030,	1.1850,	1.1440,	.8280,	.7560,	.8290,	.4220,	.9440,	1.1180,	1.0850,
+gp,	1.1030,	1.1850,	1.1440,	.8280,	.7560,	.8290,	.4220,	.9440,	1.1180,	1.0850,
FBAR 5-10,	.7193,	.7201,	.8179,	.7367,	.7289,	.9206,	.6988,	.8508,	.9383,	.9186,

Table 8		Fishing mortality (F) at age									
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
3,	.0330,	.0087,	.0134,	.0341,	.0127,	.0096,	.0103,	.0229,	.0225,	.0510,	.0321,
4,	.1291,	.0627,	.0631,	.1277,	.0944,	.1043,	.0982,	.1167,	.1944,	.2780,	.1964,
5,	.2664,	.1351,	.1887,	.2224,	.3468,	.3164,	.3200,	.3202,	.5297,	.4640,	.4380,
6,	.3985,	.2317,	.3225,	.4446,	.4630,	.6449,	.5816,	.5157,	.6774,	.6990,	.6307,
7,	.7158,	.2485,	.4259,	.5411,	.5685,	1.1633,	.8970,	.7606,	.7738,	.6940,	.7428,
8,	.9400,	.3769,	.3409,	.5970,	.5997,	.9837,	.9380,	.8772,	1.2666,	.8590,	1.0009,
9,	.8185,	.3419,	.3844,	.4466,	.6608,	1.0492,	.9558,	.7453,	1.3881,	1.2880,	1.1405,
10,	.9180,	.4113,	.2978,	.4651,	.6370,	1.0090,	1.0071,	.9253,	1.4322,	1.4530,	1.2702,
11,	.3105,	.4724,	.1830,	.3029,	.6900,	1.0393,	1.1377,	.8436,	1.3511,	1.1280,	1.1076,
12,	.5825,	.1780,	.1634,	.5389,	.9433,	1.1566,	.8462,	.7146,	1.3479,	1.0750,	1.0458,
13,	.0392,	.5899,	.0160,	.0558,	1.0913,	.9538,	.9068,	1.1447,	1.5492,	1.2720,	1.3220,
14,	.3950,	.2790,	.1800,	.1950,	.7110,	1.2960,	1.0760,	1.1390,	1.4520,	1.4120,	1.3343,
+gp,	.3950,	.2790,	.1800,	.1950,	.7110,	1.2960,	1.0760,	1.1390,	1.4520,	1.4120,	1.3343,
FBAR 5-10,	.6762,	.2909,	.3267,	.4528,	.5460,	.8611,	.7832,	.6907,	1.0113,	.9095,	

Table 3.18

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

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

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10** ⁻³				
	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
AGE										
3,	466659,	705512,	1085887,	1190838,	1592007,	644331,	272941,	440230,	805056,	497100,
4,	360680,	381173,	576467,	866758,	953214,	1260619,	517173,	219942,	350846,	643484,
5,	277476,	289152,	302188,	401768,	600907,	683389,	892276,	389461,	158284,	256655,
6,	360304,	195448,	210551,	189840,	227305,	391157,	427856,	549073,	202487,	105123,
7,	227780,	204758,	119357,	130245,	89345,	136226,	229741,	205835,	225835,	102422,
8,	101732,	111891,	111493,	64051,	62414,	52717,	75066,	112827,	90922,	106986,
9,	43365,	56609,	64632,	61067,	33999,	35956,	33524,	34216,	46738,	39388,
10,	18477,	23654,	28887,	31856,	28193,	18363,	18865,	15181,	14620,	22376,
11,	18056,	10097,	11156,	14166,	12121,	13632,	7395,	6992,	5770,	6409,
12,	35568,	7093,	2921,	5355,	4199,	4890,	5140,	2371,	2210,	1849,
13,	8259,	17340,	2134,	1241,	1229,	1871,	1889,	2060,	480,	723,
14,	4911,	3494,	8155,	853,	439,	587,	733,	773,	541,	87,
+gp,	5616,	3048,	1500,	1906,	396,	269,	264,	286,	313,	305,
TOTAL,	1928882,	2009268,	2525329,	2959943,	3605769,	3244010,	2482864,	1979246,	1904102,	1782908,

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

Table 10 YEAR,	Stock number at age (start of year)				Numbers*10** ⁻³					
	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
3,	684731,	790432,	918948,	729959,	473302,	338955,	778090,	1582377,	1292665,	169748,
4,	378823,	531452,	612962,	711327,	559366,	375592,	272729,	622847,	1245045,	1027225,
5,	406695,	240046,	347043,	382559,	429087,	361707,	266135,	199849,	459765,	875147,
6,	146333,	200146,	138853,	173517,	163745,	167870,	208175,	147618,	132409,	314070,
7,	49602,	71903,	103421,	67855,	62337,	49195,	84947,	109007,	82674,	88546,
8,	49487,	24045,	38137,	49982,	30249,	19454,	22702,	46716,	55931,	44102,
9,	55509,	24627,	12133,	15704,	21266,	10321,	7749,	11030,	21692,	23334,
10,	20292,	24772,	13665,	4765,	5765,	6830,	2948,	3157,	4496,	7671,
11,	8968,	8147,	9860,	5143,	1476,	1284,	2426,	1105,	1250,	1606,
12,	2316,	3991,	2662,	3127,	1890,	306,	356,	950,	564,	412,
13,	563,	1005,	1622,	689,	1093,	635,	98,	174,	417,	181,
14,	366,	234,	506,	518,	215,	450,	176,	21,	74,	141,
+gp,	223,	518,	195,	191,	262,	223,	347,	162,	26,	93,
TOTAL,	1803909,	1921318,	2200005,	2145336,	1750051,	1332822,	1646877,	2725012,	3297008,	2552277,

Table 3.18 (continued)

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10** ⁻³				
	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
3,	111969,	197050,	404980,	1015588,	1818302,	524879,	621883,	614690,	347901,	638524,
4,	135629,	89589,	154864,	324567,	799414,	1223748,	347054,	468307,	426390,	249150,
5,	683854,	88953,	63624,	114402,	224808,	536116,	610053,	230314,	280663,	198206,
6,	476086,	346146,	49659,	41444,	69546,	129276,	256489,	296491,	116875,	108148,
7,	161181,	227518,	160064,	32085,	23081,	38479,	63735,	104120,	136945,	48414,
8,	48535,	61173,	100065,	77949,	19154,	12395,	20179,	25821,	42495,	56897,
9,	21422,	15724,	21644,	35588,	32653,	8238,	6232,	8170,	8710,	14021,
10,	8762,	5600,	4930,	6962,	9348,	9735,	4481,	2762,	3076,	2118,
11,	3017,	2648,	1697,	1865,	1652,	3638,	2986,	2275,	1423,	1162,
12,	727,	774,	1068,	709,	451,	747,	1089,	737,	1361,	619,
13,	228,	227,	401,	500,	266,	195,	323,	379,	211,	871,
14,	39,	79,	91,	194,	130,	145,	27,	61,	186,	64,
+gp,	77,	71,	54,	64,	121,	108,	66,	124,	109,	68,
TOTAL,	1651525,	1035552,	963140,	1651919,	2998923,	2487700,	1934598,	1754252,	1366344,	1318263,

Table 10 YEAR,	Stock number at age (start of year)					Numbers*10** ⁻³				
	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	198608,	137778,	151231,	151918,	166281,	396765,	523464,	1043061,	286817,	204740,
4,	451749,	154844,	109272,	120741,	116306,	133333,	318382,	406177,	738689,	209580,
5,	163128,	300110,	111375,	80928,	80012,	77584,	96327,	219443,	268646,	481404,
6,	83212,	94330,	172085,	72465,	48871,	47115,	46618,	53906,	109181,	131979,
7,	37923,	39532,	41413,	84078,	34191,	24195,	20617,	20802,	21623,	34768,
8,	17003,	16024,	16584,	14496,	30949,	12828,	6378,	6762,	6614,	5552,
9,	18275,	6539,	6474,	4757,	4407,	9057,	3161,	1892,	1928,	1980,
10,	3156,	5217,	2230,	1523,	1340,	1345,	2115,	1199,	679,	767,
11,	644,	996,	1435,	661,	615,	520,	406,	1043,	337,	154,
12,	150,	149,	216,	392,	299,	298,	219,	209,	358,	110,
13,	114,	32,	52,	80,	91,	178,	108,	147,	51,	92,
14,	62,	41,	5,	10,	41,	23,	102,	60,	95,	23,
+gp,	73,	12,	2,	10,	10,	15,	25,	25,	32,	8,
TOTAL,	974096,	755604,	612374,	532059,	483412,	703258,	1017921,	1754727,	1435051,	1071156,

Table 10 YEAR,	Stock number at age (start of year)						Numbers*10** ⁻³						
	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	GMST 46-96 AMST 46-96	
AGE													
3,	172867,	242911,	411422,	719603,	912662,	825330,	668044,	454593,	740397,	818650,	0,	487658,	608118,
4,	157346,	136941,	197152,	330693,	565525,	690970,	549745,	319234,	237318,	426644,	463153,	378036,	468775,
5,	151061,	113218,	105304,	151549,	238284,	420040,	463863,	334858,	185997,	145579,	231377,	263439,	322504,
6,	272622,	94751,	80979,	71387,	99333,	137562,	244046,	273574,	184219,	88797,	73510,	152294,	186696,
7,	59415,	149838,	61533,	48022,	37471,	51186,	58816,	111679,	132992,	76471,	35761,	75136,	94456,
8,	9808,	23778,	95682,	32907,	22888,	17375,	13094,	19637,	42735,	50225,	31278,	33625,	45783,
9,	1611,	3137,	13355,	55709,	14830,	10288,	5319,	4196,	6687,	9859,	17418,	14899,	26203,
10,	525,	582,	1825,	7444,	29182,	6270,	2950,	1674,	1630,	1366,	2226,	6183,	14026,
11,	169,	172,	316,	1109,	3828,	12636,	1872,	882,	543,	319,	262,	2528,	7262,
12,	32,	101,	88,	215,	671,	1572,	3659,	491,	311,	115,	84,	996,	3646,
13,	29,	15,	69,	61,	103,	214,	405,	1285,	197,	66,	32,	408,	2030,
14,	37,	23,	7,	56,	47,	28,	67,	134,	335,	34,	15,	156,	1060,
+gp,	54,	9,	13,	6,	2,	6,	2,	2,	1,	76,	22,		
TOTAL	825575,	765473,	967744,	1418762,	1924827,	2173477,	2011882,	1522239,	1533363,	1618202,	855138,		

Table 3.19

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

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

Table 14	Stock biomass at age with SOP (start of year)										Tonnes
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
AGE											
3,	206222,	356818,	622063,	580483,	868813,	326239,	144950,	241749,	436726,	285346,	
4,	245213,	296587,	508055,	650013,	800311,	981969,	422544,	185815,	292810,	568267,	
5,	292401,	348728,	412806,	467016,	782001,	825113,	1129969,	509997,	204757,	351314,	
6,	575651,	357378,	436076,	334564,	448482,	716033,	821488,	1090111,	397132,	218163,	
7,	534265,	549654,	362914,	336980,	258795,	366094,	647580,	599943,	650250,	312051,	
8,	325070,	409188,	461829,	225761,	246292,	193003,	288253,	448006,	356647,	444057,	
9,	181907,	271768,	351454,	282562,	176126,	172812,	168998,	178355,	240672,	214619,	
10,	96725,	141720,	196032,	183954,	182264,	110144,	118685,	98753,	93950,	152155,	
11,	113551,	72674,	90949,	98267,	94131,	98226,	55885,	54641,	44543,	52356,	
12,	262369,	59878,	27933,	43569,	38256,	41332,	45565,	21737,	20009,	17715,	
13,	70184,	168648,	23508,	11630,	12898,	18222,	19295,	21757,	5003,	7986,	
14,	46410,	37788,	99898,	8888,	5126,	6357,	8320,	9072,	6276,	1064,	
+gp,	57272,	35576,	19828,	21441,	4989,	3149,	3237,	3628,	3919,	4047,	
TOTALBIO,	3007242,	3106404,	3613344,	3245128,	3918483,	3858692,	3874768,	3463564,	2752695,	2629141,	

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

Table 14	Stock biomass at age with SOP (start of year)										Tonnes
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	
AGE											
3,	381075,	453124,	541705,	435351,	240863,	180308,	453419,	968383,	738326,	105490,	
4,	324350,	468709,	555894,	652676,	437940,	307381,	244505,	586415,	1094041,	982109,	
5,	539731,	328145,	487836,	544074,	520710,	458827,	369820,	291647,	626205,	1296900,	
6,	294433,	414814,	295925,	374144,	301268,	322850,	438584,	326611,	273421,	705648,	
7,	146520,	218779,	323583,	214797,	168376,	138900,	262739,	354078,	250631,	292065,	
8,	199144,	99670,	162555,	215547,	111306,	74827,	95656,	206720,	230991,	198178,	
9,	293243,	134012,	67891,	88905,	102726,	52116,	42861,	64072,	117605,	137648,	
10,	133780,	168225,	95425,	33668,	34751,	43038,	20352,	22886,	30424,	56473,	
11,	71026,	66464,	82711,	43650,	10690,	9719,	20116,	9627,	10162,	14203,	
12,	21516,	38187,	26198,	31131,	16055,	2720,	3464,	9704,	5382,	4275,	
13,	6021,	11079,	18382,	7897,	10697,	6495,	1096,	2051,	4585,	2164,	
14,	4362,	2865,	6374,	6608,	2341,	5121,	2197,	272,	902,	1879,	
+gp,	2865,	6851,	2653,	2623,	3075,	2742,	4664,	2286,	341,	1333,	
TOTALBIO,	2418065,	2410924,	2667130,	2651070,	1960798,	1605043,	1959472,	2844752,	3383015,	3798365,	

Table 3.19 (continued)

Table 14		Stock biomass at age with SOP (start of year)									Tonnes
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
AGE											
3,	63635,	124673,	294342,	712130,	1350917,	350404,	364083,	408966,	224516,	416593,	
4,	118587,	87204,	173164,	350133,	913737,	1256864,	312589,	479346,	423336,	250083,	
5,	926783,	134206,	110270,	191291,	398284,	853467,	851681,	365402,	431912,	308370,	
6,	978219,	791785,	130487,	105064,	186806,	312020,	542892,	713177,	272689,	255100,	
7,	486201,	764038,	617475,	119411,	91015,	136346,	198050,	367681,	469075,	167653,	
8,	199451,	279857,	525879,	395218,	102896,	59833,	85423,	124218,	198294,	268416,	
9,	115564,	94433,	149321,	236875,	230278,	52205,	34635,	51595,	53354,	86833,	
10,	58988,	41973,	42443,	57829,	82270,	76990,	31078,	21772,	23514,	16372,	
11,	24397,	23841,	17554,	18610,	17463,	34567,	24878,	21541,	13065,	10785,	
12,	6898,	8173,	12956,	8296,	5591,	8321,	10640,	8181,	14664,	6746,	
13,	2491,	2764,	5598,	6745,	3794,	2501,	3642,	4852,	2613,	10925,	
14,	469,	1067,	1420,	2916,	2069,	2066,	336,	868,	2567,	893,	
+gp,	1013,	1033,	912,	1040,	2081,	1665,	895,	1910,	1626,	1023,	
TOTALBIO,	2982695,	2355047,	2081821,	2205561,	3387199,	3147246,	2460822,	2569509,	2131224,	1799790,	

Table 14		Stock biomass at age with SOP (start of year)									Tonnes
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
3,	138305,	87151,	108619,	106321,	55382,	158407,	220133,	329574,	56010,	43410,	
4,	483979,	150686,	120743,	130003,	96114,	146042,	283664,	363146,	382153,	84680,	
5,	270887,	452680,	190752,	135060,	114404,	132876,	157228,	327734,	351299,	380351,	
6,	209501,	215723,	446852,	183356,	106851,	124792,	133386,	135110,	216558,	251183,	
7,	140169,	132723,	157871,	312317,	116967,	86663,	85209,	82740,	72512,	103516,	
8,	85617,	73290,	86129,	73358,	131843,	55547,	37879,	39915,	34969,	24386,	
9,	120798,	39264,	44140,	31603,	24343,	52995,	24735,	12650,	12861,	15469,	
10,	26033,	39094,	18974,	12627,	9237,	9825,	21784,	8325,	6461,	9286,	
11,	6379,	8967,	14669,	6584,	5092,	4566,	5903,	11665,	4534,	2015,	
12,	1741,	1574,	2591,	4584,	2903,	3069,	2418,	2308,	3973,	1191,	
13,	1523,	384,	714,	1073,	1020,	2112,	1373,	1864,	651,	1150,	
14,	918,	548,	73,	145,	511,	306,	1441,	854,	1350,	319,	
+gp,	1173,	182,	26,	156,	138,	220,	389,	379,	494,	123,	
TOTALBIO,	1487024,	1202265,	1192154,	997187,	664804,	777419,	975543,	1316264,	1143825,	917078,	

Table 14		Stock biomass at age with SOP (start of year)									Tonnes
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
3,	51061,	97720,	202912,	325181,	317945,	187373,	134685,	89946,	149617,	177789,	
4,	80829,	97584,	213242,	316194,	671218,	524991,	267437,	157748,	123690,	227583,	
5,	129533,	135266,	174756,	282027,	439188,	601833,	530412,	329918,	200768,	169152,	
6,	397787,	164632,	187203,	199125,	283981,	334931,	518462,	570166,	346096,	172314,	
7,	157657,	372270,	188299,	192101,	152964,	197553,	204710,	399671,	448222,	225389,	
8,	44843,	85684,	413416,	174929,	127414,	94952,	64856,	109646,	224999,	229913,	
9,	11216,	14934,	87482,	387568,	101599,	68832,	38201,	33071,	59721,	73245,	
10,	5173,	4587,	18621,	73380,	253301,	48273,	26981,	17260,	19825,	14175,	
11,	1541,	1553,	2839,	14155,	35857,	103426,	18962,	9550,	5925,	3745,	
12,	345,	1110,	905,	2398,	7370,	17208,	39822,	5408,	3372,	1251,	
13,	354,	186,	825,	782,	1301,	2697,	5075,	16302,	2461,	827,	
14,	507,	317,	88,	798,	664,	396,	940,	1887,	4658,	476,	
+gp,	796,	137,	191,	96,	33,	90,	25,	24,	21,	1135,	
TOTALBIO,	881642,	975979,	1490778,	1968733,	2392834,	2182555,	1850568,	1740600,	1589375,	1296994,	

Table 3.20

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

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

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes										
YEAR,	1949,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,
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,	325070,	409188,	461829,	225761,	246292,	193003,	288253,	448006,	356647,	444057,
9,	181907,	271768,	351454,	282562,	176126,	172812,	168998,	178355,	240672,	214619,
10,	96725,	141720,	196032,	183954,	182264,	110144,	118685,	98753,	93950,	152155,
11,	113551,	72674,	90949,	98267,	94131,	98226,	55885,	54641,	44543,	52356,
12,	262369,	59878,	27933,	43569,	38256,	41332,	45565,	21737,	20009,	17715,
13,	70184,	168648,	23508,	11630,	12898,	18222,	19295,	21757,	5003,	7986,
14,	46410,	37788,	99898,	8888,	5126,	6357,	8320,	9072,	6276,	1064,
+gp,	57272,	35576,	19828,	21441,	4989,	3149,	3237,	3628,	3919,	4047,
TOTSPBIO,	1153489,	1197239,	1271431,	876072,	760081,	643244,	708237,	835948,	771019,	894000,

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Traditional vpa using file input for terminal F

Table 15 Spawning stock biomass with SOP (spawning time) Tonnes										
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
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,	199144,	99670,	162555,	215547,	111306,	74827,	95656,	206720,	230991,	198178,
9,	293243,	134012,	67891,	88905,	102726,	52116,	42861,	64072,	117605,	137648,
10,	133780,	168225,	95425,	33668,	34751,	43038,	20352,	22886,	30424,	56473,
11,	71026,	66464,	82711,	43650,	10690,	9719,	20116,	9627,	10162,	14203,
12,	21516,	38187,	26198,	31131,	16055,	2720,	3464,	9704,	5382,	4275,
13,	6021,	11079,	18382,	7897,	10697,	6495,	1096,	2051,	4585,	2164,
14,	4362,	2865,	6374,	6608,	2341,	5121,	2197,	272,	902,	1879,
+gp,	2865,	6851,	2653,	2623,	3075,	2742,	4664,	2286,	341,	1333,
TOTSPBIO,	731957,	527354,	462188,	430028,	291642,	196777,	190406,	317618,	400391,	416152,

Table 3.20 (continued)

Table 15		Spawning stock biomass with SOP (spawning time)								Tonnes	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
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,	199451,	279857,	525879,	395218,	102896,	59833,	85423,	124218,	198294,	268416,	
9,	115564,	94433,	149321,	236875,	230278,	52205,	34635,	51595,	53354,	86833,	
10,	58988,	41973,	42443,	57829,	82270,	76990,	31078,	21772,	23514,	16372,	
11,	24397,	23841,	17554,	18610,	17463,	34567,	24878,	21541,	13065,	10785,	
12,	6898,	8173,	12956,	8296,	5591,	8321,	10640,	8181,	14664,	6746,	
13,	2491,	2764,	5598,	6745,	3794,	2501,	3642,	4852,	2613,	10925,	
14,	469,	1067,	1420,	2916,	2069,	2066,	336,	868,	2567,	893,	
+gp,	1013,	1033,	912,	1040,	2081,	1665,	895,	1910,	1626,	1023,	
TOTSPBIO,	409271,	453141,	756084,	727531,	446441,	238147,	191527,	234937,	309697,	401992,	

Table 15		Spawning stock biomass with SOP (spawning time)						Tonnes		
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
3,	0,	0,	0,	0,	554,	0,	0,	0,	0,	0,
4,	0,	0,	0,	6500,	7689,	7302,	2837,	18157,	3822,	1694,
5,	0,	0,	0,	13506,	11440,	23918,	14151,	26219,	24591,	19018,
6,	0,	0,	0,	62341,	32055,	38686,	48019,	25671,	38980,	82891,
7,	0,	0,	0,	203006,	85386,	48531,	46865,	43852,	15953,	54863,
8,	85617,	73290,	86129,	60154,	116022,	49992,	32197,	28340,	16086,	15120,
9,	120798,	39264,	44140,	29075,	23612,	52465,	23745,	7843,	6431,	15469,
10,	26033,	39094,	18974,	12627,	9237,	9825,	19606,	7492,	4846,	9286,
11,	6379,	8967,	14669,	6584,	5092,	4566,	5903,	11665,	4534,	2015,
12,	1741,	1574,	2591,	4584,	2903,	3069,	2418,	2308,	3973,	1191,
13,	1523,	384,	714,	1073,	1020,	2112,	1373,	1864,	651,	1150,
14,	918,	548,	73,	145,	511,	306,	1441,	854,	1350,	319,
+gp,	1173,	182,	26,	156,	138,	220,	389,	379,	494,	123,
TOTSPBIO,	244182,	163303,	167316,	399750,	295659,	240991,	198944,	174644,	121710,	203137,

Table 15		Spawning stock biomass with SOP (spawning time)							Tonnes	
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
3,	0,	0,	0,	3252,	0,	0,	0,	0,	0,	0,
4,	0,	976,	8530,	3162,	20137,	5250,	0,	0,	0,	2276,
5,	6477,	6763,	10485,	33843,	39527,	66202,	37129,	6598,	4015,	6766,
6,	71602,	34573,	52417,	85624,	85194,	110527,	171092,	148243,	48453,	32740,
7,	64639,	215917,	122394,	144076,	93308,	118532,	126920,	251793,	251004,	99171,
8,	30942,	65977,	343135,	162684,	115947,	76911,	47993,	91006,	184499,	188528,
9,	9533,	12843,	84857,	375941,	98551,	66767,	36291,	32410,	56735,	68118,
10,	5173,	4495,	18621,	73380,	250768,	47790,	26441,	17260,	18833,	13892,
11,	1541,	1553,	2839,	14155,	35857,	102391,	18962,	9550,	5628,	3745,
12,	345,	1110,	905,	2398,	7370,	17208,	39822,	5408,	3372,	1251,
13,	354,	186,	825,	782,	1301,	2697,	5075,	16302,	2461,	827,
14,	507,	317,	88,	798,	664,	396,	940,	1887,	4658,	476,
+gp,	796,	137,	191,	96,	33,	90,	25,	24,	21,	1135,
TOTSPBIO,	191909,	344846,	645288,	900189,	748656,	614761,	510691,	580483,	579681,	418924,

Table 3.21

Run title : Arctic Cod (run: SVPBJA05/V05)

At 30/08/1999 21:18

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR	5-10,
1946,	729759,	4231927,	2585409,	706000,	.2731,	.6735,		.1928,
1947,	419945,	3410905,	1805121,	882017,	.4886,	.5708,		.3130,
1948,	440690,	3129347,	1355197,	774295,	.5714,	.6152,		.3521,
1949,	466659,	3007242,	1153489,	800122,	.6937,	.6799,		.3705,
1950,	705512,	3106404,	1197239,	731982,	.6114,	.7781,		.3652,
1951,	1085887,	3613344,	1271431,	827180,	.6506,	.8813,		.3983,
1952,	1190838,	3245128,	876072,	876795,	1.0008,	.7499,		.5386,
1953,	1592007,	3918483,	760081,	695546,	.9151,	.8396,		.3605,
1954,	644331,	3858692,	643244,	826021,	1.2841,	.7790,		.4006,
1955,	272941,	3874768,	708237,	1147841,	1.6207,	.8170,		.5498,
1956,	440230,	3463564,	835948,	1343068,	1.6066,	.8448,		.6431,
1957,	805056,	2752695,	771019,	792557,	1.0279,	.8346,		.5059,
1958,	497100,	2629141,	894000,	769313,	.8605,	.8831,		.5123,
1959,	684731,	2418065,	731957,	744607,	1.0173,	.8562,		.5602,
1960,	790432,	2410924,	527354,	622042,	1.1796,	.8819,		.4727,
1961,	918948,	2667130,	462188,	783221,	1.6946,	.9069,		.6226,
1962,	729959,	2651070,	430028,	909266,	2.1144,	.9175,		.7515,
1963,	473302,	1960798,	291642,	776337,	2.6620,	.7829,		.9697,
1964,	338955,	1605043,	196777,	437695,	2.2243,	.8184,		.6693,
1965,	778090,	1959472,	190406,	444930,	2.3367,	.8965,		.5392,
1966,	1582377,	2844752,	317618,	483711,	1.5229,	.9415,		.5082,
1967,	1292665,	3383015,	400391,	572605,	1.4301,	.8787,		.5259,
1968,	169748,	3798365,	416152,	1074084,	2.5810,	.9561,		.5520,
1969,	111969,	2982695,	409271,	1197226,	2.9253,	.8743,		.8089,
1970,	197050,	2355047,	453141,	933246,	2.0595,	.9734,		.7281,
1971,	404980,	2081821,	756084,	689048,	.9113,	1.1182,		.5875,
1972,	1015588,	2205561,	727531,	565254,	.7769,	1.0788,		.6741,
1973,	1818302,	3387199,	446441,	792685,	1.7756,	1.1430,		.5941,
1974,	524879,	3147246,	238147,	1102433,	4.6292,	1.0271,		.5614,
1975,	621883,	2460822,	191527,	829377,	4.3303,	.9007,		.6204,
1976,	614690,	2569509,	234937,	867463,	3.6923,	1.0236,		.6457,
1977,	347901,	2131224,	309697,	905301,	2.9232,	.9928,		.8350,
1978,	638524,	1799790,	401992,	698715,	1.7381,	1.0037,		.9301,
1979,	198608,	1487024,	244182,	440538,	1.8041,	1.0713,		.7193,
1980,	137778,	1202265,	163303,	380434,	2.3296,	.9731,		.7201,
1981,	151231,	1192154,	167316,	399038,	2.3849,	1.1050,		.8179,
1982,	151918,	997187,	399750,	363730,	.9099,	1.0767,		.7367,
1983,	166281,	664804,	295659,	289992,	.9808,	.8953,		.7289,
1984,	396765,	777419,	240991,	277651,	1.1521,	.9483,		.9206,
1985,	523464,	975543,	198944,	307920,	1.5478,	1.0182,		.6988,
1986,	1043061,	1316264,	174644,	430113,	2.4628,	1.0160,		.8508,
1987,	286817,	1143825,	121710,	523071,	4.2977,	1.0224,		.9383,
1988,	204740,	917078,	203137,	434939,	2.1411,	1.0001,		.9186,
1989,	172867,	881642,	191909,	332481,	1.7325,	.9879,		.6762,
1990,	242911,	975979,	344846,	212000,	.6148,	1.0108,		.2909,
1991,	411422,	1490778,	645288,	319158,	.4946,	.9521,		.3267,
1992,	719603,	1968733,	900189,	513234,	.5701,	1.0270,		.4528,
1993,	912662,	2392834,	748656,	581611,	.7769,	1.0127,		.5460,
1994,	825330,	2182555,	614761,	771086,	1.2543,	1.0090,		.8611,
1995,	668044,	1850568,	510691,	739999,	1.4490,	1.0030,		.7832,
1996,	454593,	1740600,	580483,	732228,	1.2614,	1.0147,		.6907,
1997,	740397,	1589375,	579681,	762403,	1.3152,	1.0004,		1.0113,
1998,	818650,	1296994,	418924,	592682,	1.4148,	1.0008,		.9095,
Arith.								
Mean	614586,	2303864,	579902,	679364,	1.6420			.6275,
Units	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),				

Table 3.22

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

Prediction with management option table: Input data

Year: 1999									
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
3	627800.00	0.2780	0.0000	0.0000	0.0000	0.203	0.0510	0.711	
4	463153.00	0.2330	0.0000	0.0000	0.0000	0.520	0.2780	1.081	
5	231377.00	0.2050	0.0100	0.0000	0.0000	1.174	0.4640	1.740	
6	73510.000	0.2030	0.1000	0.0000	0.0000	2.031	0.6990	2.414	
7	35761.000	0.2000	0.4500	0.0000	0.0000	3.034	0.6940	3.255	
8	31278.000	0.2000	0.7900	0.0000	0.0000	4.464	0.8590	4.598	
9	17418.000	0.2000	0.8800	0.0000	0.0000	6.482	1.2880	6.482	
10	2226.000	0.2000	1.0000	0.0000	0.0000	10.269	1.4530	10.269	
11	262.000	0.2000	1.0000	0.0000	0.0000	10.882	1.1280	10.882	
12	84.000	0.2000	1.0000	0.0000	0.0000	10.850	1.0750	10.850	
13	32.000	0.2000	1.0000	0.0000	0.0000	12.500	1.2720	12.500	
14	15.000	0.2000	1.0000	0.0000	0.0000	13.900	1.4120	13.900	
15+	22.000	0.2000	1.0000	0.0000	0.0000	15.000	1.4120	15.000	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Year: 2000									
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
3	541748.00	0.2570	0.0000	0.0000	0.0000	0.295	0.0510	0.778	
4	.	0.2240	0.0000	0.0000	0.0000	0.800	0.2780	1.349	
5	.	0.2030	0.0200	0.0000	0.0000	1.394	0.4640	1.700	
6	.	0.2020	0.1400	0.0000	0.0000	2.082	0.6990	2.376	
7	.	0.2000	0.4800	0.0000	0.0000	3.432	0.6940	3.762	
8	.	0.2000	0.8100	0.0000	0.0000	4.821	0.8590	4.834	
9	.	0.2000	0.9200	0.0000	0.0000	5.977	1.2880	5.977	
10	.	0.2000	0.9800	0.0000	0.0000	7.700	1.4530	7.700	
11	.	0.2000	1.0000	0.0000	0.0000	9.250	1.1280	9.250	
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.0750	10.850	
13	.	0.2000	1.0000	0.0000	0.0000	12.500	1.2720	12.500	
14	.	0.2000	1.0000	0.0000	0.0000	13.900	1.4120	13.900	
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	1.4120	15.000	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Year: 2001									
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
3	525000.00	0.2570	0.0000	0.0000	0.0000	0.304	0.0510	0.801	
4	.	0.2240	0.0000	0.0000	0.0000	0.843	0.2780	1.422	
5	.	0.2030	0.0200	0.0000	0.0000	1.523	0.4640	1.858	
6	.	0.2020	0.1400	0.0000	0.0000	2.329	0.6990	2.658	
7	.	0.2000	0.4800	0.0000	0.0000	3.638	0.6940	3.988	
8	.	0.2000	0.8100	0.0000	0.0000	5.271	0.8590	5.285	
9	.	0.2000	0.9200	0.0000	0.0000	6.683	1.2880	6.683	
10	.	0.2000	0.9800	0.0000	0.0000	7.700	1.4530	7.700	
11	.	0.2000	1.0000	0.0000	0.0000	9.250	1.1280	9.250	
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.0750	10.850	
13	.	0.2000	1.0000	0.0000	0.0000	12.500	1.2720	12.500	
14	.	0.2000	1.0000	0.0000	0.0000	13.900	1.4120	13.900	
15+	.	0.2000	1.0000	0.0000	0.0000	15.000	1.4120	15.000	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Notes: Run name : MANBJA03
Date and time: 31AUG99:12:04

Table 3.23

Prediction with management option table

Year: 1999						Year: 2000					Year: 2001		
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight		F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass	
0.7936	0.7217	1177805	303689	480000		0.0000	0.0000	1530304	285764	0	2383888	606418	
.	0.0500	0.0455	.	285764	42957	2332037	582318	
.	0.1000	0.0910	.	285764	84549	2281910	559294	
.	0.1500	0.1364	.	285764	124832	2233436	537292	
.	0.2000	0.1819	.	285764	163858	2186549	516261	
.	0.2500	0.2274	.	285764	201679	2141184	496153	
.	0.3000	0.2729	.	285764	238342	2097279	476924	
.	0.3500	0.3183	.	285764	273894	2054776	458530	
.	0.4000	0.3638	.	285764	308377	2013620	440931	
.	0.4500	0.4093	.	285764	341835	1973758	424088	
.	0.5000	0.4548	.	285764	374306	1935139	407966	
.	0.5500	0.5002	.	285764	405829	1897715	392530	
.	0.6000	0.5457	.	285764	436439	1861440	377746	
.	0.6500	0.5912	.	285764	466170	1826271	363585	
.	0.7000	0.6367	.	285764	495057	1792165	350017	
.	0.7500	0.6821	.	285764	523129	1759082	337015	
.	0.8000	0.7276	.	285764	550417	1726985	324551	
.	0.8500	0.7731	.	285764	576949	1695836	312602	
.	0.9000	0.8186	.	285764	602753	1665602	301143	
.	0.9500	0.8640	.	285764	627855	1636248	290152	
.	1.0000	0.9095	.	285764	652280	1607743	279607	
.	1.0500	0.9550	.	285764	676052	1580056	269489	
.	1.1000	1.0005	.	285764	699193	1553157	259778	
.	1.1500	1.0459	.	285764	721726	1527020	250456	
.	1.2000	1.0914	.	285764	743671	1501617	241506	
.	1.2500	1.1369	.	285764	765049	1476923	232910	
.	1.3000	1.1824	.	285764	785878	1452912	224654	
.	1.3500	1.2278	.	285764	806177	1429562	216723	
.	1.4000	1.2733	.	285764	825965	1406850	209101	
.	1.4500	1.3188	.	285764	845257	1384753	201777	
.	1.5000	1.3643	.	285764	864070	1363253	194736	
.	1.5500	1.4097	.	285764	882420	1342327	187967	
.	1.6000	1.4552	.	285764	900321	1321958	181458	
.	1.6500	1.5007	.	285764	917788	1302126	175198	
.	1.7000	1.5462	.	285764	934835	1282815	169177	
.	1.7500	1.5916	.	285764	951476	1264007	163383	
.	1.8000	1.6371	.	285764	967722	1245685	157809	
.	1.8500	1.6826	.	285764	983586	1227835	152444	
.	1.9000	1.7281	.	285764	999080	1210441	147280	
.	1.9500	1.7735	.	285764	1014215	1193488	142309	
.	2.0000	1.8190	.	285764	1029003	1176963	137522	

Notes: Run name : MANBJA03
 Date and time : 31AUG99:12:04
 Computation of ref. F: Simple mean, age 5 - 10
 Basis for 1999 : TAC constraints

Table 3.24

September 8, 1999

North-East Arctic cod (Sub-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		Spawning time	
						Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.047	22020.188	1.935	18653.015	1.935	18653.015
0.0500	0.0455	0.117	776.711	4.464	15415.461	1.409	12204.320	1.409	12204.320
0.1000	0.0910	0.192	1098.598	4.093	11689.066	1.091	8621.549	1.091	8621.549
0.1500	0.1364	0.246	1234.092	3.830	9334.116	0.878	6399.042	0.878	6399.042
0.2000	0.1819	0.287	1284.359	3.631	7731.212	0.725	4918.493	0.725	4918.493
0.2500	0.2274	0.319	1293.389	3.471	6580.751	0.610	3881.266	0.610	3881.266
0.3000	0.2729	0.346	1282.122	3.340	5721.140	0.521	3126.632	0.521	3126.632
0.3500	0.3183	0.369	1261.141	3.229	5058.118	0.450	2561.100	0.450	2561.100
0.4000	0.3638	0.389	1235.993	3.134	4533.339	0.392	2127.009	0.392	2127.009
0.4500	0.4093	0.406	1209.641	3.050	4108.959	0.344	1787.132	0.344	1787.132
0.5000	0.4548	0.422	1183.658	2.976	3759.488	0.304	1516.523	0.304	1516.523
0.5500	0.5002	0.436	1158.854	2.910	3467.203	0.271	1297.955	0.271	1297.955
0.6000	0.5457	0.448	1135.607	2.850	3219.449	0.242	1119.212	0.242	1119.212
0.6500	0.5912	0.460	1114.056	2.796	3006.977	0.217	971.444	0.217	971.444
0.7000	0.6367	0.470	1094.199	2.746	2822.889	0.195	848.110	0.195	848.110
0.7500	0.6821	0.480	1075.966	2.700	2661.949	0.176	744.294	0.176	744.294
0.8000	0.7276	0.489	1059.245	2.658	2520.115	0.160	656.247	0.160	656.247
0.8500	0.7731	0.497	1043.913	2.618	2394.224	0.145	581.067	0.145	581.067
0.9000	0.8186	0.505	1029.841	2.582	2281.765	0.132	516.482	0.132	516.482
0.9500	0.8640	0.513	1016.907	2.547	2180.726	0.121	460.694	0.121	460.694
1.0000	0.9095	0.520	1004.994	2.515	2089.471	0.111	412.263	0.111	412.263
1.0500	0.9550	0.526	993.997	2.485	2006.661	0.101	370.029	0.101	370.029
1.1000	1.0005	0.532	983.821	2.456	1931.187	0.093	333.044	0.093	333.044
1.1500	1.0459	0.538	974.378	2.429	1862.126	0.086	300.533	0.086	300.533
1.2000	1.0914	0.544	965.593	2.404	1798.702	0.079	271.854	0.079	271.854
1.2500	1.1369	0.549	957.399	2.380	1740.256	0.073	246.473	0.073	246.473
1.3000	1.1824	0.554	949.734	2.357	1686.230	0.068	223.942	0.068	223.942
1.3500	1.2278	0.559	942.547	2.335	1636.142	0.063	203.886	0.063	203.886
1.4000	1.2733	0.564	935.790	2.314	1589.581	0.058	185.985	0.058	185.985
1.4500	1.3188	0.568	929.423	2.294	1546.186	0.054	169.968	0.054	169.968
1.5000	1.3643	0.573	923.408	2.274	1505.646	0.050	155.604	0.050	155.604
1.5500	1.4097	0.577	917.715	2.256	1467.689	0.047	142.695	0.047	142.695
1.6000	1.4552	0.581	912.313	2.239	1432.075	0.044	131.067	0.044	131.067
1.6500	1.5007	0.585	907.179	2.222	1398.593	0.041	120.575	0.041	120.575
1.7000	1.5462	0.588	902.289	2.205	1367.056	0.038	111.089	0.038	111.089
1.7500	1.5916	0.592	897.625	2.190	1337.298	0.036	102.497	0.036	102.497
1.8000	1.6371	0.595	893.167	2.175	1309.171	0.033	94.702	0.033	94.702
1.8500	1.6826	0.598	888.900	2.160	1282.544	0.031	87.618	0.031	87.618
1.9000	1.7281	0.602	884.810	2.146	1257.298	0.029	81.171	0.029	81.171
1.9500	1.7735	0.605	880.884	2.133	1233.327	0.028	75.293	0.028	75.293
2.0000	1.8190	0.608	877.110	2.120	1210.535	0.026	69.928	0.026	69.928

Notes: Run name : YLDBJA02
 Date and time : 31AUG99:12:05
 Computation of ref. F: Simple mean, age 5 - 10
 F-0.1 factor : 0.1303
 F-max factor : 0.2416
 F-0.1 reference F : 0.1185
 F-max reference F : 0.2197
 Recruitment : Single recruit

Table 3.25

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	0.7936	0.7218	237277	480019	1482938	1177805	68436	303689	68436	303689
2000	0.2070	0.1883	79091	169221	1493131	1530283	72012	285755	72012	285755
2001	0.4620	0.4202	210929	533240	1642215	2180085	123667	513379	123667	513379
2002	0.4620	0.4202	220210	605016	1647653	2405621	166575	715068	166575	715068
2003	0.4620	0.4202	224145	665727	1644227	2555714	197425	913299	197425	913299
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
 Date and time : 01SEP99:14:27
 Computation of ref. F: Simple mean, age 5 - 10
 Prediction basis : F factors

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	0.7936	0.7218	237277	480019	1482938	1177805	68436	303689	68436	303689
2000	0.4620	0.4202	166429	349711	1493131	1530283	72012	285755	72012	285755
2001	0.4620	0.4202	192799	469329	1564285	1964359	103950	420145	103950	420145
2002	0.4620	0.4202	207474	550016	1600320	2227060	145675	610772	145675	610772
2003	0.4620	0.4202	215773	619870	1616938	2418629	179087	809922	179087	809922
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
 Date and time : 01SEP99:14:27
 Computation of ref. F: Simple mean, age 5 - 10
 Prediction basis : F factors

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	0.7936	0.7218	237277	480019	1482938	1177805	68436	303689	68436	303689
2000	0.2420	0.2201	91705	195703	1493131	1530283	72012	285755	72012	285755
2001	0.2420	0.2201	115323	294024	1630937	2148321	120726	499298	120726	499298
2002	0.2420	0.2201	132607	379769	1723812	2638302	190359	828353	190359	828353
2003	0.2420	0.2201	145893	470497	1784556	3077801	258479	1229702	258479	1229702
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
 Date and time : 01SEP99:14:27

Table 3.25 (Continued)

The SAS System

14:09 Wednesday, September 1, 1999

North-East Arctic cod (Sub-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		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	0.7936	0.7217	237267	480000	1482938	1177805	68436	303689	68436	303689
2000	0.5406	0.4917	191359	400000	1493139	1530304	72014	285764	72014	285764
2001	0.4017	0.3654	165596	400000	1542119	1904630	98607	395368	98607	395368
2002	0.3204	0.2914	149956	400000	1606505	2235192	145687	609153	145687	609153
2003	0.2553	0.2322	134363	400000	1673267	2599151	198517	903604	198517	903604
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
 Date and time : 01SEP99:14:27
 Computation of ref. F: Simple mean, age 5 - 10
 Prediction basis : TAC constraints

The SAS System

14:09 Wednesday, September 1, 1999

North-East Arctic cod (Sub-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		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	0.7936	0.7217	237267	480000	1482938	1177805	68436	303689	68436	303689
2000	0.3877	0.3526	142046	300000	1493139	1530304	72014	285764	72014	285764
2001	0.2682	0.2440	120485	300000	1586010	2023612	109303	445184	109303	445184
2002	0.2030	0.1846	107172	300000	1682559	2486494	172906	740597	172906	740597
2003	0.1548	0.1408	94164	300000	1773625	2998442	246935	1159840	246935	1159840
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
 Date and time : 01SEP99:14:27
 Computation of ref. F: Simple mean, age 5 - 10
 Prediction basis : TAC constraints

The SAS System

14:09 Wednesday, September 1, 1999

North-East Arctic cod (Sub-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		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	0.7936	0.7218	237277	480019	1482938	1177805	68436	303689	68436	303689
2000	0.7920	0.7203	265397	546093	1493131	1530283	72012	285755	72012	285755
2001	0.7920	0.7203	274952	628236	1476470	1732041	83490	326503	83490	326503
2002	0.7920	0.7203	273661	652951	1455945	1779726	99036	393979	99036	393979
2003	0.7920	0.7203	270052	665109	1440621	1792794	106690	448241	106690	448241
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
 Date and time : 01SEP99:14:27
 Computation of ref. F: Simple mean, age 5 - 10
 Prediction basis : F factors

Table 3.26

The SAS System 14:13 Wednesday, September 8, 1999
 North-East Arctic cod (Sub-areas I and II)

Single option prediction: Detailed tables

Year: 1999 F-factor: 0.7936 Reference F: 0.7218 3 1 January 3 Spawning time 3										
3 Age 3	3 Absolute F 3	3 Catch in numbers 3	3 Catch in weight 3	3 Stock size 3	3 Stock biomass 3	3 Sp.stock size 3	3 Sp.stock biomass 3	3 Sp.stock size 3	3 Sp.stock biomass 3	3 Sp.stock biomass 3
3 3	0.0405 ³	21761 ³	15472 ³	627800 ³	127443 ³	0 ³	0 ³	0 ³	0 ³	0 ³
3 4 3	0.2206 ³	82146 ³	88800 ³	463153 ³	240840 ³	0 ³	0 ³	0 ³	0 ³	0 ³
3 5 3	0.3682 ³	64848 ³	112835 ³	231377 ³	271637 ³	2314 ³	2716 ³	2314 ³	2716 ³	2716 ³
3 6 3	0.5547 ³	28591 ³	69018 ³	73510 ³	149299 ³	7351 ³	14930 ³	7351 ³	14930 ³	14930 ³
3 7 3	0.5508 ³	13852 ³	45087 ³	35761 ³	108499 ³	16092 ³	48824 ³	16092 ³	48824 ³	48824 ³
3 8 3	0.6817 ³	14169 ³	65151 ³	31278 ³	139625 ³	24710 ³	110304 ³	24710 ³	110304 ³	110304 ³
3 9 3	1.0222 ³	10276 ³	66610 ³	17418 ³	112903 ³	15328 ³	99355 ³	15328 ³	99355 ³	99355 ³
3 10 3	1.1531 ³	1407 ³	14446 ³	2226 ³	22859 ³	2226 ³	22859 ³	2226 ³	22859 ³	22859 ³
3 11 3	0.8952 ³	143 ³	1551 ³	262 ³	2851 ³	262 ³	2851 ³	262 ³	2851 ³	2851 ³
3 12 3	0.8531 ³	44 ³	481 ³	84 ³	911 ³	84 ³	911 ³	84 ³	911 ³	911 ³
3 13 3	1.0095 ³	19 ³	234 ³	32 ³	400 ³	32 ³	400 ³	32 ³	400 ³	400 ³
3 14 3	1.1206 ³	9 ³	130 ³	15 ³	209 ³	15 ³	209 ³	15 ³	209 ³	209 ³
3 15+ 3	1.1206 ³	14 ³	205 ³	22 ³	330 ³	22 ³	330 ³	22 ³	330 ³	330 ³
3 Total		237277 ³	480019 ³	1482938 ³	1177805 ³	68436 ³	303689 ³	68436 ³	303689 ³	303689 ³
3 Unit	-	3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³

Year: 2000 F-factor: 0.4620 Reference F: 0.4202 3 1 January 3 Spawning time 3										
3 Age 3	3 Absolute F 3	3 Catch in numbers 3	3 Catch in weight 3	3 Stock size 3	3 Stock biomass 3	3 Sp.stock size 3	3 Sp.stock biomass 3	3 Sp.stock size 3	3 Sp.stock biomass 3	3 Sp.stock biomass 3
3 3 3	0.0236 ³	11130 ³	8659 ³	541748 ³	159816 ³	0 ³	0 ³	0 ³	0 ³	0 ³
3 4 3	0.1284 ³	49421 ³	66669 ³	456573 ³	365258 ³	0 ³	0 ³	0 ³	0 ³	0 ³
3 5 3	0.2144 ³	51570 ³	87669 ³	294252 ³	410187 ³	5885 ³	8204 ³	5885 ³	8204 ³	8204 ³
3 6 3	0.3229 ³	32770 ³	77861 ³	130428 ³	271550 ³	18260 ³	38017 ³	18260 ³	38017 ³	38017 ³
3 7 3	0.3206 ³	8612 ³	32399 ³	34456 ³	118254 ³	16539 ³	56762 ³	16539 ³	56762 ³	56762 ³
3 8 3	0.3969 ³	5044 ³	24385 ³	16879 ³	81376 ³	13672 ³	65915 ³	13672 ³	65915 ³	65915 ³
3 9 3	0.5951 ³	5316 ³	31776 ³	12952 ³	77411 ³	11915 ³	71218 ³	11915 ³	71218 ³	71218 ³
3 10 3	0.6713 ³	2299 ³	17704 ³	5131 ³	39511 ³	5029 ³	38720 ³	5029 ³	38720 ³	38720 ³
3 11 3	0.5211 ³	214 ³	1976 ³	575 ³	5321 ³	575 ³	5321 ³	575 ³	5321 ³	5321 ³
3 12 3	0.4967 ³	31 ³	340 ³	88 ³	951 ³	88 ³	951 ³	88 ³	951 ³	951 ³
3 13 3	0.5877 ³	12 ³	149 ³	29 ³	366 ³	29 ³	366 ³	29 ³	366 ³	366 ³
3 14 3	0.6523 ³	4 ³	58 ³	10 ³	133 ³	10 ³	133 ³	10 ³	133 ³	133 ³
3 15+ 3	0.6523 ³	4 ³	65 ³	10 ³	148 ³	10 ³	148 ³	10 ³	148 ³	148 ³
3 Total		166429 ³	349711 ³	1493131 ³	1530283 ³	72012 ³	285755 ³	72012 ³	285755 ³	285755 ³
3 Unit	-	3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³

Year: 2001 F-factor: 0.4620 Reference F: 0.4202 3 1 January 3 Spawning time 3										
3 Age 3	3 Absolute F 3	3 Catch in numbers 3	3 Catch in weight 3	3 Stock size 3	3 Stock biomass 3	3 Sp.stock size 3	3 Sp.stock biomass 3	3 Sp.stock size 3	3 Sp.stock biomass 3	3 Sp.stock biomass 3
3 3 3	0.0236 ³	10786 ³	8640 ³	525000 ³	159600 ³	0 ³	0 ³	0 ³	0 ³	0 ³
3 4 3	0.1284 ³	44295 ³	62987 ³	409214 ³	344968 ³	0 ³	0 ³	0 ³	0 ³	0 ³
3 5 3	0.2144 ³	56250 ³	104513 ³	320959 ³	488820 ³	6419 ³	9776 ³	6419 ³	9776 ³	9776 ³
3 6 3	0.3229 ³	48704 ³	129455 ³	193847 ³	451469 ³	27139 ³	63206 ³	27139 ³	63206 ³	63206 ³
3 7 3	0.3206 ³	19286 ³	76911 ³	77160 ³	280708 ³	37037 ³	134740 ³	37037 ³	134740 ³	134740 ³
3 8 3	0.3969 ³	6118 ³	32334 ³	20472 ³	107909 ³	16582 ³	87406 ³	16582 ³	87406 ³	87406 ³
3 9 3	0.5951 ³	3815 ³	25492 ³	9293 ³	62104 ³	8549 ³	57136 ³	8549 ³	57136 ³	57136 ³
3 10 3	0.6713 ³	2621 ³	20178 ³	5848 ³	45032 ³	5731 ³	44132 ³	5731 ³	44132 ³	44132 ³
3 11 3	0.5211 ³	797 ³	7374 ³	2147 ³	19860 ³	2147 ³	19860 ³	2147 ³	19860 ³	19860 ³
3 12 3	0.4967 ³	100 ³	1086 ³	280 ³	3035 ³	280 ³	3035 ³	280 ³	3035 ³	3035 ³
3 13 3	0.5877 ³	18 ³	222 ³	44 ³	546 ³	44 ³	546 ³	44 ³	546 ³	546 ³
3 14 3	0.6523 ³	6 ³	81 ³	13 ³	185 ³	13 ³	185 ³	13 ³	185 ³	185 ³
3 15+ 3	0.6523 ³	4 ³	55 ³	8 ³	124 ³	8 ³	124 ³	8 ³	124 ³	124 ³
3 Total		192799 ³	469329 ³	1564285 ³	1964359 ³	103950 ³	420145 ³	103950 ³	420145 ³	420145 ³
3 Unit	-	3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³	Tonnes 3Thousands ³

Table 3.26 (Continued)

Wednesday, September 8, 1999

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

Single option prediction: Detailed tables

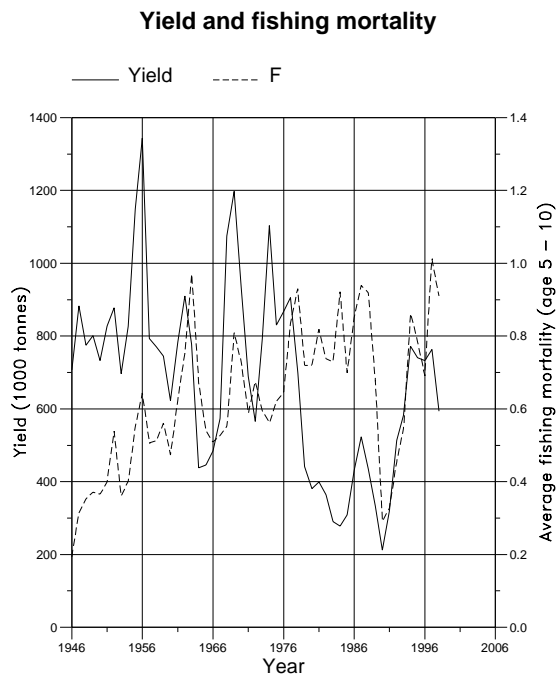
(cont.)

Year: 2002		F-factor: 0.4620	Reference F: 0.4202		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	0.0236	10786	8640	525000	159600	0	0	0	0
4	0.1284	42925	61040	396564	334303	0	0	0	0
5	0.2144	50416	93673	287667	438117	5753	8762	5753	8762
6	0.3229	53124	141205	211441	492445	29602	68942	29602	68942
7	0.3206	28663	114309	114678	417200	55046	200256	55046	200256
8	0.3969	13701	72408	45844	241646	37134	195733	37134	195733
9	0.5951	4626	30918	11271	75322	10369	69297	10369	69297
10	0.6713	1880	14478	4196	32311	4112	31665	4112	31665
11	0.5211	909	8404	2447	22635	2447	22635	2447	22635
12	0.4967	373	4051	1044	11326	1044	11326	1044	11326
13	0.5877	57	708	139	1742	139	1742	139	1742
14	0.6523	9	121	20	276	20	276	20	276
15+	0.6523	4	61	9	138	9	138	9	138
Total		207474	550016	1600320	2227060	145675	610772	145675	610772
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

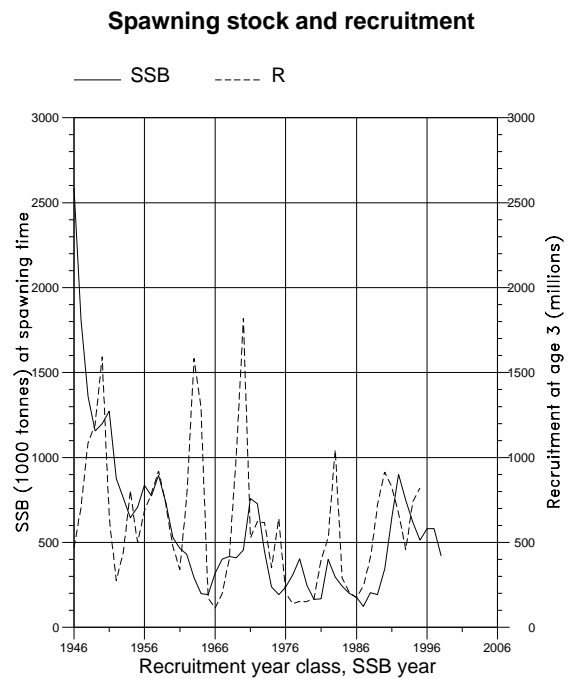
Year: 2003		F-factor: 0.4620	Reference F: 0.4202		1 January		Spawning time		
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
3	0.0236	10786	8640	525000	159600	0	0	0	0
4	0.1284	42925	61040	396564	334303	0	0	0	0
5	0.2144	48857	90777	278774	424572	5575	8491	5575	8491
6	0.3229	47614	126558	189509	441366	26531	61791	26531	61791
7	0.3206	31265	124683	125087	455065	60042	218431	60042	218431
8	0.3969	20363	107616	68136	359144	55190	290906	55190	290906
9	0.5951	10360	69237	25239	168673	23220	155179	23220	155179
10	0.6713	2280	17560	5089	39188	4988	38404	4988	38404
11	0.5211	652	6030	1756	16241	1756	16241	1756	16241
12	0.4967	426	4617	1190	12909	1190	12909	1190	12909
13	0.5877	212	2644	520	6501	520	6501	520	6501
14	0.6523	28	387	63	881	63	881	63	881
15+	0.6523	5	82	12	186	12	186	12	186
Total		215773	619870	1616938	2418629	179087	809922	179087	809922
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLOR01
 Date and time : 01SEP99:18:54
 Computation of ref. F: Simple mean, age 5 - 10
 Prediction basis : F factors

Figure 3.1 A-b Fish Stock Summary. North-east Arctic Cod (Sub-areas I and II)



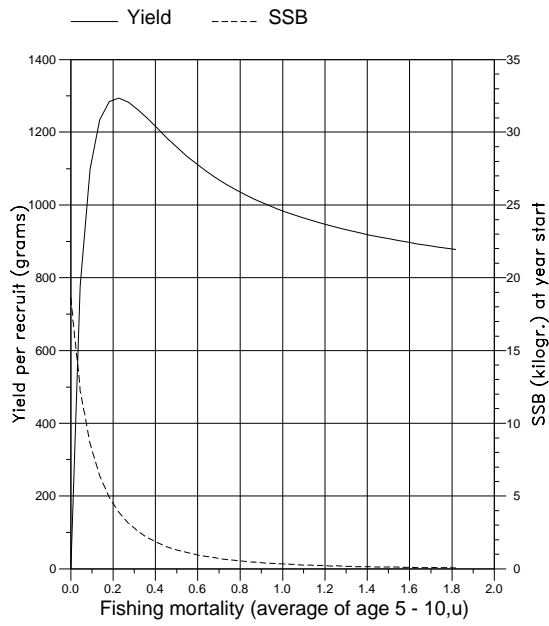
(run: SVPBJA05) **A**



(run: SVPBJA05) **B**

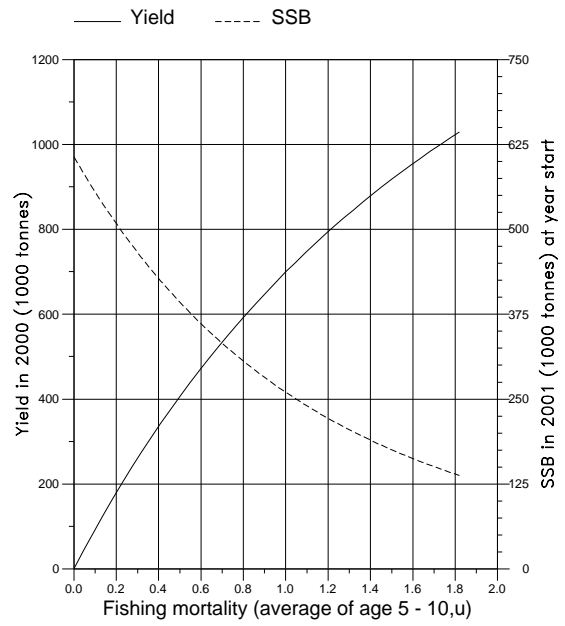
Figure 3.1 c-d Fish Stock Summary. North-east Arctic Cod (Sub-areas I and II)

Long term yield and spawning stock biomass



(run: YLDBJA02) **C**

Short term yield and spawning stock biomass



(run: MANBJA03) **D**

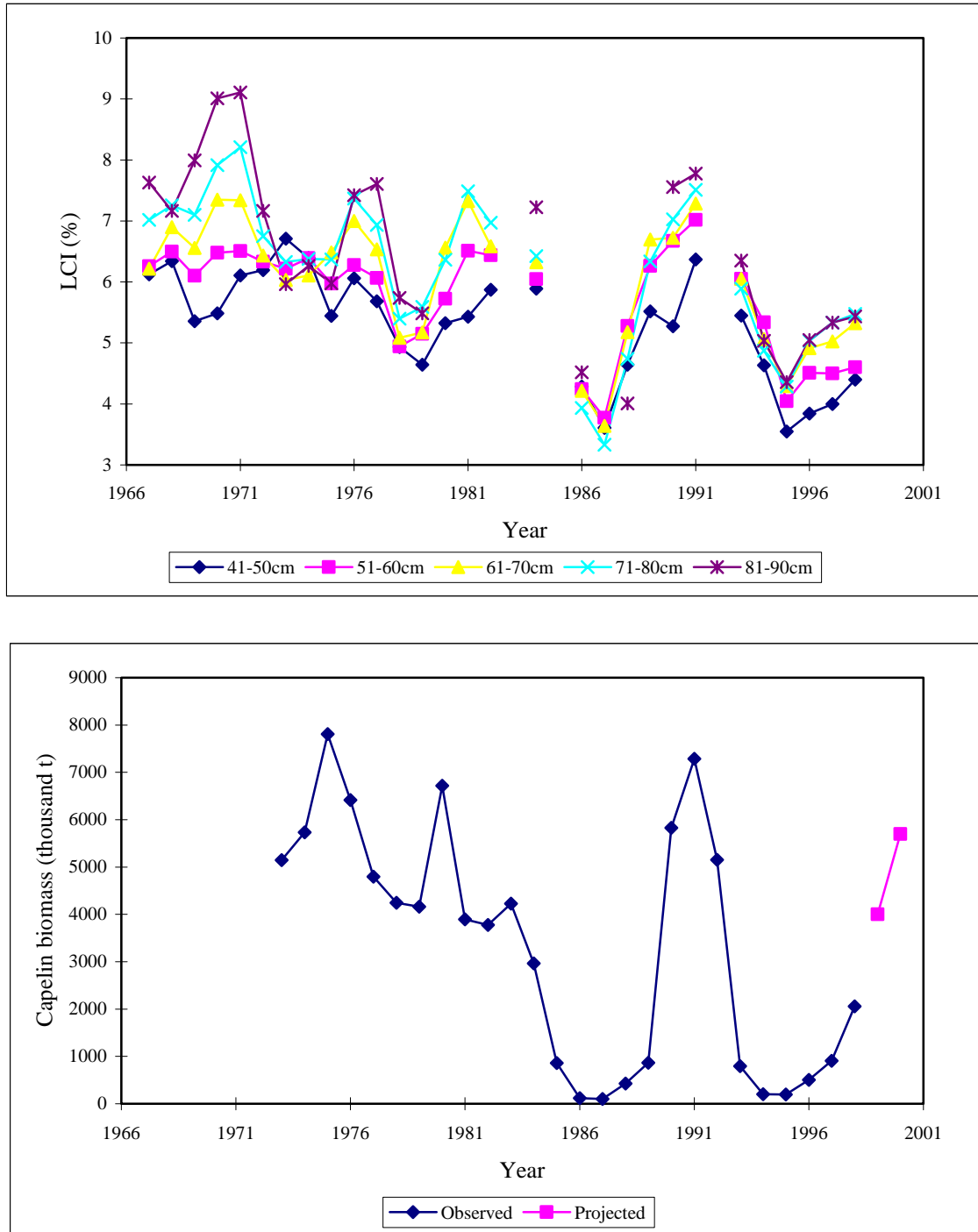


Figure 3.2: A) time series of the liver condition index for five 10-cm length classes of cod sampled in the southern Barents Sea (Yaragina and Marshall in press). Values shown are the annual means estimated by average monthly values for January through December. Source: Russian surveys and sampling of commercial catch. B) time series of capelin stock biomass estimated from acoustic surveys (1973-1998) or projected values (Gjørseter WD 17 1999).

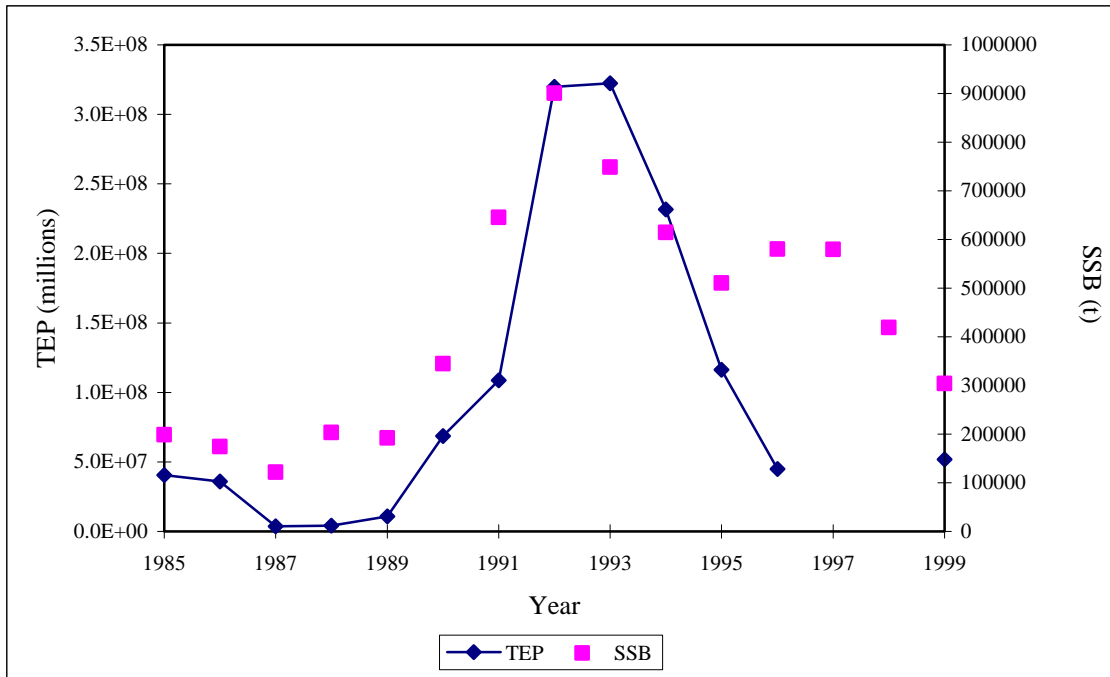
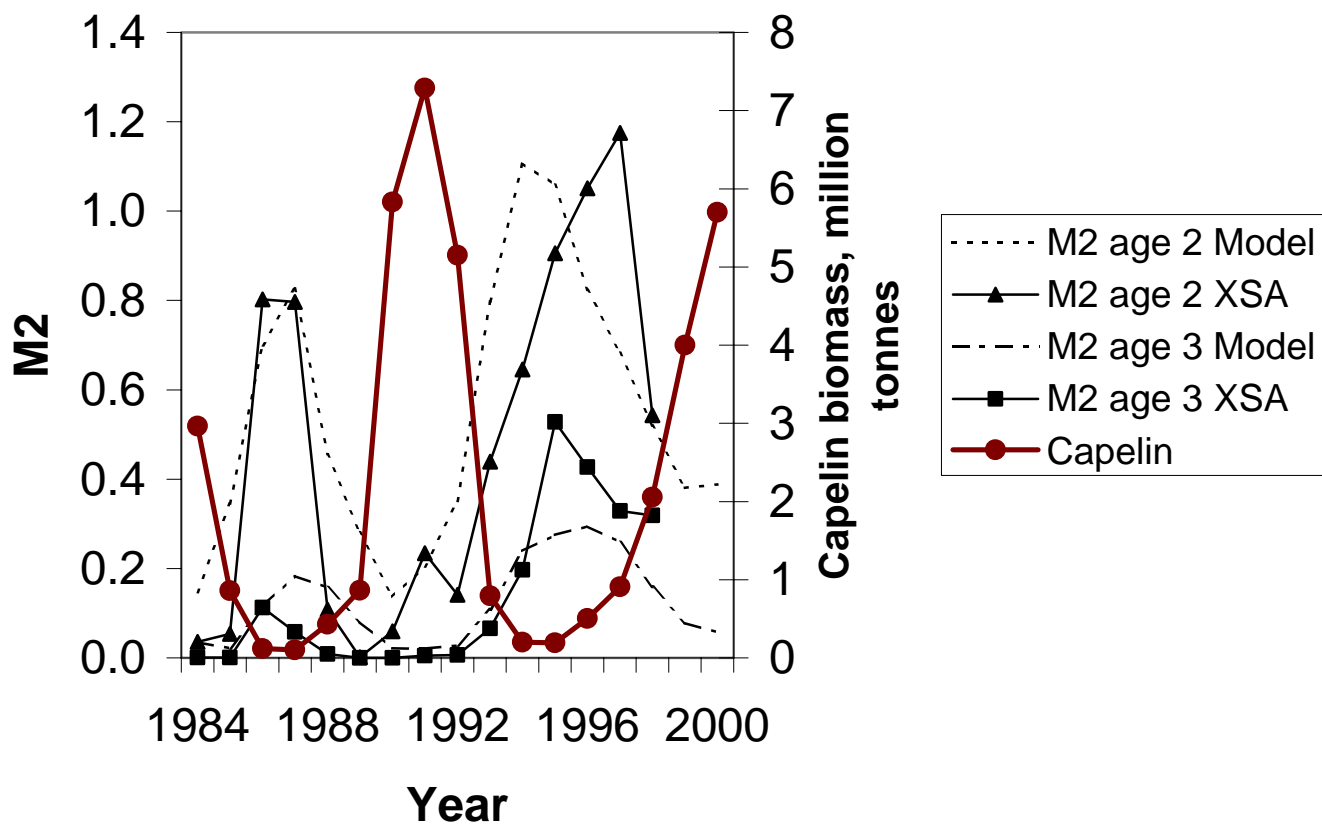


Figure 3.3: Time series of total egg production (TEP) and VPA estimates of spawning stock biomass. TEP estimates for 1997 and 1998 are unavailable due to the reduced spatial coverage of the Norwegian winter survey.

Fig 3.4. Northeast cod, M2 from cannibalism vs. capelin stock size



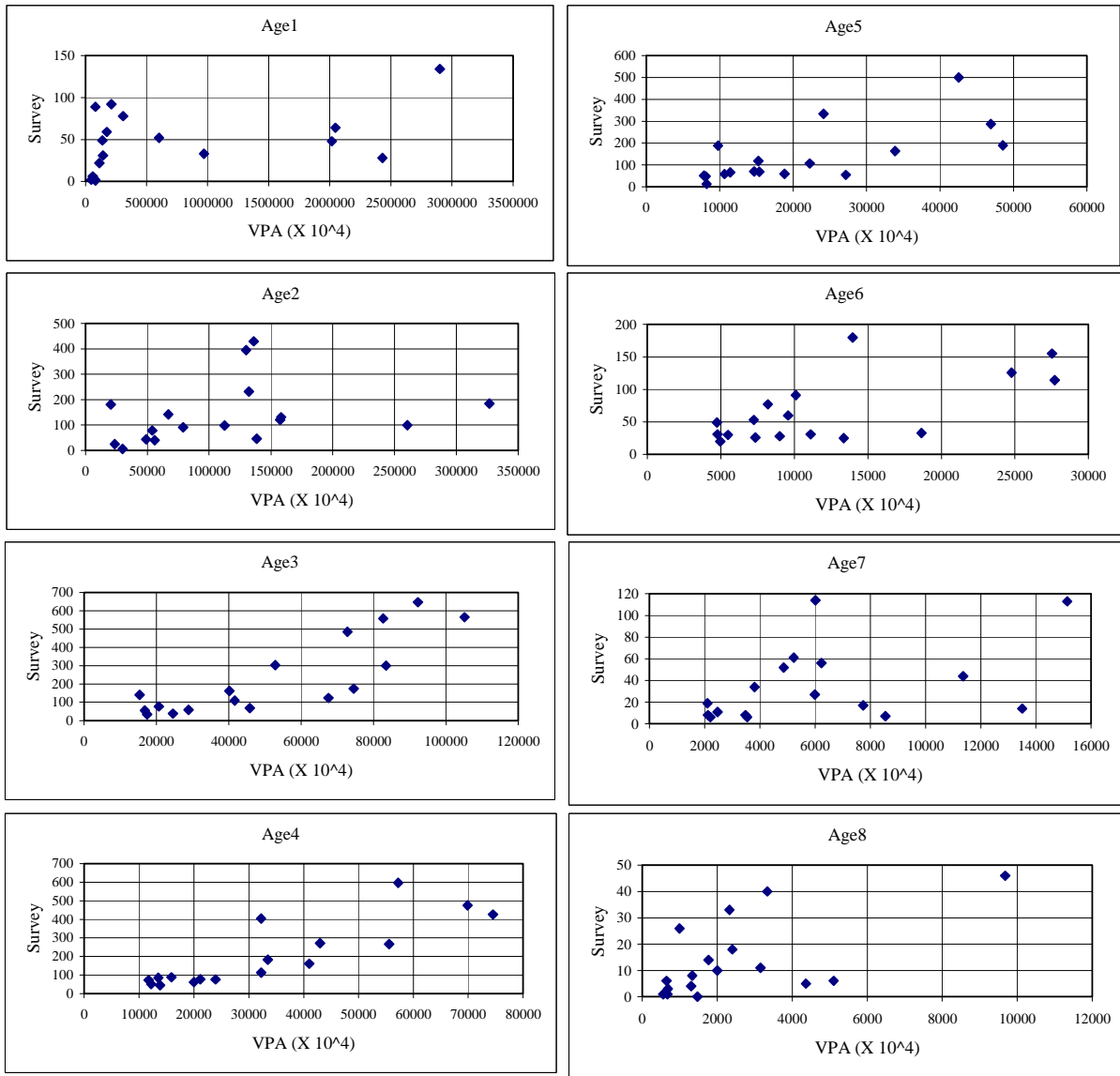


Figure 3.5A (FLT01) Northeast Arctic cod abundance index from the Russian bottom trawl survey.

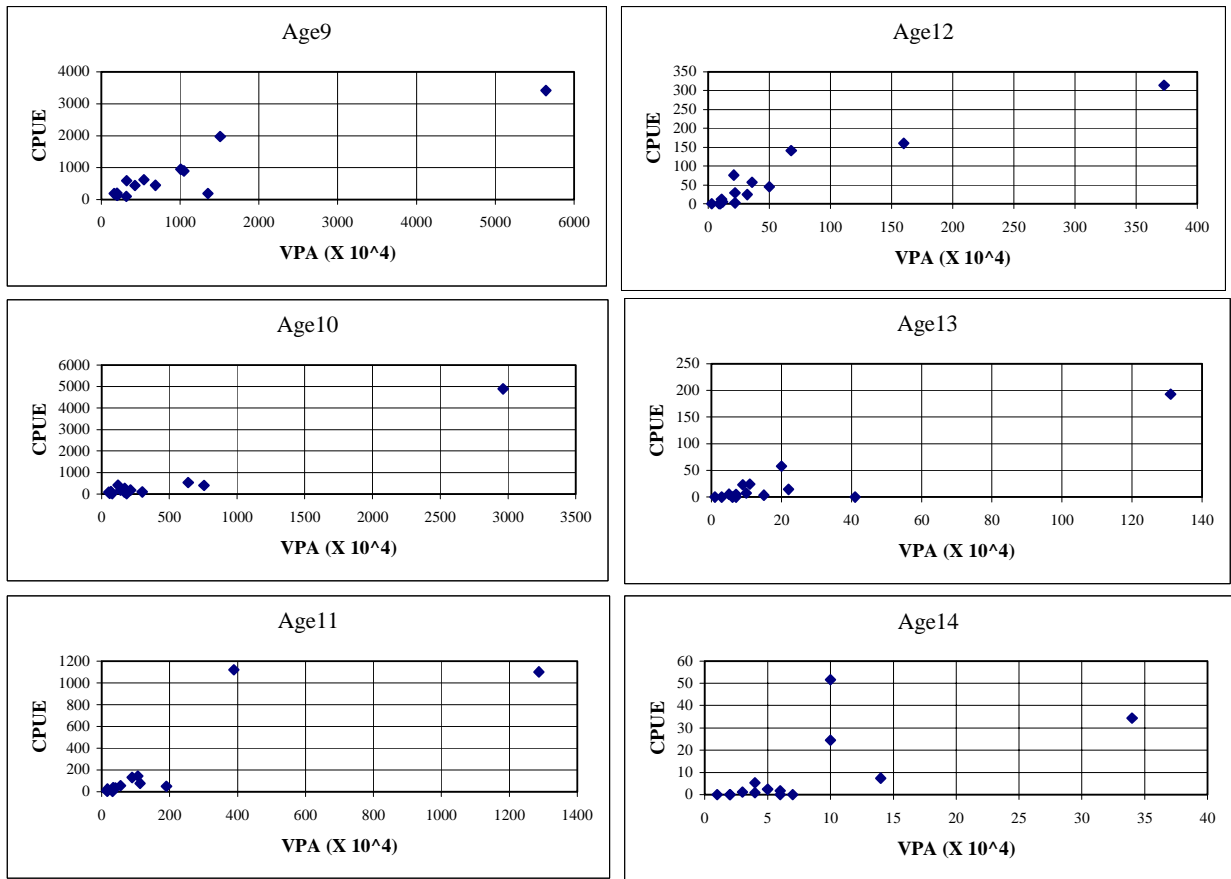


Figure 3.5B (FLT02) Northeast Arctic cod abundance index from the Norwegian trawl catch and effort.

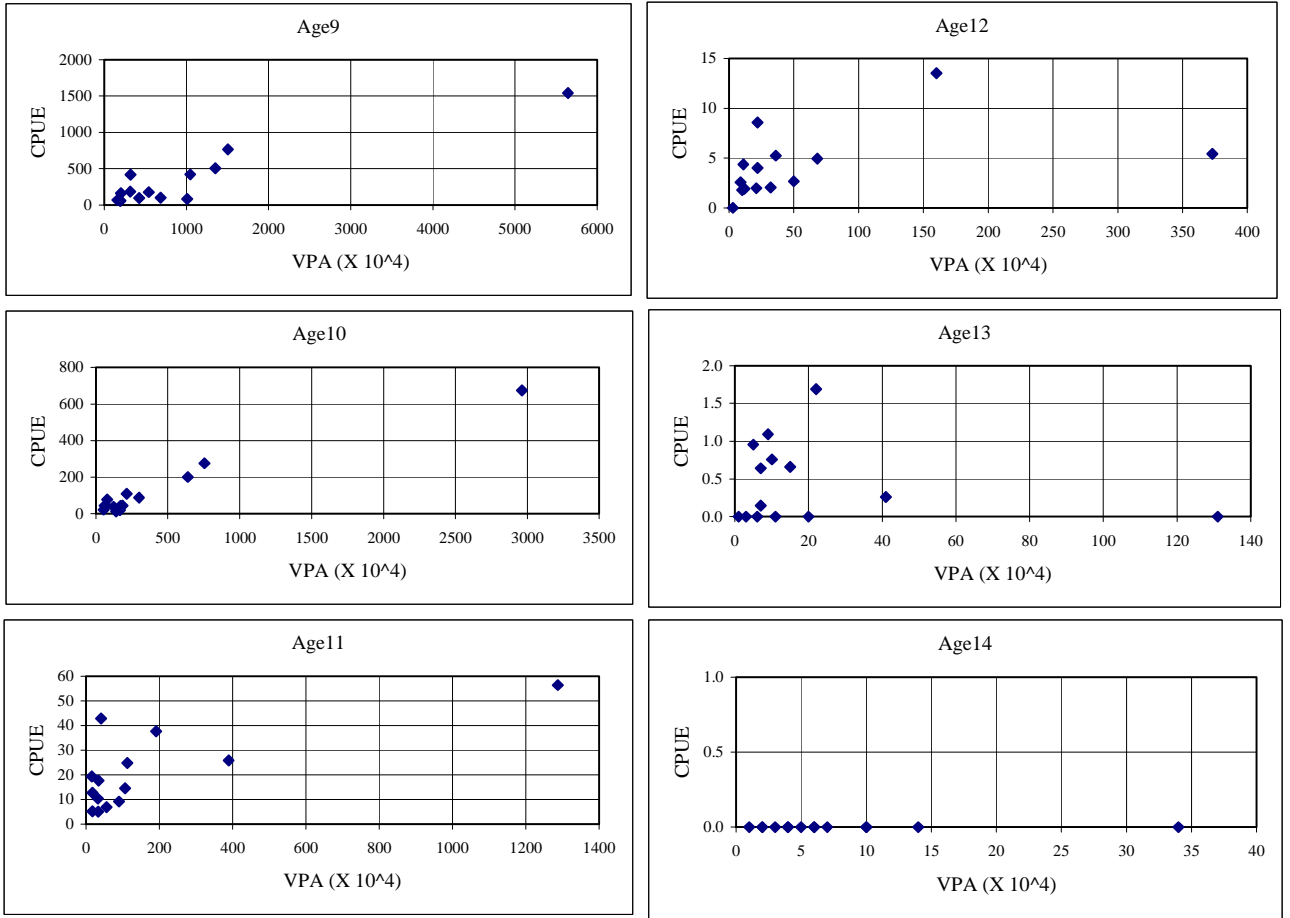


Figure 3.5C (FLT03) Northeast Arctic cod abundance index from the Russian trawl catch and effort.

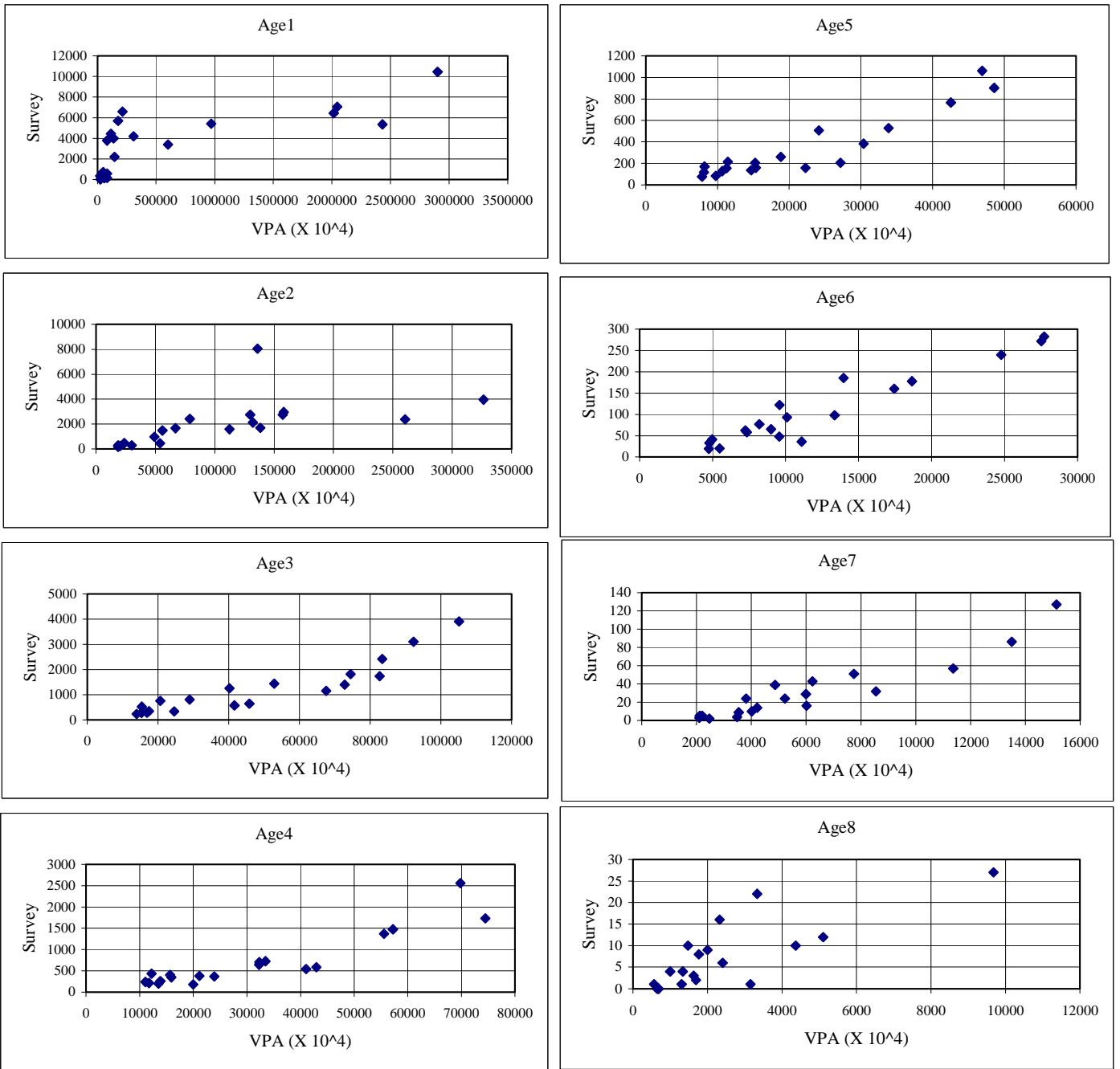


Figure 3.5D (FLT04) Northeast Arctic cod abundance index from the Norwegian bottom trawl survey.

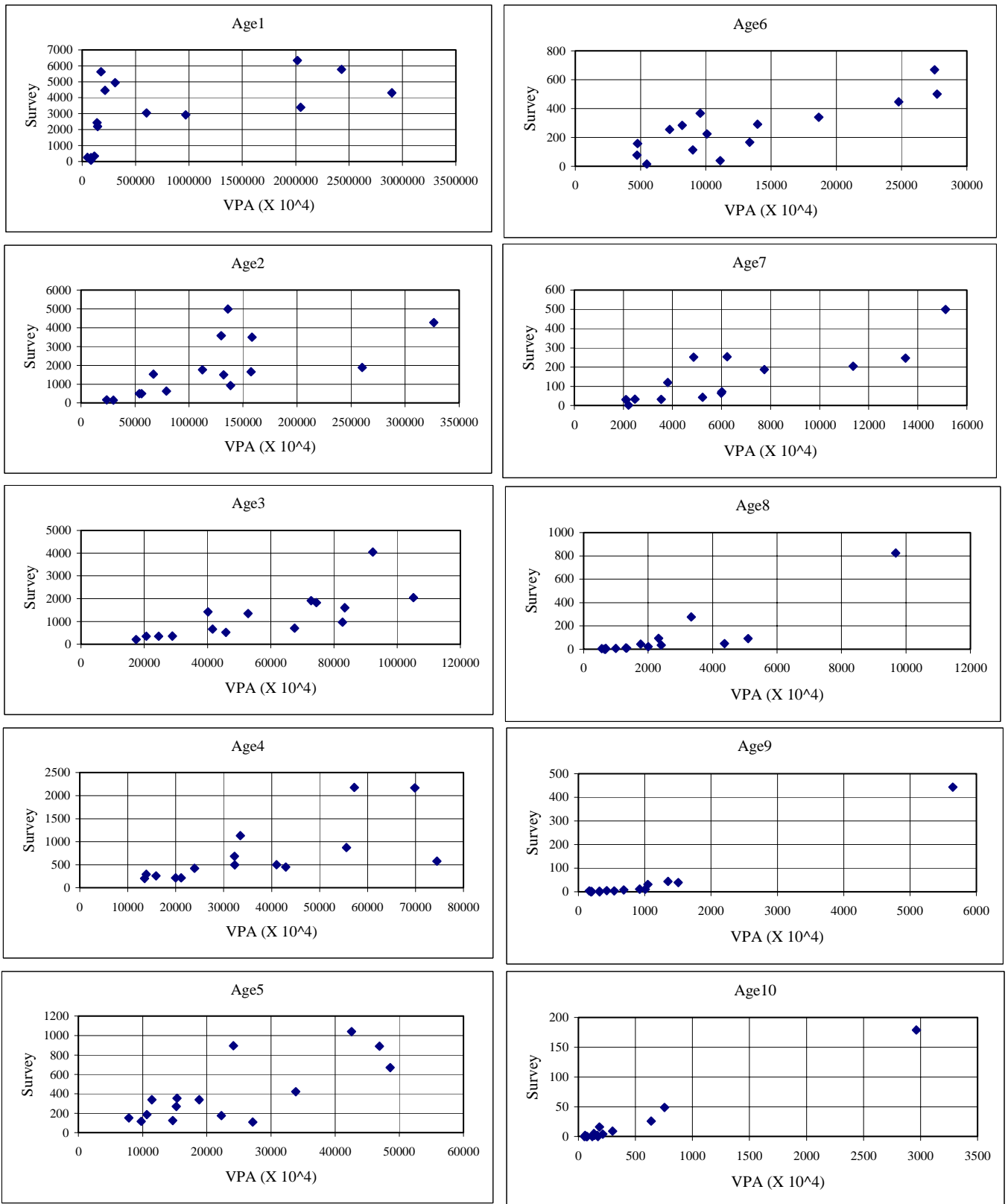


Figure 3.5E (FLT05) Northeast Arctic cod abundance index from the Norwegian Winter and Lofoten acoustic surveys combined.

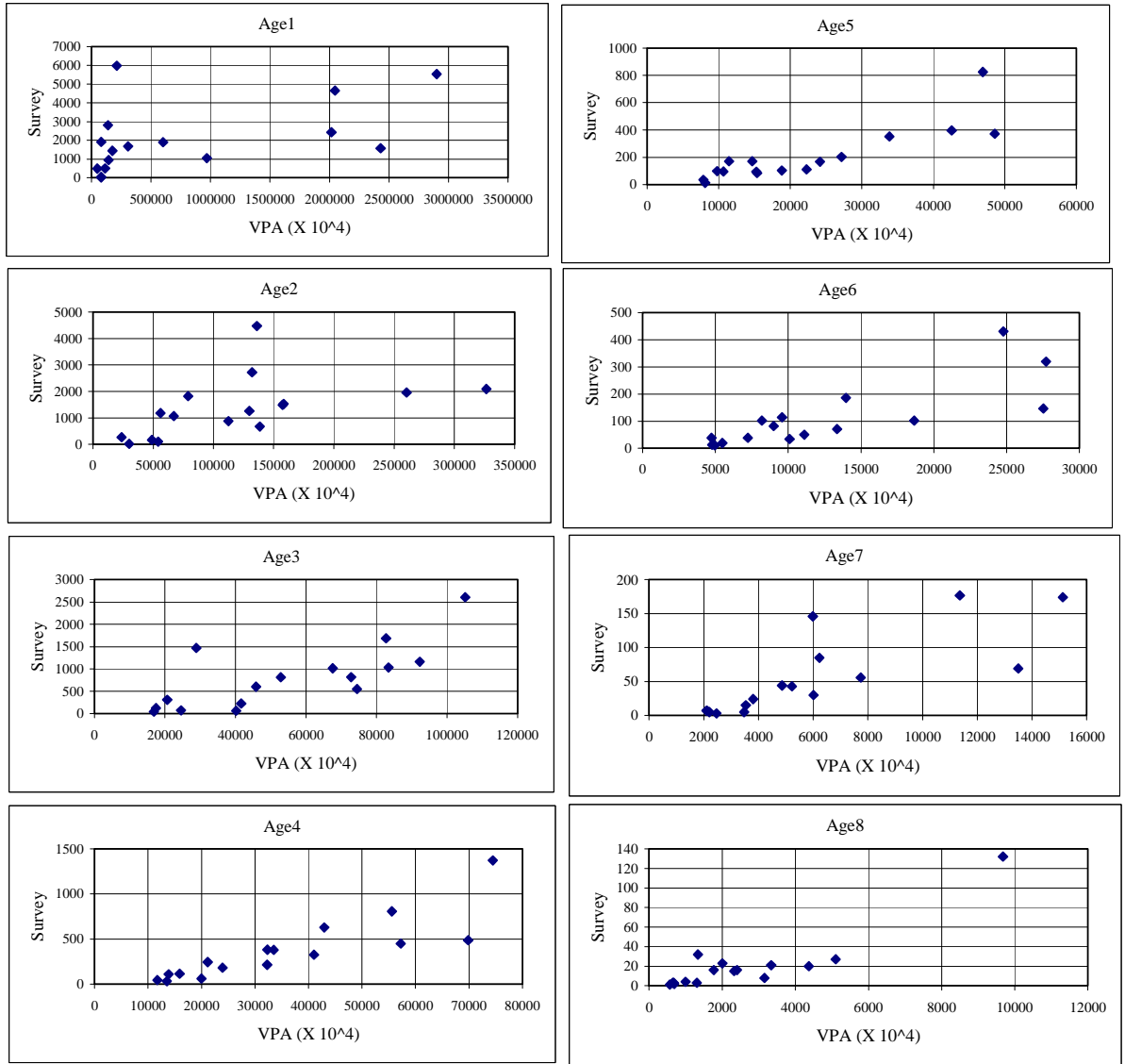


Figure 3.5F (FLT06) Northeast Arctic cod abundance index from the Norwegian Svalbard bottom trawl survey.

**Fig 3.6 Retrospective analysis
NEA cod, cannibalism included**

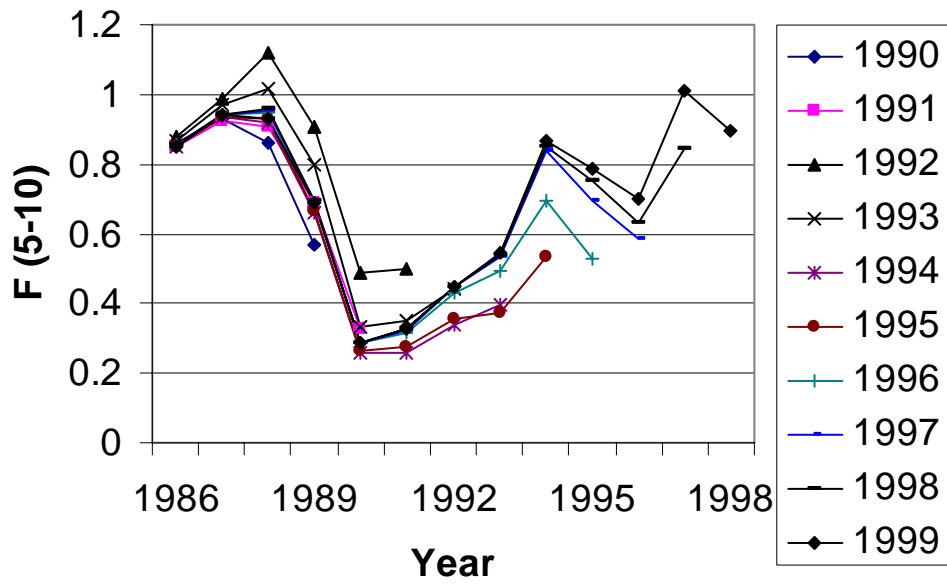
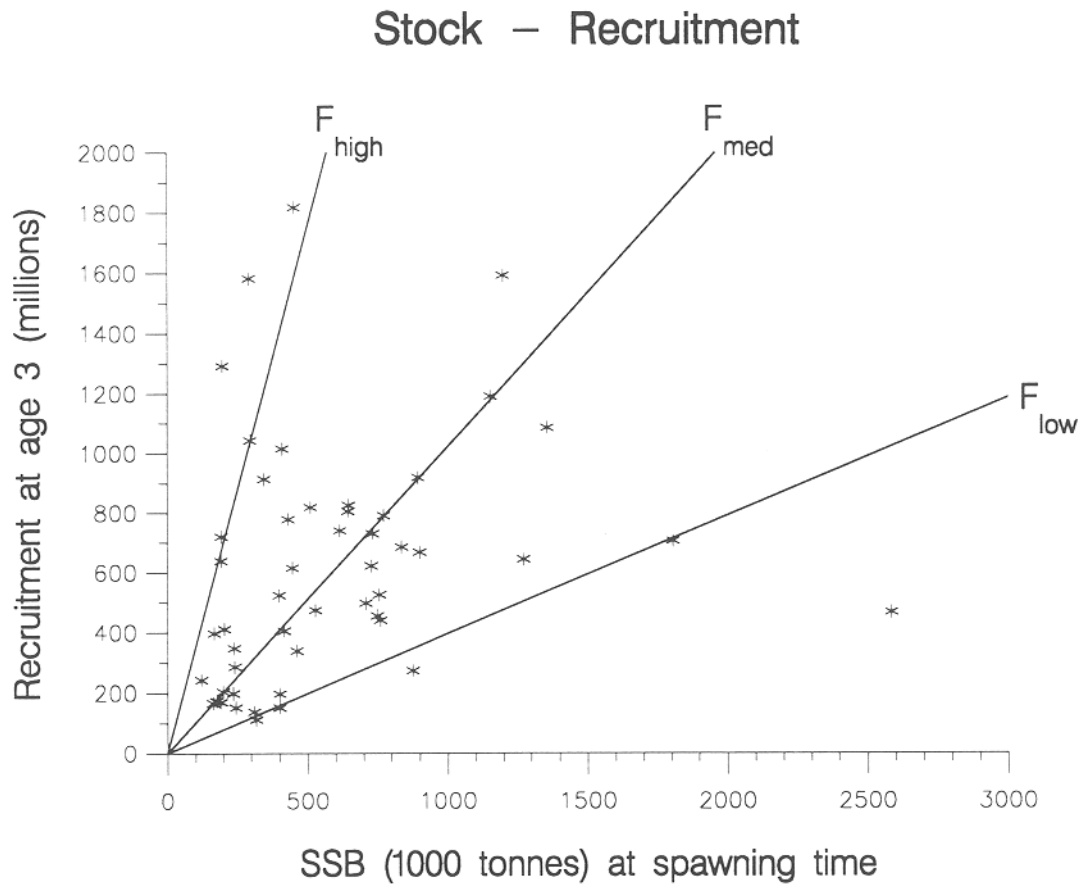


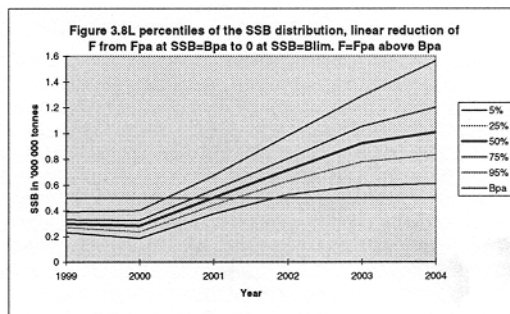
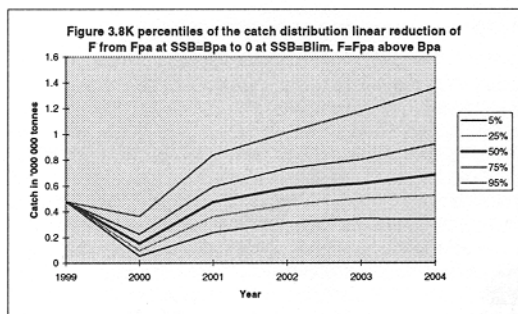
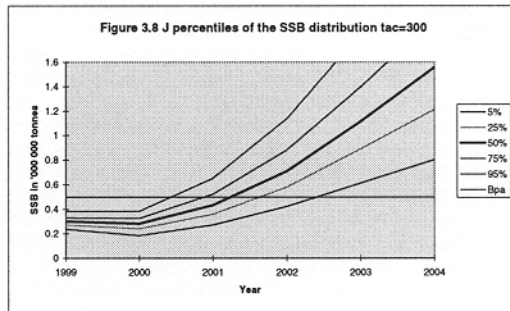
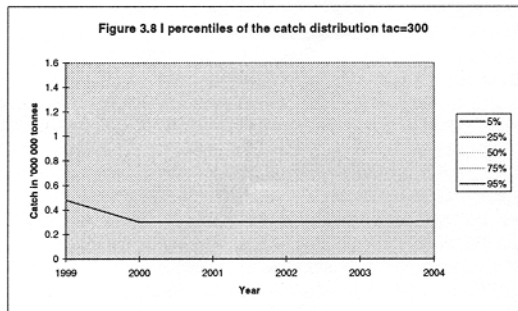
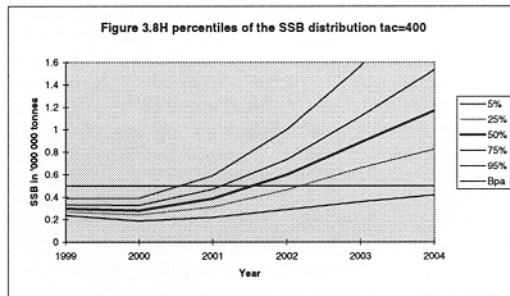
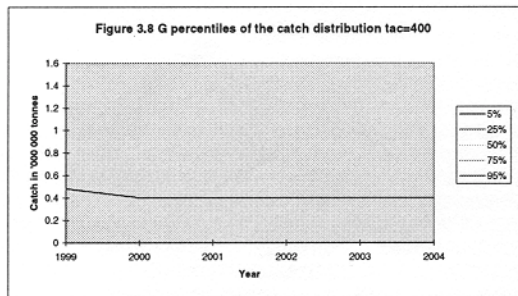
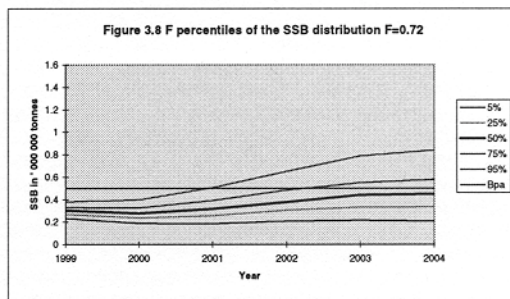
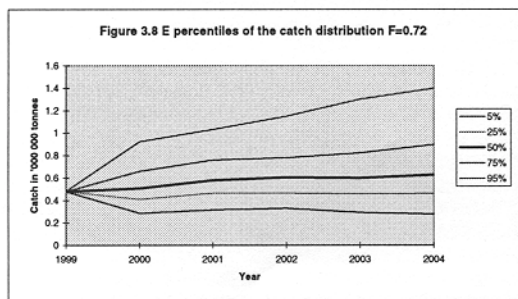
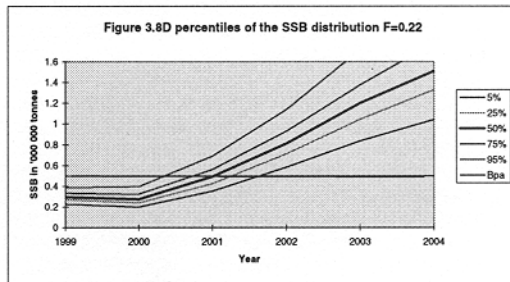
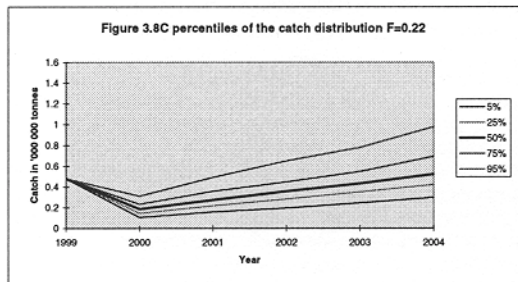
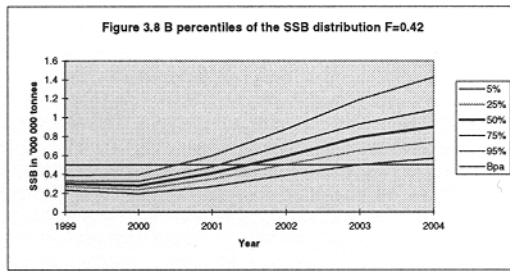
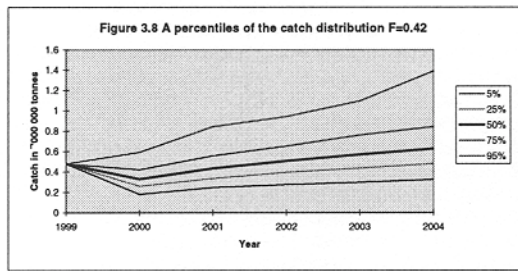
Figure 3.7

North-East Arctic cod (Sub-areas I and II)
30-8-1999



(run: SVPBJA05)

Figure 3.8a-l



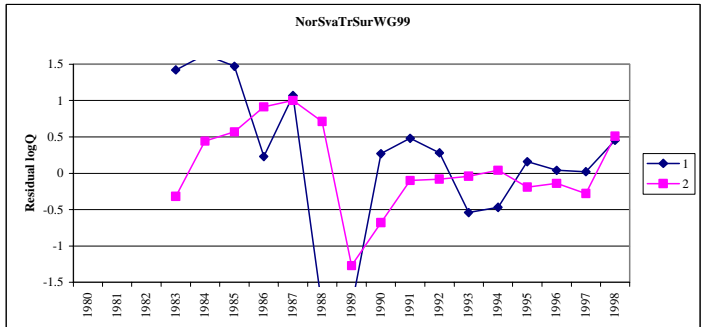
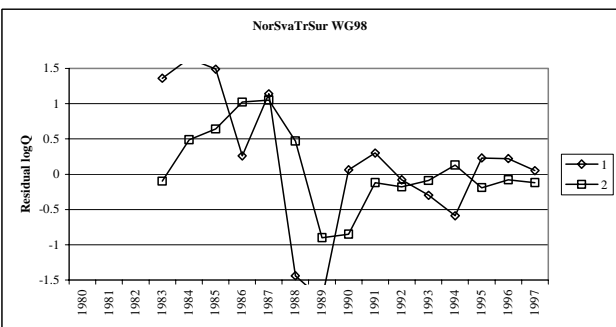
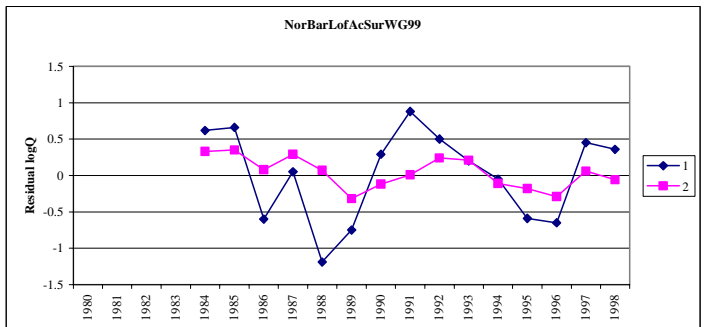
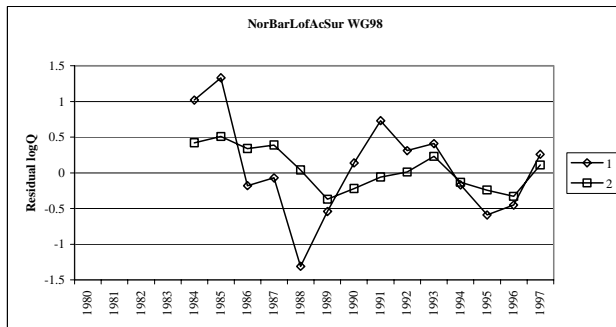
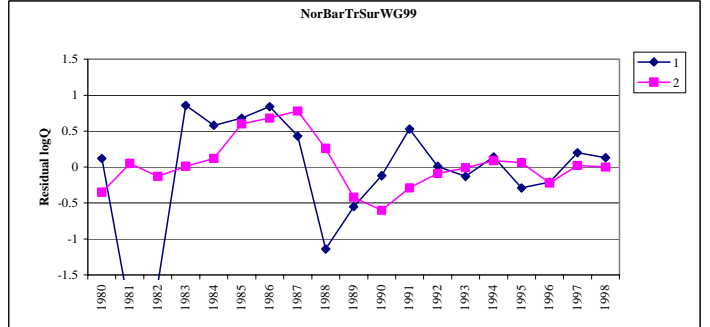
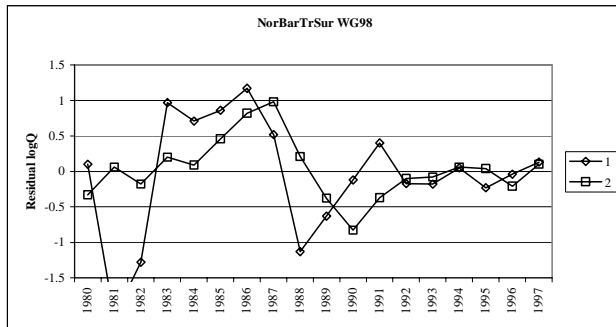
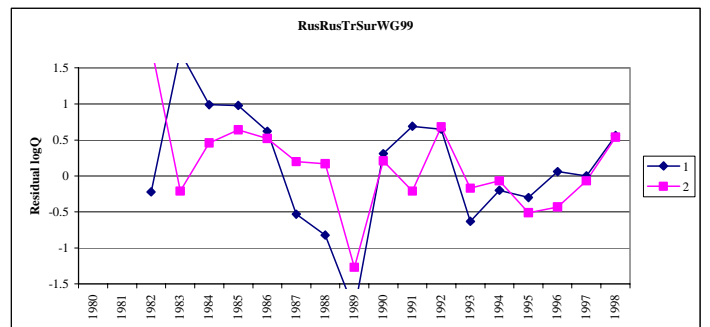
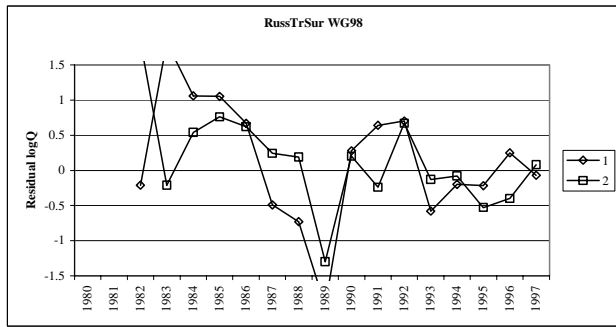


Figure 3.9.1 NE Arctic cod. Residual log catchability by fleet and age for the XSA outputs in the 1998 assessment (left) and the 1999 assessment (right)

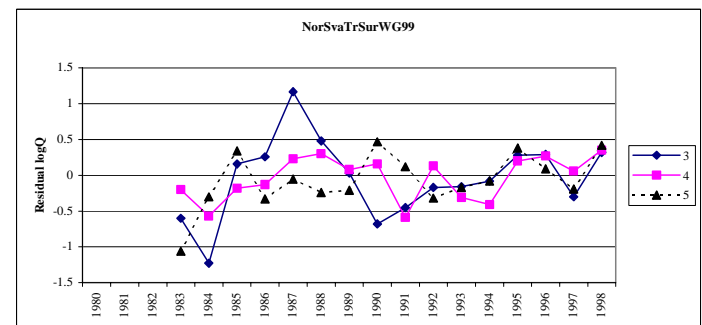
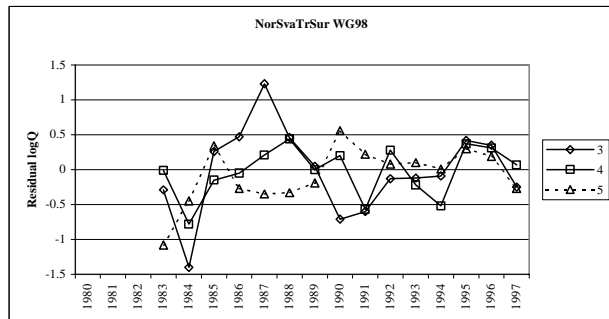
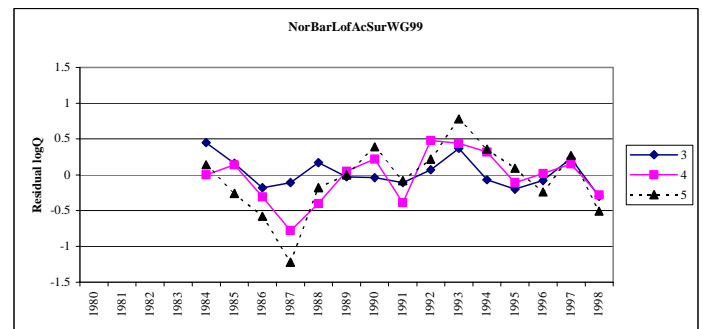
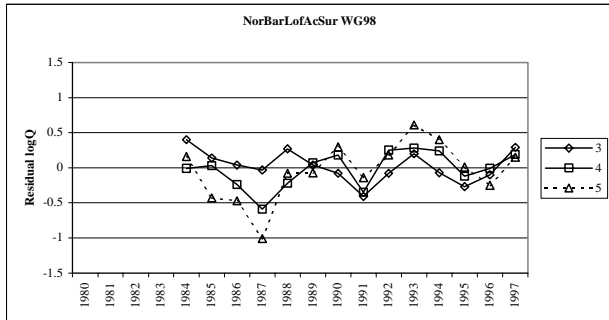
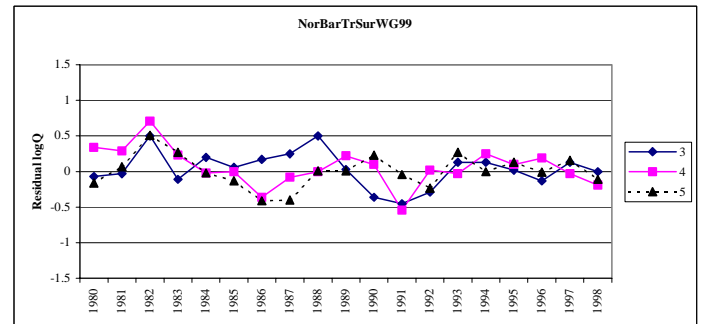
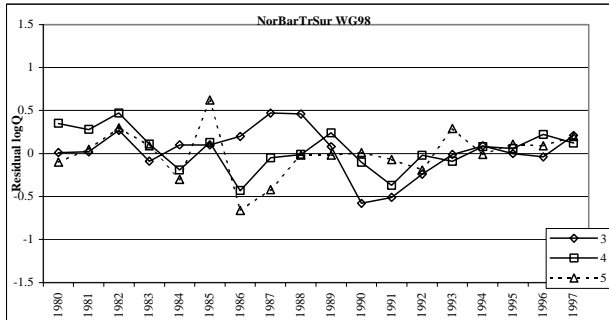
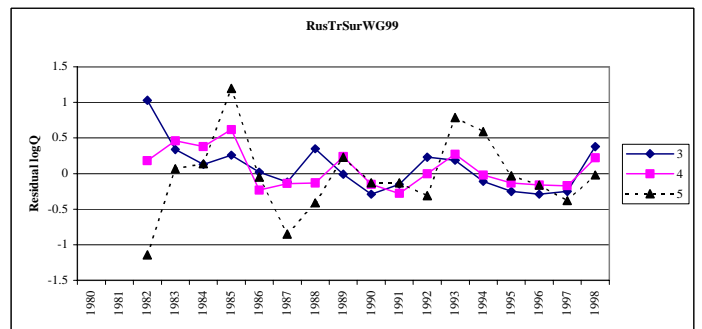
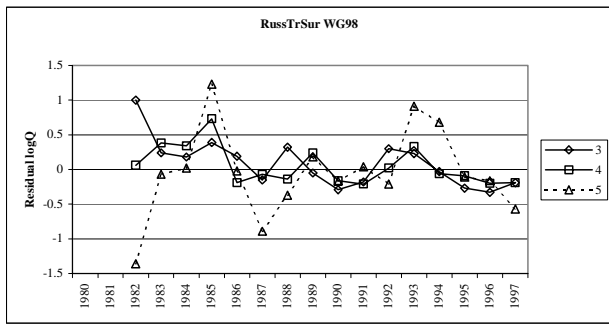


Figure 3.9.2 NE Arctic cod. Residual log catchability by fleet and age for the XSA outputs in the 1998 assessment (left) and the 1999 assessment (right)

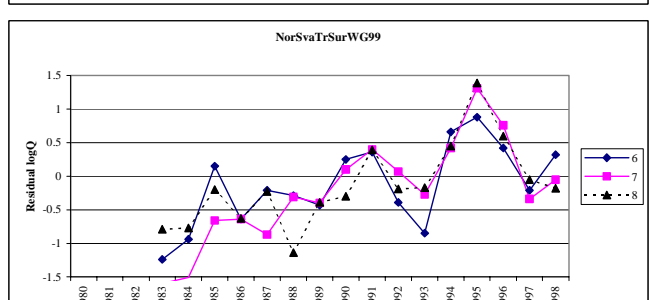
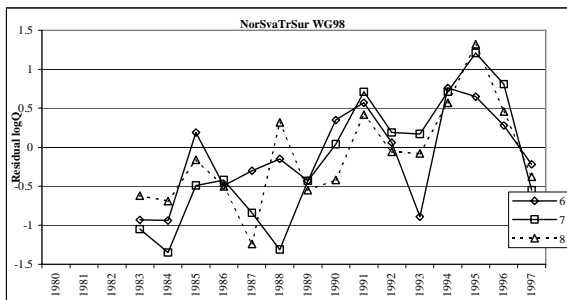
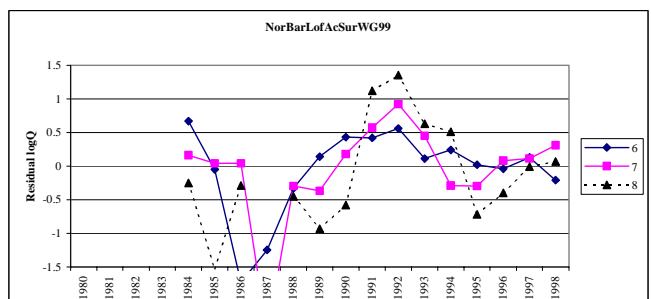
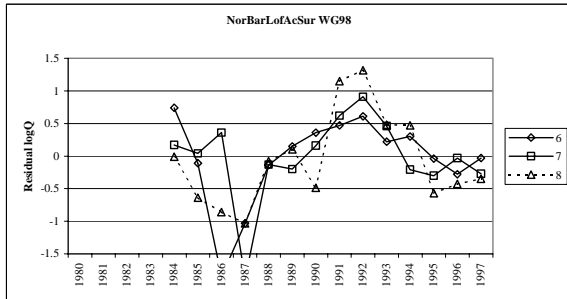
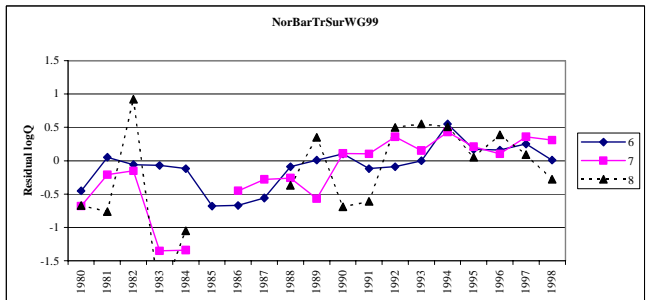
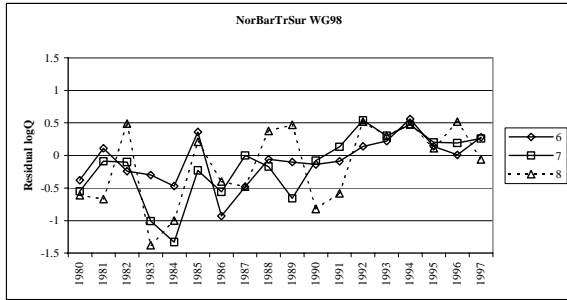
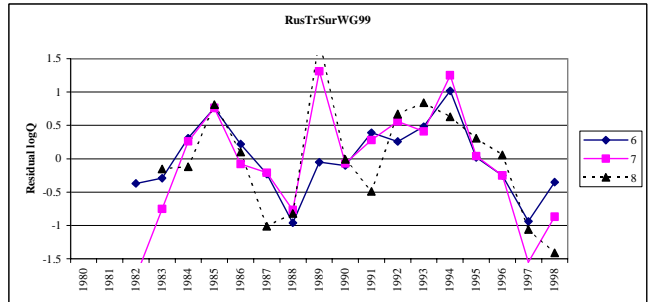
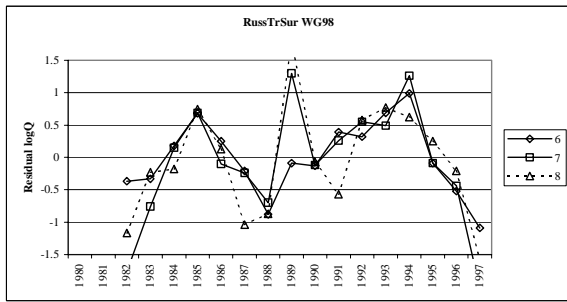


Figure 3.9.3 NE Arctic cod. Residual log catchability by fleet and age for the XSA outputs in the 1998 assessment (left) and the 1999 assessment (right)

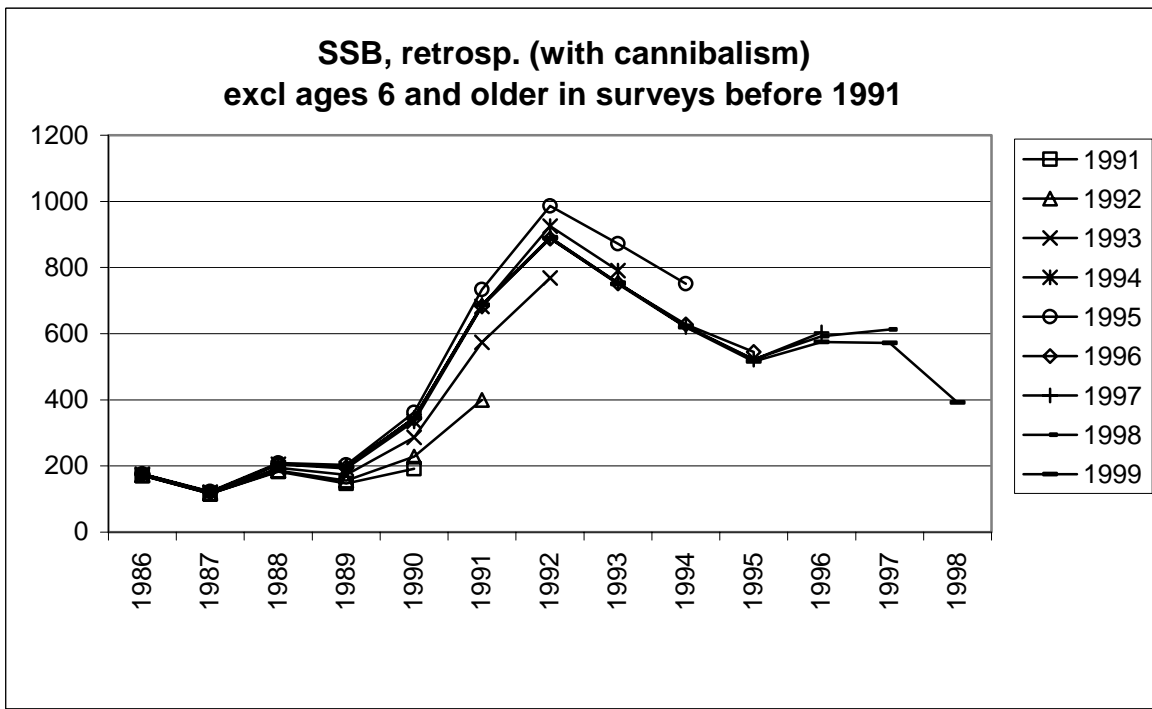
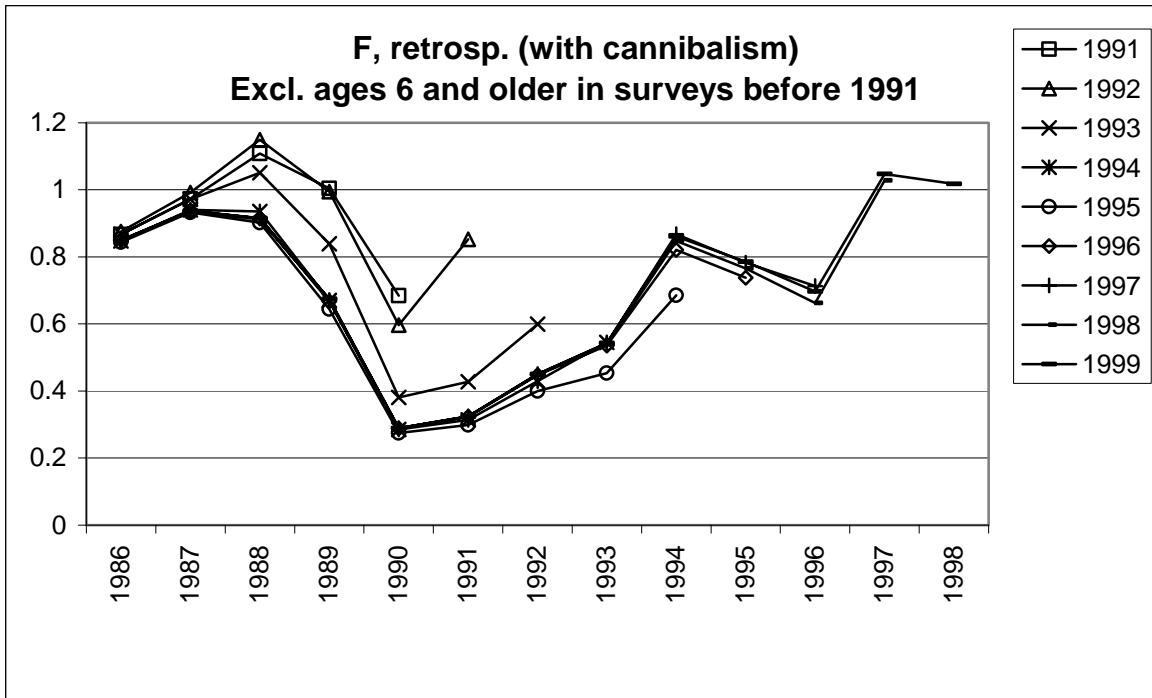


Figure 3.9.4. NE Arctic cod. Retrospective Fbar(5-10) and SSB when deleting survey data for age 6 and older for the years prior to 1992.

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

Year	Sub-area I			Division IIa			Division IIb		
	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
					Russia⁴			Spain⁶	
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	0.92	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	-	0.54	0.98	0.69	-	3.06	2.47	1.40
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		0.85			1.11	0.99
1997			0.61		0.57				0.74
1998			0.37		0.29				0.40

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. 1983-1999 re-calculated from raw data.

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

¹ Survey covered a larger area

² Adjusted indices

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

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

¹ Survey covered a larger area

² Adjusted indices

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

Year	5	6	7	8	9	10	11	12+	Sum
1985	0.68	7.45	12.36	3.11	1.15	1.01	0.45		26.21
1986	2.49	3.30	5.54	2.71	0.16		0.40	0.08	14.66
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
1999	0.25	1.92	4.84	14.58	8.42	0.75	0.19	0.10	31.05

Table A5. North-east Arctic COD. Abundance indices (millions) from the Norwegian Bottom Trawl survey in the Svalbard area in September-October. Index of number of fish at each age. Rock-hopper gear (1983-1988 back-calculated from bobbins gear). Corrected for length-dependent effective spread of trawl. 1983 and 1987-1998 re-calculated from raw data.

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

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

Year	1	2	3	4	5	6	7	8
1978	14.2	23.1	32.1	45.9	54.2	64.6	67.6	76.9
1979	12.8	22.9	33.1	40.0	52.3	64.4	74.7	83.0
1980	17.6	24.8	34.2	40.5	52.5	63.5	73.6	83.6
1981	17.0	26.1	35.5	44.7	52.0	61.3	69.6	77.9
1982	14.8	25.8	37.6	46.3	54.7	63.1	70.8	82.9
1983	12.8	27.6	34.0	45.9	54.5	62.7	73.1	78.6
1984	14.2	28.4	35.0	48.6	56.6	66.2	74.1	79.7
1985	16.5	23.7	40.6	48.7	61.3	71.1	81.2	85.7
1986	11.9	21.6	34.3	49.9	59.8	69.4	80.3	93.8
1987	13.9	21.0	32.0	41.3	56.3	66.3	77.6	87.9
1988	15.3	23.3	30.0	38.7	47.6	56.8	71.7	79.4
1989	12.5	25.4	33.5	39.9	46.8	56.2	67.0	83.3
1990	14.4	27.9	38.8	47.1	53.8	60.6	68.2	79.2
1991	13.6	27.2	42.6	51.7	59.5	67.1	72.3	77.6
1992	13.2	23.9	40.0	49.9	60.2	68.4	76.1	82.8
1993	11.3	20.3	35.5	50.8	59.0	68.2	76.8	85.8
1994	12.0	18.3	30.4	44.7	55.4	64.3	73.5	82.4
1995	12.7	18.7	29.9	42.0	54.1	64.1	74.8	80.6
1996	12.6	19.6	28.3	41.0	49.3	61.4	72.2	85.3
1997 ¹	11.4	18.8	28.6	40.4	49.9	59.3	69.1	80.6
1998 ¹	10.9	17.4	29.3	40.0	50.5	58.9	67.5	76.3
1999	12.1	18.8	29.0	40.6	50.6	59.9	70.3	78.0

¹ Adjusted lengths

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

Year	Age							
	1	2	3	4	5	6	7	8
1983		190	372	923	1597	2442	3821	4758
1984	23	219	421	1155	1806	2793	3777	4566
1985		171	576	1003	2019	3353	5015	6154
1986		119	377	997	1623	2926	3838	7385
1987								
1988	45	114	241	492	892	1635	3040	4373
1989	16	158	374	604	947	1535	2582	4906
1990	26	217	580	1009	1435	1977	2829	4435
1991	18	196	805	1364	2067	2806	3557	4502
1992	20	136	619	1118	1912	2792	3933	5127
1993	9	71	415	1179	1743	2742	3977	5758
1994	13	55	259	788	1468	2233	3355	4908
1995	16	54	248	654	1335	2221	3483	4713
1996	15	62	210	636	1063	1999	3344	5514
1997 ¹	12	54	213	606	1112	1790	2851	4761
1998 ¹	10	47	231	579	1145	1732	2589	3930
1999	13	55	219	604	1161	1865	2981	3991

¹ Adjusted weights

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

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

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

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

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

Year	Age										Total	
	0	1	2	3	4	5	6	7	8	9 10+		
1985 ¹	45	105	895	422	255	83	44	50	21	2	16	1939
1986 ¹	60	53	141	980	444	183	56	62	19	0	2	2000
1987 ²	8	15	170	170	738	99	67	42	20	9	5	1344
1988 ²	+	+	43	161	106	245	34	10	2	+	+	602
1989 ¹	2	1	4	17	44	56	99	82	20	6	4	335
1990 ¹	29	22	57	29	35	52	46	89	14	2	1	376
1991 ¹	33	44	75	89	51	53	61	45	43	+	+	494
1992 ¹	228	61	333	317	110	45	37	38	29	22	3	1223
1993 ¹	9	10	45	215	243	136	43	14	14	8	11	783
1994 ¹	215	58	110	208	282	277	120	44	8	4	3	1332
1995 ¹	255	59	47	86	160	203	100	28	8	2	3	951
1996 ^{1,3,5}	210	297	188	130	201	290	276	123	23	1	3	1742
1997 ^{4,5}	342	98	263	216	99	68	49	27	9	1	1	1172
1998 ¹	7	28	117	299	147	41	17	11	4	1	+	673
New method												
1995 ¹	2950	331	75	112	150	180	81	20	6	1	1	3907
1996 ^{1,3}	13765	5869	365	127	63	75	58	23	5	1	+	20352
1997 ⁴	1326	76	303	231	80	38	21	11	3	1	+	2901
1998 ¹	136	130	142	331	133	36	15	9	3	1	+	936

¹ October-December

² September-October

³ Area IIb not covered

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

⁵ Adjusted for incomplete area coverage

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

Year	Age											Total
	0	1	2	3	4	5	6	7	8	9	10+	
	<u>Sub-area I</u>											
1982	1.4	0.2	6.9	13.2	7.4	1.9	2.8	0.4	0.0	0.0	0.0	34.2
1983	4.3	8.0	5.1	4.6	5.4	5.9	2.7	0.7	1.2	0.1	0.0	38.0
1984	0.7	12.3	11.6	25.5	13.7	6.5	4.0	1.6	0.6	0.3	0.0	76.8
1985	3.3	2.9	51.3	35.2	53.1	25.2	4.4	1.8	0.8	0.1	0.1	178.2
1986	0.3	2.2	7.0	60.4	15.8	8.2	1.8	0.6	0.1	0.1	0.0	96.5
1987	+	0.1	3.6	4.0	35.9	6.3	3.6	0.6	0.1	0.1	+	54.4
1988	0.2	0.1	1.7	5.7	5.2	17.2	2.6	0.6	0.2	0.1	+	33.4
1989	0.4	0.1	1.0	3.5	11.2	15.4	20.8	16.1	3.7	0.7	0.3	73.4
1990	6.8	4.8	12.7	5.3	6.0	9.4	8.2	14.6	2.2	0.2	+	70.2
1991	3.1	5.9	10.9	14.0	7.5	7.7	8.1	5.5	4.2	0.3	0.1	67.3
1992	10.3	2.9	26.4	42.3	22.4	8.5	4.6	5.6	3.3	2.7	0.6	129.6
1993	1.7	1.1	7.8	67.9	89.5	47.2	16.0	4.6	4.2	2.0	3.2	245.3
1994	15.8	2.8	10.9	28.4	45.0	52.4	17.9	6.3	1.4	0.7	1.1	182.6
1995	24.8	7.3	3.8	13.1	30.4	40.5	13.8	3.1	1.1	0.3	0.3	138.5
1996	10.4	12.8	10.4	7.0	11.7	16.9	12.1	5.1	1.1	0.1	0.1	87.7
1997	-	-	-	-	-	-	-	-	-	-	-	-
1998	1.2	4.5	27.1	51.0	14.7	5.5	1.8	1.1	0.4	0.1	+	107.4
	<u>Division IIa</u>											
1982	0.1	+	11.7	10.6	4.7	1.1	4.1	2.0	0.2	0.3	0.2	35.0
1983	0.7	0.4	0.3	1.5	6.4	5.0	2.1	1.3	1.2	0.1	0.2	19.2
1984	0.4	0.7	0.6	3.7	4.0	6.7	4.7	1.1	0.3	0.1	0.2	22.5
1985	0.2	0.2	1.4	3.7	9.5	12.6	6.4	2.5	0.6	0.1	0.1	37.6
1986	0.0	+	0.1	2.5	2.9	3.2	1.5	0.5	0.4	0.0	0.2	11.3
1987	0.0	0.0	0.0	0.0	3.0	1.7	2.3	0.9	0.1	0.0	0.1	8.1
1988	0.2	+	0.1	0.2	1.2	10.0	2.4	0.7	0.2	0.1	+	15.1
1989	0.0	+	0.1	0.3	0.9	1.3	3.9	3.9	1.2	0.5	0.2	12.3
1990	0.0	+	0.3	1.1	1.6	2.2	1.9	4.4	0.9	0.1	+	12.5
1991	1.0	0.1	0.5	1.3	1.9	2.2	2.5	1.9	1.7	0.2	0.1	13.3
1992	0.4	0.3	0.3	2.7	3.8	3.0	2.2	2.1	1.8	1.3	0.1	18.0
1993	0.2	0.1	0.1	3.5	9.9	13.1	4.5	1.3	1.2	0.7	0.8	35.4
1994	0.2	0.1	0.3	4.0	28.3	46.2	22.4	6.3	1.4	0.8	1.6	116.6
1995	4.8	1.3	1.0	1.6	6.1	19.6	8.8	2.7	0.7	0.1	0.2	46.9
1996	4.3	15.6	7.1	5.7	9.2	12.4	6.9	1.7	0.4	+	+	63.5
1997	8.1	0.6	1.5	2.9	2.5	2.3	2.8	2.0	0.7	+	+	23.5
1998	0.4	1.8	1.1	11.9	10.8	6.7	5.6	3.8	1.6	0.1	0.1	43.8

Table A11 (Continued)

	<u>Division IIb</u>											
1982	9.9	1.7	42.5	17.8	1.1	0.2	1.5	0.5	0.0	0.0	0.0	75.2
1983	9.7	14.9	5.0	9.4	11.0	2.6	0.7	0.8	0.7	0.1	0.1	55.0
1984	1.4	7.7	22.7	7.4	2.7	2.4	1.3	0.4	0.2	0.2	0.0	46.4
1985	9.1	9.4	45.2	32.3	32.8	11.5	5.3	1.8	0.3	0.0	0.1	147.8
1986	1.6	2.9	14.8	67.2	19.9	16.4	5.4	1.3	0.6	0.1	0.0	127.1
1987	0.0	0.2	5.6	11.0	64.4	4.0	2.2	0.5	0.1	0.0	0.0	88.0
1988	0.1	0.4	4.8	13.7	15.1	25.0	2.5	0.6	0.1	0.2	0.0	62.8
1989	0.6	0.1	0.3	3.8	6.4	6.1	9.2	5.4	0.2	0.4	0.2	33.7
1990	0.1	0.7	1.3	2.3	2.9	3.7	3.9	8.6	1.6	0.3	+	25.4
1991	6.4	7.1	10.1	8.4	5.2	6.3	8.2	6.5	5.9	0.5	0.1	64.7
1992	60.5	15.1	60.5	60.8	13.8	5.2	6.5	5.0	5.1	3.4	0.5	236.4
1993	4.7	5.9	23.8	60.3	44.6	24.7	5.6	3.2	3.4	2.5	3.6	182.3
1994	3.0	6.0	19.5	44.3	61.4	45.3	16.3	5.6	1.5	1.0	1.9	205.6
1995	36.0	8.6	7.7	18.3	35.5	21.7	13.6	2.3	0.5	0.1	0.3	144.6
1996	-	-	-	-	-	-	-	-	-	-	-	-
1997	15.9	7.3	25.7	20.1	7.0	4.2	2.3	0.8	0.3	+	+	83.6
1998	2.2	7.9	25.7	81.9	54.4	9.6	3.3	1.9	0.4	0.1	+	187.6
	<u>Total (Sub-area I and Division IIa and IIb)</u>											
1982	3.7	0.6	18.1	14.1	5.1	1.3	2.6	0.7	0.0	0.1	0.0	46.3
1983	5.4	8.9	4.3	5.6	7.3	4.7	2.0	0.8	1.1	0.1	0.0	40.2
1984	0.9	9.2	14.2	16.2	8.6	5.0	3.1	1.1	0.4	0.3	0.1	59.1
1985	5.0	4.9	43.0	30.3	40.5	18.8	4.9	1.9	0.6	0.0	0.0	150.0
1986	0.7	2.2	9.1	56.5	16.1	10.6	3.0	0.8	0.3	0.1	0.0	99.4
1987	0.0	0.2	4.0	5.9	42.6	5.4	3.1	0.6	0.1	+	0.0	61.9
1988	0.1	0.2	2.5	7.7	7.8	19.0	2.5	0.6	0.1	0.2	0.0	40.8
1989	0.4	0.1	0.6	3.4	8.8	11.8	15.5	11.4	2.6	0.5	0.3	54.8
1990	4.0	3.1	7.8	3.8	4.4	6.6	6.0	11.3	1.8	0.2	+	49.0
1991	4.2	5.9	9.8	11.0	6.2	5.8	7.7	5.6	4.6	0.4	0.1	62.3
1992	30.6	7.8	39.5	48.5	18.2	6.9	5.3	5.2	4.0	2.9	0.5	169.4
1993	2.8	2.8	13.1	64.7	59.7	33.4	9.1	3.4	3.3	2.1	2.9	197.4
1994	11.2	3.3	12.0	30.0	47.5	50.0	18.0	6.1	1.4	0.8	1.3	181.5
1995	24.9	6.4	4.6	12.4	26.7	28.7	12.6	2.7	0.8	0.2	0.3	120.3
1996 ¹	9.3	13.4	9.9	6.8	11.3	16.4	11.4	4.4	1.0	0.1	0.1	84.2
1997 ¹	11.7	4.8	18.4	17.4	7.6	5.9	3.3	1.4	0.5	0.1	+	71.0
1998	1.5	5.2	23.2	55.8	27.1	7.0	2.8	1.7	0.6	0.1	+	125.0

¹ Adjusted assuming area distribution as 1984-1995 average.

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

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

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

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

Table A14 Abundance indices of 0-group fish in the Barents Sea and adjacent waters in 1965–1998

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

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 1965–1998

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

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

Table A16. The North-east arctic COD stock's consumption of various prey species in 1984-1998 (1000 tonnes)

Year	Other Amphipods	Krill	Shrimp	Capelin	Herring	Polar cod	Cod	Haddock	Redfish	G. halibut	Total	
1984	512	27	114	443	735	80	15	22	51	370	0	2369
1985	1173	172	58	157	1640	185	3	32	47	227	0	3695
1986	670	1232	109	143	844	135	142	83	110	316	0	3784
1987	668	1064	66	189	226	32	202	25	4	318	0	2794
1988	408	1228	316	128	334	8	90	9	3	220	0	2743
1989	733	816	243	133	585	3	32	8	11	234	0	2797
1990	1571	137	83	193	1594	7	6	19	15	241	0	3866
1991	1091	66	76	188	2894	8	12	26	20	309	7	4697
1992	1021	103	159	376	2463	331	97	54	106	188	20	4920
1993	788	254	720	317	3058	165	278	285	72	100	2	6039
1994	691	579	725	532	1115	150	604	235	50	80	0	4761
1995	860	981	519	368	638	115	256	393	117	194	1	4441
1996	676	637	1181	349	555	48	106	552	70	98	0	4272
1997	527	391	537	324	950	6	120	360	43	38	1	3298
1998	479	537	537	382	881	65	49	154	21	10	0	3115

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	1115.7	938.0	276.3	77.0	55.4	50.8	30.8	11.0	2.9	2557.9
1998	1321.4	916.2	585.9	239.1	62.5	27.1	17.4	8.9	2.2	3180.7

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. On the average approximately 25% of the catch is with conventional gears, mostly long line, which are used almost exclusively by Norway. 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. In the first periods, 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 other gears (Table 4.2). In recent years Norway and Russia have accounted for more than 90% of the landings (Table 4.3). Before the introduction of national economic 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 1990s 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 1999 (Tables 4.1–4.3, Figure 4.1A)

Final reported landings in 1997 are 148,741 t (Table 4.1) which is close to the figure used in last year's assessment. The provisional landings for 1998 are 94,269 t which is nearly 16,000 t below the landings expected by the Working Group last year. The agreed TAC was 130,000 t, but especially Russia fished well below their quota. Catches decreased substantially in all areas. 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 1999

In 1997 and 1998 only 71% and 73%, respectively, of the TAC was taken. The agreed TAC in 1999 is 78,000 t. The Norwegian quota of 41,000 t is expected to be taken. Russia has transferred 2,600 t of their quota to Norway and expects to take approximately 90% of the remaining 30,400 t. On this basis the landings in 1999 are estimated to be 75,000 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. 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 actual trawl effort on haddock.

4.2.2 Survey results (Tables B1-B6)

Norway provided indices from the 1999 Barents Sea bottom trawl and acoustic survey in January-March. The results of this survey are given by Mehl (1999, WD 23). In 1999 there was full area coverage. Due to the restriction of the survey

to the Norwegian Economic Zone in 1997 and 1998, adjustments were made to the abundance indices using the same procedure as for cod described in Section 3.2.2.

Tables B1 and B3 show the time series of abundance estimates (acoustic and bottom trawl, respectively) from this survey. All the bottom trawl survey indices from 1983 onwards have been recalculated in the same way as for cod (Section 3.2.2). High indices, caused by the good period of recruitment around 1990, can be tracked from year to year in both series and the 1990 year class appears as the strongest for age groups 3–8. Although recruitment has been lower in more recent years, the indices are still well above historical low levels.

Russia provided indices from the 1998 Barents Sea trawl and acoustic survey (Tables B2 and B4) which was carried out in November-January, slightly later than in earlier years. The Russian survey shows the same main trends as the Norwegian survey. From 1995 onwards there has been a substantial change in the method for calculating acoustic indices. The acoustic survey (Table B4) 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, average from 1995 to 1997, and good in 1998.

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 figures have been revised in the process of revising the abundance indices. 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)

Revised age compositions for the Norwegian landings, with final total landings from all countries, were used to revise the number at age in the 1997 landings. Age compositions of the landings for 1998 were available from Norway and Russia in Sub-area I, from Norway, Russia and Germany in Division IIa, and from Norway and Germany in Division IIb. The catches of the other countries were distributed among ages using the combined Norwegian/Russian age composition in Sub-area I, the Russian trawl age composition in Division IIa and the German age composition in Division IIb. The SOP check gave a deviation of 1.2% and 0.6% from the nominal catch for 1997 and for 1998, 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 1998 show an increase for most age groups, but are still well below the level of the early 1990s.

Stock weights (Table 4.9) used from 1985 to 1999 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, fixed weights have been used when survey data are missing or inadequate. The fixed weights have been reduced in the most recent years to be more consistent with observed weights on the younger year classes. The stock weights show an increasing trend for the age groups 3-7 since 1997.

4.3.3 Natural mortality (Table 4.12)

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 1999. The ogive is similar to the 1998 ogive which showed a change towards earlier maturation.

4.3.5 Data for tuning (Table 4.10)

The Norwegian bottom trawl survey indices have been revised and the tuning input has been extended by one age group, but has been reduced by the two earliest years which were not included in the revision. In the tuning, the age range was extended by one year to include the 1990 year class. This extension could not be made for the two first years in the series which therefore were excluded from the tuning. 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	1983–1998
Norwegian bottom trawl	Barents Sea	Winter	1–8	1982–1998
Norwegian acoustic	Barents Sea	Winter	1–7	1980–1998
Norwegian trawl fleet	Total area	All year	8–13	1985–1998

4.3.6 Recruitment indices (Table 4.5)

Four time series of recruitment indices were updated with data from 1998. 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 4.19)

The data used for 1999–2001 in the short-term prediction were also used for these years in the medium-term prediction (1999–2003), with the 2001 data extended forward to 2002 and 2003.

The stock numbers at age are taken from the VPA (Table 4.14) and the recruitment of the 1998 year class from the RCT3 analysis (Table 4.6). The recruitment at age 3 of the 1999 and later year classes is set as the long-term geometric mean of 97 million.

The fishing pattern in 1998 is used in the predictions to take into account a shift towards younger fish from 1997 to 1998

The Russian maturity ogive for 1999 was similar to the 1998 ogive (Table 4.4) and was used for all the years in the prediction because maturity in 1994–1997 was unusually slow.

The most recent surveys show evidence of improved growth for most age groups. Recent averages therefore seem inappropriate for prediction of both catch and stock weights and instead the values for the most recent year are used.

The natural mortality, as estimated from cod predation plus an assumed value of 0.2, shows declining trends for the ages 3–4 and is stable for ages 5–6. For all these ages the 1998 M-value is in the range 0.221–0.234, i.e. predation mortality is only 0.021–0.034. The 1998 values are used in the prediction.

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). As last year, stock size dependent catchability was assumed for ages < 6 years. The XSA has for some years been run with shrinkage over two years and a standard error of the mean of 1.0. The rationale for this was that management had caused large changes in fishing mortality and shrinkage over a longer period might prevent the XSA from picking up such changes. The recent development has been more stable and changing to default settings (5 years and S.E.=0.5) made little difference to the results of the current assessment. However, with default settings the XSA converged and the exploitation pattern became smoother. The Working Group therefore agreed to use the defaults.

The estimated consumption of haddock by cod is incorporated into the XSA analysis by first constructing a catch number at age matrix, adding the numbers of haddock eaten by cod to the catches for the years where such data are available (1984–1998) (Table A16). The consumption of haddock by cod is given below:

Consumption of haddock by cod (million individuals)							
Year	Age						
	0	1	2	3	4	5	6
1984	1944.64	996.46	14.90	0.08	0.00	0.00	0.00
1985	1712.25	1218.13	5.26	0.00	0.00	0.00	0.00
1986	91.95	572.39	245.30	167.68	0.00	0.00	0.00
1987	0.00	760.11	0.00	0.00	0.00	0.00	0.00
1988	0.00	16.64	0.49	8.87	0.00	0.22	0.00
1989	22.83	242.92	0.00	0.00	0.00	0.00	0.00
1990	51.12	143.15	37.21	3.60	0.00	0.00	0.00
1991	0.00	457.71	14.39	0.00	0.00	0.00	0.00
1992	166.61	2113.04	150.23	1.07	0.00	0.00	0.00
1993	786.77	1395.03	167.36	37.43	3.44	2.92	0.00
1994	1396.61	1456.27	80.53	25.02	7.83	0.94	0.01
1995	195.82	2955.63	164.09	11.89	30.04	30.48	0.35
1996	361.99	1678.53	161.35	39.72	5.39	2.59	3.40
1997	0.00	954.51	37.31	26.91	1.70	0.75	0.51
1998	0.00	1292.91	49.12	0.90	1.60	0.45	0.37

The fishing mortality estimated by this XSA was split into the mortality caused by the fishing fleet (F) and the mortality caused by the cod's predation (M2) according to ratio of fleet catch and predation "catch". The new natural mortality data set was then prepared by adding 0.2 (M1) to the predation mortality. This new M matrix (Table 4.12) was used in the final VPA.

The retrospective analysis shows that changes from one year to the next in the assessment can be considerable (Figure 4.2). There has been a tendency towards overestimation of fishing mortality, but an underestimates in the three most recent years are indicated by the current assessment.

4.4.2 Recruitment (Tables 4.6, 4.14)

The XSA estimate of the strength of the 1996 year class at age 3 was accepted. The strength of the 1997 year class at age 3 was calculated from the XSA estimate at age 2 in the terminal year. Total mortality at age 2 shows a declining trend and the 1998 value was used to project the 1997 year class to age 3. The only year class estimated by the RCT3 program was thus the 1998 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 4.11–4.17 and Figures 4.1A and 4.1B)

The tuning diagnostics of the final XSA (predation included) are given in Table 4.11. 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 4.12, 4.13 and 4.14, respectively, while the stock biomass at age and the spawning biomass at age are given in Tables 4.15 and 4.16. A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1950 is given in Table 4.17 and Figures 4.1A and 4.1B.

Compared to last year, the fishing mortality in 1997 was increased by 17%. The fishing mortality in 1998 is 0.475 and virtually the same as in 1997, but a shift in the exploitation pattern towards younger fish is seen. Current fishing mortality is well above $F_{pa}(0.35)$.

The spawning stock biomass in 1998 was decreased by 33% and is now estimated at 150,000 t, slightly less than in the two previous years. A much stronger decline is seen in the total biomass which in 1998 is 250,000 t, less than half of the 1995 level.

4.5.2 Recruitment (Tables 4.5–4.6, 4.14, 4.19)

The estimates of the 1995–1997 year classes at age 3, derived from the XSA (Table 4.14), are 41, 127 and 33 million, respectively. The RCT3 estimate of the 1998 year class is 152 million at age 3 (Table 4.6). The long-term geometric mean is 97 million individuals.

4.5.3 Yield per Recruit (Table 4.18, Figure 4.1C)

The yield per recruit analysis using the fishing pattern and stock parameters for 1999 from the management option input table gave an estimate of $F_{0.1} = 0.20$ while F_{max} was not defined. The *status quo* exploitation level is $F_{98} = 0.475$.

4.5.4 Catch options for 2000 (Table 4.20)

The expected catch of 75,000 t in 1999 gives $F = 0.52$ and the spawning stock biomass will decline from 133,000 t in 1999 to 99,000 t in 2000. A *status quo* F (0.475) in 2000 corresponds to a catch of 68,000 t, and there will be a further reduction of the spawning stock to 76,000 t in 2001. The 1990 year class is still dominating in the stock, but its influence is decreasing and a reduction in fishing mortality to below 0.2 in 2000 is needed to keep SSB above the proposed B_{pa} level of 100,000 t.

4.6 Biological reference points.

4.6.1 Biomass reference points (Figure 4.4)

Historically, an SSB below 60,000 t has produced only poor year classes (Figure 4.4) and ACFM proposes this as B_{lim} . B_{pa} is proposed at 100,000 t, which gives a 95% probability of maintaining SSB above F_{lim} . The Working Group last year, using a different approach, proposed a higher B_{pa} (140,000 t), but did not define B_{lim} . The Working Group agrees with the approach and the values proposed by ACFM.

4.6.2 Fishing mortality reference points

The Working Group last year did not estimate F_{lim} because attempts at estimating F_{loss} gave no reasonable results. ACFM accepted the F_{pa} of 0.35, corresponding to F_{med} , which was proposed by the Working Group. ACFM also estimated F_{loss} and used the median value of 0.49 as F_{lim} .

4.7 Medium-term forecasts and management scenarios.

4.7.1 Input data (Table 4.19)

The input data were the same as used for the short-term prediction. The recruitment at age 3 of the 1999 and later year classes was set equal to the long-term geometric mean of 97 million.

4.7.2 Methods

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

4.7.3 Results (Tables 4.21–4.22 and Figure 4.1D)

In Figure 4.1D the catch level in 2000 and spawning stock biomass level in 2001 are plotted against the fishing mortality, F , in 2000. In Table 4.21, the results of the medium-term prediction are given, for 0.25, 0.5, 0.75 and $1.0 \cdot F_{sq}$, the 0.75 option corresponding to F_{pa} . Detailed output of the prediction for F_{sq} is also given (Table 4.22). In the medium term, the spawning stock will decrease to approximately 50,000 t when fishing at F_{sq} with catches of about 60,000 t. Reduction of fishing mortality to 0.2 is needed to halt the decline in the stock and prevent it from falling below B_{pa} . This corresponds to catches of about 40,000 t.

4.8 Comments to the assessment and forecasts

As shown by the retrospective analysis, the assessment is unstable. In spite of the large uncertainty about the stock level, the Working Group concludes that the spawning stock is still at a fairly a high level. However, the stock will continue to decline as the influence of the 1990 year class is reduced. Improved growth might reduce the decline.

The absolute error in the assessment is likely to be gradually reduced as less abundant year classes recruit to the stock. The methods being developed for cod should in the future also be suitable for haddock, but will not be attempted before the they are accepted for the cod assessment.

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	78,149	67,832	2,760	148,741
1998 ¹	45,403	47,756	1,110	94,269

¹ Provisional figures.

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

Year	Sub-area I		Division IIa		Division IIb
	Trawl	Others	Trawl	Others	Trawl
1967	73.8	34.3	20.5	7.5	0.4
1968	98.1	42.9	31.4	8.6	0.7
1969	41.3	47.7	33.1	7.1	1.3
1970	36.7	22.8	20.2	6.4	0.5
1971	27.3	29.0	15.0	6.6	0.4
1972	193.4	27.8	34.4	7.6	2.2
1973	241.2	42.5	13.9	9.4	13.0
1974	133.1	25.9	39.9	7.1	15.1
1975	103.5	18.2	34.6	9.7	9.7
1976	77.7	16.4	28.1	9.5	5.6
1977	57.6	14.6	19.9	8.6	9.5
1978	53.9	10.1	15.7	14.8	1.0
1979	47.8	16.0	20.3	18.9	0.6
1980	30.5	23.7	14.8	18.9	0.1
1981	19.0	17.9	21.8	18.7	0.5
1982	9.0	8.9	18.5	10.5	-
1983	3.7	3.8	7.6	6.3	0.2
1984	1.6	2.4	6.4	6.9	0.1
1985	24.4	6.0	4.5	6.3	0.1
1986	51.7	18.1	12.8	13.2	0.7
1987	77.8	31.6	22.1	16.1	3.0
1988	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	57.4	20.8	42.5	25.3	2.5
1998 ¹	25.8	19.6	24.7	23.0	0.7

¹ Provisional

Table 4.3 North-East Arctic HADDOCK. Nominal catch (t) by countries
Sub-area I and Divisions IIa and IIb combined. (Data provided by Working Group members).

Year	Faroe Islands	France	German Dem.Re.	Fed. Re. Germ.	Norway	Poland	United Kingdom	Russia ²	Others	Total
1960	172	-	-	5,597	46,263	-	45,469	57,025	125	155,651
1961	285	220	-	6,304	60,862	-	39,650	85,345	558	193,234
1962	83	409	-	2,895	54,567	-	37,486	91,910	58	187,438
1963	17	363	-	2,554	59,955	-	19,809	63,526	-	146,224
1964	-	208	-	1,482	38,695	-	14,653	43,870	250	99,158
1965	-	226	-	1,568	60,447	-	14,345	41,750	242	118,578
1966	-	1,072	11	2,098	82,090	-	27,723	48,710	74	161,778
1967	-	1,208	3	1,705	51,954	-	24,158	57,346	23	136,397
1968	-	-	-	1,867	64,076	-	40,129	75,654	-	181,726
1969	2	-	309	1,490	67,549	-	37,234	24,211	25	130,820
1970	541	-	656	2,119	37,716	-	20,423	26,802	-	87,257
1971	81	-	16	896	45,715	43	16,373	15,778	3	78,905
1972	137	-	829	1,433	46,700	1,433	17,166	196,224	2,231	266,153
1973	1,212	3,214	22	9,534	86,767	34	32,408	186,534	2,501	322,626
1974	925	3,601	454	23,409	66,164	3,045	37,663	78,548	7,348	221,157
1975	299	5,191	437	15,930	55,966	1,080	28,677	65,015	3,163	175,758
1976	536	4,459	348	16,660	49,492	986	16,940	42,485	5,358	137,265
1977	213	1,510	144	4,798	40,118	-	10,878	52,210	287	110,158
1978	466	1,411	369	1,521	39,955	1	5,766	45,895	38	95,422
1979	343	1,198	10	1,948	66,849	2	6,454	26,365	454	103,623
1980	497	226	15	1,365	61,886	-	2,948	20,706	246	87,889
1981	381	414	22	2,398	58,856	Spain	1,682	13,400	-	77,153
1982	496	53	-	1,258	41,421	-	827	2,900	-	46,955
1983	428	-	1	729	19,371	139	259	680	-	21,607
1984	297	15	4	400	15,186	37	276	1,103	-	17,318
1985	424	21	20	395	17,490	77	153	22,690	-	41,270
1986	893	33	75	1,079	48,314	22	431	45,738	-	96,585
1987	464	26	83	3,106	69,333	99	563	76,980	-	150,654
1988	1,113	116	78	1,324	57,273	72	435	31,293	41	91,745
1989	1,218	125	26	171	31,825	1	590	20,903	-	54,859
1990	875	-	5	128	17,634	-	494	6,605	-	25,741
1991	1,117	60	Greenld	219	19,285	-	514	12,388	22	33,605
1992	1,093	151	1,719	387	30,203	38	596	19,699	1	53,887
1993	546	1,215	880	1,165	36,590	76	1,802	34,700	646	77,619
1994	2,761	678	770	2,412	64,688	22	4,673	44,484	877	121,365
1995	2,833	598	1,097	2,675	72,864	14	3,108	54,516	718	138,423
1996	3,743	538	1,510	942	89,500	669	2,275	74,131	217	173,525
1997	3,327	540	1,877	972	97,789	364	2,340	41,228	304	148,741
1998 ¹	1,903	241	854	385	68,747	257	1,229	20,559	94	94,269

¹ Provisional figures.

² USSR prior to 1991.

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

Year	Age									
	3	4	5	6	7	8	9	10	11	12
1981	1	12	64	73	96	100	100	-	-	-
1982	9	55	73	93	96	100	93	-	-	-
1983	17	70	100	99	99	100	-	-	-	-
1984	7	14	35	47	74	82	89	-	-	-
1985	2	8	80	93	96	91	96	-	-	-
1986	+	22	53	86	86	100	83	100	-	-
1987	-	1	21	53	100	100	-	100	-	-
1988	-	3	33	51	-	-	-	-	-	-
1989	-	4	30	63	82	100	-	-	-	-
1990	-	2	30	54	77	87	80	100	-	-
1991	-	7	30	50	80	92	100	100	-	-
1992	2	13	50	62	77	80	94	100	-	-
1993	2	22	49	76	79	88	88	87	100	100
1994	-	2	13	41	90	88	100	100	97	100
1995	-	2	12	42	81	88	100	87	100	94
1996	-	-	10	36	78	86	90	93	90	100
1997	-	3	10	29	60	82	100	83	100	100
1998	-	5	28	50	66	81	91	100	-	100
1999	-	8	24	51	64	84	89	100	100	-

Table 4.5

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.)
59	244	7	-11	-11	-11
60	277	30	-11	-11	-11
61	323	32	-11	-11	-11
62	101	5	-11	-11	-11
63	242	16	-11	-11	-11
64	293	11	-11	-11	-11
65	20	0.3	-11	-11	-11
66	17	0.3	1	-11	-11
67	166	3	8	-11	-11
68	97	0.3	0.3	-11	-11
69	1028	31	29	-11	-11
70	272	10	64	-11	-11
71	54	3	26	-11	-11
72	49	2	16	-11	-11
73	57	13	26	-11	-11
74	115	15	51	-11	-11
75	172	163	60	-11	-11
76	135	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	9	0.3	3	3.9	9
82	260	23	38	2919.3	0.3
83	537	40	62	3832.6	1685
84	85	9	78	1901.1	1809
85	43	5	27	665	680
86	18	0.2	39	163.8	111
87	25	0.4	10	35.4	20
88	85	2	13	81.2	58
89	210	3	14	644.1	493
90	698	81	61	2006	1938
91	299	17	117	1659.4	859
92	84	20	87	727.9	1424
93	91	6	64	603.2	848
94	103	14	64	1463.6	1380
95	41	10	25	309.5	249
96	127	9	39	1268	779
97	-11	-11	21	212.9	246
98	-11	11	59	1244.9	856

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

Analysis by RCT3 ver3.1 of data from file :
 rctl.inp
 NORTHEAST ARCTIC HADDOCK : recruits as 3 year-olds (inc. data for ages 0 & 1)
 Data for 4 surveys over 40 years : 59 - 98

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 = 96

Survey/ Series	I-----Regression-----I					I-----Prediction-----I			
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-T-1	1.17	2.06	.90	.659	37	2.30	4.74	1.031	.332
INT0GP	.07	1.06	2.18	.250	30	39.00	3.83	2.492	.057
N-BST1	.90	-.99	.93	.637	16	7.15	5.41	1.073	.306
N-BSA1	1.21	-2.51	2.11	.253	16	6.66	5.56	2.424	.060
VPA Mean =							4.52	1.199	.245

Yearclass = 97

Survey/ Series	I-----Regression-----I					I-----Prediction-----I			
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-T-1									
INT0GP	.07	1.10	2.15	.223	31	21.00	2.60	2.522	.075
N-BST1	.93	-1.28	.91	.608	17	5.37	3.72	1.058	.427
N-BSA1	1.21	-2.62	1.90	.263	17	5.51	4.03	2.172	.101
VPA Mean =							4.59	1.099	.396

Yearclass = 98

Survey/ Series	I-----Regression-----I					I-----Prediction-----I			
	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
R-T-1	1.17	2.05	.91	.598	38	2.48	4.95	1.049	.299
INT0GP	.07	1.14	2.15	.210	31	59.00	5.25	2.484	.053
N-BST1	.99	-1.65	.94	.579	17	7.13	5.39	1.096	.273
N-BSA1	1.22	-2.77	1.79	.274	17	6.75	5.46	2.079	.076
VPA Mean =							4.63	1.049	.299

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
96	132	4.89	.59	.23	.15	128	4.85
97	55	4.01	.69	.33	.22		
98	152	5.03	.57	.16	.08		

Table 4.7

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Table 1		Catch numbers at age							Numbers*10** ⁻³	
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
AGE										
1,	0,	4069,	0,	392,	1726,	0,	97,	828,	153,	
2,	4446,	222,	13674,	8031,	493,	989,	3012,	243,	2312,	
3,	3189,	65643,	6012,	64528,	6563,	1154,	16437,	2074,	1727,	
4,	37949,	9178,	151996,	13013,	154696,	10689,	5922,	24704,	5914,	
5,	35344,	18014,	13634,	70781,	5885,	176678,	14713,	7942,	31438,	
6,	18849,	13551,	9850,	5431,	27590,	4993,	127879,	12535,	5820,	
7,	28868,	6808,	4693,	2867,	3233,	28273,	3182,	46619,	12748,	
8,	9199,	6850,	3237,	1080,	1302,	1445,	8003,	1087,	17565,	
9,	1979,	3322,	2434,	424,	712,	271,	450,	1971,	822,	
10,	1093,	1182,	606,	315,	319,	100,	200,	356,	1072,	
11,	853,	734,	534,	393,	126,	50,	80,	17,	226,	
12,	867,	178,	185,	202,	68,	30,	60,	0,	79,	
13,	712,	81,	138,	121,	51,	15,	30,	33,	89,	
+gp,	545,	355,	23,	289,	298,	5,	15,	126,	207,	
0 TOTALNUM,	143893,	130187,	207016,	167867,	203062,	224692,	180080,	98535,	80172,	
TONSLAND,	132125,	120077,	127660,	123920,	156788,	202286,	213924,	123583,	112672,	
SOPCOF %,	45,	65,	51,	57,	60,	47,	55,	57,	61,	

Table 1		Catch numbers at age							Numbers*10** ⁻³	
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	169,	2319,	362,	0,	3,	149,	0,	0,	0,	0,
2,	2425,	3632,	5531,	4536,	2151,	832,	3483,	2559,	53,	33,
3,	20318,	40117,	15430,	39604,	28567,	22305,	5911,	26157,	15917,	657,
4,	7826,	71280,	56858,	30947,	72995,	49162,	46161,	22469,	41373,	67632,
5,	7243,	13718,	63354,	49028,	19036,	30592,	40032,	62724,	13505,	41267,
6,	14040,	7138,	8706,	33923,	13627,	5800,	12578,	28840,	25736,	7748,
7,	3154,	6268,	3578,	3209,	9290,	3518,	1672,	5711,	8878,	15599,
8,	2237,	1587,	4407,	1344,	1243,	2709,	970,	578,	1617,	5292,
9,	5918,	2352,	788,	1778,	561,	831,	893,	435,	218,	655,
10,	285,	2015,	527,	243,	410,	104,	122,	188,	175,	182,
11,	316,	497,	1287,	247,	80,	206,	204,	186,	155,	101,
12,	71,	70,	67,	483,	84,	235,	123,	25,	75,	115,
13,	4,	30,	60,	20,	168,	121,	14,	8,	27,	18,
+gp,	109,	12,	20,	8,	44,	69,	457,	22,	14,	52,
0 TOTALNUM,	64115,	151035,	160975,	165370,	148259,	116633,	112620,	149902,	107743,	139351,
TONSLAND,	88211,	155454,	193234,	187888,	146744,	98900,	118079,	160621,	136486,	181726,
SOPCOF %,	80,	84,	80,	74,	74,	62,	69,	66,	79,	79,

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Table 1		Catch numbers at age							Numbers*10** ⁻³	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	0,	480,	15,	133,	0,	281,	1321,	3475,	184,	46,
2,	1058,	276,	3535,	9369,	5916,	3713,	4355,	7496,	18456,	2033,
3,	1520,	23004,	1978,	230217,	70205,	9684,	10037,	13989,	55967,	47311,
4,	1963,	2408,	24359,	22245,	258773,	41702,	14088,	13449,	22043,	18812,
5,	44526,	1870,	1257,	42846,	24018,	88112,	33871,	6808,	7368,	4076,
6,	18956,	21996,	918,	3196,	6873,	5828,	49711,	20789,	2586,	1389,
7,	3611,	7948,	9279,	1606,	419,	4138,	2135,	40044,	7781,	1626,
8,	4925,	1974,	3056,	6737,	423,	382,	1236,	1247,	11043,	2596,
9,	1624,	1978,	826,	2630,	1681,	618,	92,	1350,	311,	6215,
10,	315,	726,	1043,	897,	525,	2043,	131,	193,	388,	162,
11,	43,	166,	369,	989,	147,	935,	500,	280,	96,	258,
12,	43,	26,	130,	538,	339,	276,	147,	652,	101,	3,
13,	14,	52,	27,	53,	68,	457,	53,	332,	84,	74,
+gp,	9,	44,	8,	67,	27,	202,	234,	340,	98,	65,
0 TOTALNUM,	78607,	62948,	46800,	321523,	369414,	158371,	117911,	110444,	126506,	84666,
TONSLAND,	130502,	86601,	78908,	265317,	320065,	221138,	175758,	137218,	110158,	95422,
SOPCOF %,	80,	75,	101,	86,	83,	86,	81,	62,	77,	95,

Table 4.7 (Continued)

Table 1		Catch numbers at age				Numbers*10**-3					
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
1,	0,	0,	1,	2,	0,	0,	1,	96,	8,	0,	
2,	48,	0,	68,	29,	162,	252,	2288,	690,	154,	46,	
3,	17540,	627,	486,	883,	704,	456,	29548,	25596,	3928,	794,	
4,	35290,	22878,	2561,	900,	1930,	841,	1153,	61470,	88297,	9031,	
5,	10645,	21794,	22124,	3372,	884,	836,	546,	1013,	52611,	50868,	
6,	1429,	2971,	10685,	12203,	1374,	307,	715,	376,	586,	19465,	
7,	812,	250,	1034,	2625,	3282,	765,	316,	346,	207,	382,	
8,	546,	504,	162,	344,	906,	2250,	634,	144,	123,	65,	
9,	1466,	230,	162,	75,	52,	499,	1312,	295,	74,	35,	
10,	2310,	842,	72,	80,	37,	70,	416,	484,	119,	44,	
11,	181,	1299,	330,	91,	29,	25,	50,	112,	175,	142,	
12,	87,	111,	564,	320,	21,	36,	5,	35,	87,	135,	
13,	2,	35,	27,	204,	21,	44,	1,	3,	4,	22,	
+gp,	53,	15,	42,	34,	91,	185,	57,	7,	19,	11,	
0 TOTALNUM,	70409,	51556,	38318,	21162,	9493,	6566,	37042,	90667,	146392,	81040,	
TONSLAND,	103623,	87889,	77153,	46955,	21607,	17661,	41270,	96585,	150659,	91744,	
SOPCOF %,	112,	103,	98,	93,	91,	91,	97,	90,	98,	99,	

Table 1		Catch numbers at age				Numbers*10**-3					
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
1,	0,	6,	21,	1258,	117,	11,	33,	69,	75,	11,	
2,	180,	294,	329,	2668,	455,	388,	206,	413,	266,	2139,	
3,	1050,	518,	3968,	12342,	13398,	3202,	1347,	1704,	2303,	2532,	
4,	3951,	1174,	1967,	12652,	25902,	45943,	13565,	5790,	6347,	14301,	
5,	12305,	1871,	1886,	2411,	13154,	34257,	74583,	36543,	12086,	8628,	
6,	23032,	4138,	2876,	1740,	2784,	8750,	21227,	74463,	33929,	7671,	
7,	3423,	6754,	4442,	2070,	973,	1709,	3530,	10834,	49680,	12607,	
8,	247,	851,	4422,	2619,	1297,	693,	385,	1980,	4810,	18708,	
9,	11,	389,	398,	2737,	2131,	1200,	310,	438,	557,	1173,	
10,	36,	50,	21,	241,	2011,	1844,	469,	295,	192,	238,	
11,	12,	3,	1,	12,	314,	1655,	344,	251,	161,	39,	
12,	22,	3,	7,	4,	55,	281,	627,	228,	134,	36,	
13,	17,	9,	2,	1,	9,	46,	39,	790,	121,	50,	
+gp,	15,	15,	7,	1,	6,	2,	2,	23,	147,	113,	
0 TOTALNUM,	44301,	16075,	20347,	40756,	62606,	99981,	116667,	133821,	110808,	68246,	
TONSLAND,	55122,	25816,	33605,	53886,	77619,	121365,	138423,	173525,	148741,	94269,	
SOPCOF %,	96,	96,	96,	100,	100,	100,	100,	100,	100,	100,	

1

Table 4.8

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Table 2		Catch weights at age (kg)								
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,
0 SOPCOFAC,	.4483,	.6468,	.5115,	.5709,	.5998,	.4730,	.5526,	.5668,	.6119,	

Table 2		Catch weights at age (kg)								
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,
0 SOPCOFAC,	.7979,	.8371,	.8017,	.7438,	.7422,	.6155,	.6922,	.6598,	.7910,	.7910,
1										

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Table 2		Catch weights at age (kg)								
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,
0 SOPCOFAC,	.8023,	.7531,	1.0074,	.8566,	.8267,	.8597,	.8093,	.6228,	.7678,	.9477,

Table 4.8 (Continued)

Table 2		Catch weights at age (kg)									
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	
3,	.6600,	.6600,	.6600,	.6600,	1.5200,	1.5700,	.9200,	.8600,	.6400,	.5800,	
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.8600,	1.9900,	1.6600,	1.2500,	.8600,	.8400,	
5,	1.7900,	1.7900,	1.7900,	1.7900,	2.1000,	2.4200,	2.3900,	1.8800,	1.3300,	1.0500,	
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.3800,	2.6800,	2.7100,	2.4100,	2.4500,	1.4300,	
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.8600,	2.9300,	2.8900,	2.6600,	2.9800,	1.9700,	
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3700,	3.2200,	3.0400,	2.9800,	2.5200,	
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,	
0 SOPCOFAC,	1.1247,	1.0321,	.9828,	.9337,	.9107,	.9105,	.9654,	.9013,	.9825,	.9923,	

Table 2		Catch weights at age (kg)									
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
1,	.0000,	.2500,	.0000,	.0400,	.0900,	.2500,	.1900,	.1000,	.1000,	.1200,	
2,	.0000,	.6400,	.0000,	.2800,	.3000,	.4400,	.3100,	.2400,	.3900,	.5300,	
3,	.8000,	.8900,	.7700,	.8400,	.5900,	.5400,	.6300,	.6400,	.6600,	.7100,	
4,	.8900,	1.2200,	1.3100,	1.3600,	1.0600,	.8800,	.6600,	.7900,	.9900,	.9000,	
5,	1.1700,	1.4000,	1.6100,	1.7000,	1.5200,	1.3300,	1.0600,	1.0400,	1.0900,	1.2700,	
6,	1.3700,	1.6000,	1.8600,	1.9600,	1.8400,	1.7400,	1.6800,	1.3400,	1.2200,	1.3800,	
7,	1.7100,	1.7700,	2.1100,	2.2900,	2.1800,	2.0600,	2.1100,	1.8100,	1.4800,	1.5400,	
8,	2.0100,	2.1600,	2.3400,	2.3900,	2.3000,	2.2000,	2.3400,	2.2900,	1.9900,	1.7900,	
9,	3.7000,	3.7000,	2.9300,	2.3200,	2.5200,	2.5000,	2.6700,	2.3100,	2.2600,	2.3700,	
10,	4.4100,	4.4100,	2.3400,	2.8800,	2.6400,	2.5800,	2.9100,	3.1800,	2.2600,	2.5100,	
11,	5.4000,	5.4000,	5.4000,	3.1400,	3.1100,	2.8900,	3.0200,	2.6200,	2.9800,	2.6800,	
12,	6.7000,	6.7000,	6.7000,	2.9200,	3.8000,	2.8200,	3.0700,	3.3700,	2.7800,	3.4300,	
13,	7.4000,	7.4000,	7.4000,	2.2800,	2.8600,	3.2400,	2.7400,	3.2700,	2.8300,	2.7600,	
+gp,	8.0000,	8.0000,	8.0000,	3.2900,	4.4100,	3.1500,	3.1500,	3.1500,	3.1500,	3.1500,	
0 SOPCOFAC,	.9617,	.9562,	.9581,	.9983,	.9997,	.9976,	1.0015,	.9988,	.9987,	.9992,	
1											

Table 4.9

Run title : Arctic Haddock (run: XSATJA04/X04)

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Table 3	Stock weights at age (kg)									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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,

1

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Table 3	Stock weights at age (kg)									
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
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 4.9 (Continued)

Table 3		Stock weights at age (kg)									
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
1,	.0000,	.0000,	.0000,	.0000,	.0520,	.0360,	.0360,	.0420,	.0380,	.0230,	
2,	.0000,	.0000,	.0000,	.0000,	.1330,	.1960,	.1330,	.1030,	.0880,	.1170,	
3,	.6600,	.6600,	.6600,	.6600,	.4800,	.2890,	.4350,	.2960,	.2090,	.2140,	
4,	1.0300,	1.0300,	1.0300,	1.0300,	1.0430,	.9640,	.7730,	.7760,	.4190,	.3860,	
5,	1.7900,	1.7900,	1.7900,	1.7900,	1.6410,	1.8100,	1.8740,	1.5300,	.9190,	.6200,	
6,	2.3800,	2.3800,	2.3800,	2.3800,	2.0810,	2.5060,	2.4560,	2.2620,	2.2400,	1.1240,	
7,	2.8600,	2.8600,	2.8600,	2.8600,	2.5920,	2.2400,	2.6880,	2.2630,	2.8600,	1.5690,	
8,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.3300,	3.1000,	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,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
1,	.0390,	.0430,	.0520,	.0450,	.0330,	.0280,	.0290,	.0290,	.0320,	.0230,	
2,	.1160,	.1270,	.1410,	.1350,	.1010,	.0910,	.0890,	.0940,	.0960,	.1140,	
3,	.2790,	.2640,	.3730,	.3420,	.2980,	.2340,	.2150,	.2080,	.2040,	.2340,	
4,	.4410,	.7300,	.7740,	.8200,	.8080,	.5400,	.3620,	.4480,	.3880,	.4590,	
5,	.6790,	.9450,	1.4380,	1.5190,	1.4300,	1.0590,	.8030,	.6850,	.6840,	.8280,	
6,	1.0050,	1.2910,	1.6300,	1.9620,	2.0020,	1.5310,	1.4440,	1.1250,	1.1080,	1.1920,	
7,	1.4150,	1.5570,	1.7930,	2.2400,	2.2650,	1.9390,	1.9500,	1.8450,	1.4680,	1.4620,	
8,	3.3300,	2.0040,	2.2330,	2.3200,	3.0450,	2.5090,	2.9130,	2.4300,	2.4420,	1.9660,	
9,	3.7000,	2.7160,	2.7310,	2.5680,	3.3910,	2.3740,	2.9340,	2.8150,	3.2180,	3.1550,	
10,	4.4100,	4.4100,	3.0920,	3.5250,	3.4000,	2.6210,	3.0330,	3.3230,	3.3330,	3.2000,	
11,	5.4000,	5.4000,	5.4000,	5.4000,	4.2000,	3.1600,	3.1630,	3.4790,	4.6480,	3.6000,	
12,	6.7000,	6.7000,	6.7000,	6.7000,	4.0000,	4.0000,	4.0000,	4.0000,	4.0000,	4.0000,	
13,	7.4000,	7.4000,	7.4000,	7.4000,	4.4000,	4.4000,	4.4000,	4.4000,	4.4000,	4.4000,	
+gp,	8.0000,	8.0000,	8.0000,	8.0000,	5.0000,	5.0000,	5.0000,	5.0000,	5.0000,	5.0000,	

Table 4.10

HAD-ARCT: North-East Arctic haddock (Sub-areas I and II)
 FLT01: Russian bottom trawl, total area, Nov-Dec, age 1-7, calendar

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1983	1	592.0	95.0	5.0	4.0	0.1	0.0	0.0
1984	1	586.0	584.0	15.0	2.0	1.0	0.1	0.0
1985	1	144.0	1343.0	900.0	4.0	1.0	1.0	0.0
1986	1	14.0	107.0	363.0	164.0	1.0	0.1	0.1
1987	1	9.0	17.0	83.0	225.0	57.0	0.1	0.1
1988	1	3.0	7.0	17.0	40.0	76.0	8.0	0.1
1989	1	18.0	24.0	4.0	14.0	41.0	81.0	11.0
1990	1	143.0	106.0	73.0	42.0	73.0	74.0	57.0
1991	1	429.0	176.0	62.0	9.0	3.0	6.0	18.0
1992	1	282.0	1286.0	346.0	50.0	4.0	6.0	9.0
1993	1	48.0	357.0	1985.0	356.0	48.0	8.0	4.0
1994	1	49.0	58.0	442.0	1014.0	116.0	15.0	1.0
1995	1	72.0	42.0	31.0	123.0	370.0	40.0	5.0
1996	1	23.0	57.0	28.0	49.0	362.0	334.0	29.0
1997	1	46.0	19.0	32.0	32.0	10.0	27.0	10.0
1998	1	29.0	115.0	38.0	46.0	8.0	5.0	15.0

14:13 Wednesday,

September 8, 1999

FLT04: Norway acoustic surv, Barents sea, Jan-Mar, age 1-7, shift, rev94 (Catch: Number)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1980	1	140	50	210	600	180	10	3
1981	1	20	30	40	40	100	60	3
1982	1	50	20	30	10	10	40	20
1983	1	1730	60	20	10	3	3	3
1984	1	8390	2740	60	3	3	3	10
1985	1	3120	4880	1620	3	3	3	3
1986	1	260	710	1900	470	3	3	3
1987	1	50	80	200	380	60	3	3
1988	1	60	80	100	170	190	20	3
1989	1	440	40	30	40	70	110	10
1990	1	2650	490	70	20	20	20	40
1991	1	6850	1100	190	20	3	3	10
1992	1	6900	5650	990	100	3	3	10
1993	1	2280	2400	5060	770	80	3	3
1994	1	2850	360	1130	3910	400	20	3
1995	1	2290	440	310	760	1500	80	10
1996	1	320	660	220	150	480	470	30
1997	1	1560	290	410	150	60	130	180
1998	1	460	570	130	140	40	10	20

September 8, 1999

HAD-ARCT: North-East Arctic haddock (Sub-areas I and II)
 FLT05: Norwegian trawl, catch and effort, ages 8 -13 (Catch: Thousands)

Year	Fishing effort	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13
1985	0.49	166.0	365.0	26.0	7.0	3.0	1.0
1986	0.48	57.0	142.0	236.0	27.0	23.0	2.0
1987	0.47	28.0	41.0	41.0	69.0	43.0	1.0
1988	0.95	16.0	1.0	8.0	79.0	54.0	8.0
1989	0.85	127.0	1.0	9.0	3.0	8.0	1.0
1990	0.48	149.0	3.0	0.1	0.1	1.0	0.5
1991	0.56	703.0	58.0	7.0	0.1	0.5	0.5
1992	0.49	394.0	599.0	96.0	2.0	2.0	0.1
1993	0.49	200.0	279.0	282.0	36.0	9.0	1.0
1994	0.77	209.4	213.6	496.9	223.7	64.1	16.3
1995	0.81	53.0	72.0	120.0	77.0	197.0	0.0
1996	0.61	1197.0	257.0	118.0	106.0	50.0	315.0
1997	0.86	2278.0	240.0	14.0	43.0	47.0	30.0
1998	1.01	6514.0	206.0	68.0	3.0	4.0	12.0

14:13 Wednesday,

September 8, 1999

HAD-ARCT: North-East Arctic haddock (Sub-areas I and II)
 FLT06: Norway bottom trawl survey, Jan-Mar, age 1-7, shifted, reviced94 (Catch: Thousands)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1982	1	48	31	24	9	19	25	7	0
1983	1	5146	189	15	8	2	1	4	1
1984	1	15938	4759	147	5	5	1	1	4
1985	1	3703	3846	1108	6	2	1	1	1
1986	1	799	1544	2902	529	0	0	0	0
1987	1	153	253	689	1164	138	1	0	0
1988	1	95	141	216	340	327	34	1	0
1989	1	546	45	34	50	92	118	18	0
1990	1	3003	334	51	42	27	17	42	0
1991	1	13755	1505	244	21	6	7	16	23
1992	1	5990	5077	1056	105	6	4	3	4
1993	1	2280	3395	4366	497	34	2	1	2
1994	1	1793	536	1711	3395	345	28	0	1
1995	1	2636	525	481	1486	2528	116	9	0
1996	1	679	861	280	194	467	622	35	1
1997	1	1379	227	332	132	34	80	81	7

Table 4.11

Lowestoft VPA Version 3.1

31/08/1999 10:01

Extended Survivors Analysis

Arctic Haddock (run: XSATJA04/X04)

CPUE data from file fleet

Catch data for 49 years. 1950 to 1998. Ages 1 to 14.

Fleet,	First, Last,	First, Last,	Alpha,	Beta
,	year, year,	age , age		
FLT01: Russian botto,	1983, 1998,	1, 7,	.900,	1.000
FLT04: Norway acoust,	1980, 1998,	1, 7,	.990,	1.000
FLT05: Norwegian tra,	1985, 1998,	8, 13,	.000,	1.000
FLT06: Norway bottom,	1982, 1998,	1, 8,	.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 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 29 iterations

Regression weights

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

Fishing mortalities

Age,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1,	.000,	.000,	.000,	.001,	.000,	.000,	.000,	.000,	.000,	.000
2,	.006,	.003,	.001,	.003,	.001,	.003,	.001,	.002,	.004,	.013
3,	.068,	.025,	.053,	.067,	.022,	.012,	.020,	.028,	.030,	.071
4,	.176,	.101,	.139,	.240,	.200,	.101,	.077,	.126,	.193,	.318
5,	.350,	.118,	.233,	.252,	.448,	.451,	.251,	.338,	.461,	.452
6,	.475,	.189,	.269,	.350,	.517,	.659,	.569,	.453,	.628,	.620
7,	.622,	.245,	.318,	.317,	.338,	.708,	.616,	.650,	.636,	.511
8,	.243,	.304,	.251,	.314,	.336,	.430,	.333,	.875,	.685,	.525
9,	.085,	.751,	.227,	.243,	.456,	.599,	.348,	.796,	.655,	.347
10,	.927,	.678,	.077,	.209,	.284,	.943,	.497,	.660,	1.054,	.660
11,	.518,	.169,	.024,	.057,	.461,	.401,	.442,	.547,	.977,	.624
12,	.525,	.232,	.743,	.126,	.400,	1.020,	.259,	.597,	.644,	.603
13,	.473,	.423,	.240,	.214,	.462,	.699,	.358,	.608,	.754,	.530

Table 4.11 (Continued)

1

XSA population numbers (Thousands)

YEAR ,	AGE									
	1,	2,	3,	4,	5,	6,	7,	8,	9,	10,
1989 ,	4.39E+05	3.13E+04	1.77E+04	2.70E+04	4.61E+04	6.74E+04	8.17E+03	1.27E+03	1.49E+02	6.58E+01
1990 ,	4.71E+05	1.44E+05	2.55E+04	1.35E+04	1.85E+04	2.66E+04	3.43E+04	3.59E+03	8.14E+02	1.12E+02
1991 ,	1.64E+06	2.70E+05	8.45E+04	1.68E+04	1.00E+04	1.35E+04	1.80E+04	2.20E+04	2.17E+03	3.14E+02
1992 ,	2.87E+06	9.95E+05	2.10E+05	6.56E+04	1.20E+04	6.50E+03	8.43E+03	1.08E+04	1.40E+04	1.41E+03
1993 ,	1.74E+06	5.40E+05	6.98E+05	1.60E+05	4.23E+04	7.63E+03	3.75E+03	5.03E+03	6.43E+03	8.98E+03
1994 ,	1.78E+06	1.90E+05	2.99E+05	5.31E+05	1.05E+05	2.00E+04	3.72E+03	2.19E+03	2.94E+03	3.34E+03
1995 ,	3.51E+06	2.74E+05	8.38E+04	2.20E+05	3.87E+05	5.41E+04	8.48E+03	1.50E+03	1.17E+03	1.32E+03
1996 ,	1.93E+06	2.98E+05	9.15E+04	5.68E+04	1.43E+05	2.27E+05	2.51E+04	3.75E+03	8.82E+02	6.74E+02
1997 ,	1.49E+06	9.08E+04	1.03E+05	4.10E+04	3.68E+04	8.11E+04	1.17E+05	1.07E+04	1.28E+03	3.26E+02
1998 ,	8.31E+05	2.20E+05	4.12E+04	5.87E+04	2.62E+04	1.83E+04	3.48E+04	5.06E+04	4.42E+03	5.44E+02

Estimated population abundance at 1st Jan 1999

, 0.00E+00, 6.08E+04, 1.27E+05, 3.06E+04, 3.42E+04, 1.37E+04, 8.08E+03, 1.71E+04, 2.45E+04, 2.56E+03,

Taper weighted geometric mean of the VPA populations:

, 1.04E+06, 1.76E+05, 8.97E+04, 6.02E+04, 3.66E+04, 1.90E+04, 8.65E+03, 3.52E+03, 1.36E+03, 5.89E+02,

Standard error of the weighted Log(VPA populations) :

, 1.1625, 1.1896, 1.2250, 1.3144, 1.4085, 1.4504, 1.4969, 1.5255, 1.3778, 1.4025,

YEAR ,	AGE		
	11,	12,	13,
1989 ,	3.28E+01	5.95E+01	4.99E+01
1990 ,	2.13E+01	1.60E+01	2.88E+01
1991 ,	4.66E+01	1.48E+01	1.04E+01
1992 ,	2.38E+02	3.73E+01	5.74E+00
1993 ,	9.40E+02	1.84E+02	2.69E+01
1994 ,	5.53E+03	4.86E+02	1.01E+02
1995 ,	1.06E+03	3.03E+03	1.43E+02
1996 ,	6.59E+02	5.60E+02	1.92E+03
1997 ,	2.85E+02	3.12E+02	2.52E+02
1998 ,	9.29E+01	8.79E+01	1.34E+02

Estimated population abundance at 1st Jan 1999

, 2.30E+02, 4.08E+01, 3.94E+01,

Taper weighted geometric mean of the VPA populations:

, 2.56E+02, 1.34E+02, 5.39E+01,

Standard error of the weighted Log(VPA populations) :

, 1.5708, 1.5800, 1.7271,

1

Log catchability residuals.

Fleet : FLT01: Russian botto

Age ,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988
1 ,	99.99	99.99	99.99	1.75,	.90,	.18,	-.05,	.26,	-.48
2 ,	99.99	99.99	99.99	2.54,	.75,	.74,	.19,	-.45,	-.31
3 ,	99.99	99.99	99.99	.80,	.91,	.88,	-.29,	.04,	-.37
4 ,	99.99	99.99	99.99	.21,	.05,	-.24,	.04,	-.04,	-.43
5 ,	99.99	99.99	99.99	-1.30,	.19,	.63,	-.38,	.02,	-.40
6 ,	99.99	99.99	99.99	99.99	-2.18,	.23,	-1.77,	-3.05,	-.14
7 ,	99.99	99.99	99.99	99.99	99.99	99.99	-1.01,	-.90,	-2.49
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								

Table 4.11 (Continued)

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.57	.68	.33	.36	-.21	-.50	-.36	-.26	-.34	.42
2	.37	.37	-.05	.41	.13	-.19	-.61	-.46	-.42	.03
3	-.77	1.27	-.18	.29	.47	.15	-.62	-.47	-.67	.19
4	-.46	1.14	-.41	-.16	.69	.33	-.57	-.04	-.08	-.04
5	.13	1.30	-.33	-.28	.47	.14	-.41	.60	-.57	-.42
6	.78	1.34	-.41	.39	.68	.48	.38	.97	-.34	-.57
7	1.15	1.00	.56	.63	.65	-.38	.32	1.03	-1.59	-.09
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	-6.8605	-6.9818
S.E(Log q)	1.0904	1.0853

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	.917	9.04	.80	16	.52	-8.22
2	.85	1.003	7.85	.82	16	.55	-7.10
3	.79	1.292	7.71	.80	16	.63	-6.73
4	.89	.917	7.07	.88	16	.50	-6.59
5	.73	2.139	7.79	.86	16	.59	-6.76

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

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

6	.70	2.135	7.75	.84	15	.66	-6.86
7	.87	.600	7.26	.72	13	.98	-6.98

Fleet : FLT04: Norway acoust

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	
1	1.62	.63	.66	.05	.39	.09	-.11	-.75	-.28	
2	1.08	.32	.52	.72	.43	.17	.21	-.58	.31	
3	1.10	.96	.39	.61	.77	.31	.03	-.43	-.15	
4	.66	.46	.76	.59	.18	-.71	-.08	-.60	-.01	
5	.83	.17	.25	.75	.56	1.01	.00	-.47	-.30	
6	.95	1.61	.69	-.59	.67	.80	1.10	-.19	.28	
7	1.06	.45	1.02	-1.57	.86	1.14	1.47	1.57	-.04	
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	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-.38	.51	-.05	.30	.37	.25	-.14	-.61	-.01	.17
2	-.60	.12	-.08	-.01	.11	-.17	-.16	.05	.37	-.17
3	-.45	.03	-.46	.05	.24	-.16	.08	.05	.26	-.03
4	-.15	-.03	-.21	-.33	.26	.17	-.06	.11	.44	.10
5	-.01	-.13	-.75	-.91	.30	.45	-.03	.20	.21	.23
6	.55	-.51	-1.65	-.84	-.83	.24	.54	.78	.70	-.40
7	.12	-.30	-.97	-.21	-.58	-.21	.08	.13	.37	-.74
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									

Table 4.11 (Continued)

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,	-6.2949,	-6.0113,
S.E(Log q),	.7984,	.7261,

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,	2.187,	7.03,	.90,	19,	.40,	-5.05,
2,	.80,	2.522,	6.65,	.94,	19,	.32,	-5.26,
3,	.85,	1.956,	6.21,	.94,	19,	.31,	-5.30,
4,	.73,	3.684,	7.08,	.95,	19,	.32,	-5.63,
5,	.69,	2.901,	7.41,	.90,	19,	.50,	-6.03,

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,	.942,	6.78,	.83,	19,	.69,	-6.29,
7,	1.32,	-1.817,	5.04,	.76,	19,	.87,	-6.01,

1

Fleet : FLT05: Norwegian tra

Age ,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988
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,	.52,	.95,	.65,	-.66
9 ,	99.99,	99.99,	99.99,	99.99,	99.99,	1.41,	1.59,	1.87,	-2.16
10 ,	99.99,	99.99,	99.99,	99.99,	99.99,	-.24,	1.68,	.79,	.17
11 ,	99.99,	99.99,	99.99,	99.99,	99.99,	.71,	1.04,	1.66,	2.01
12 ,	99.99,	99.99,	99.99,	99.99,	99.99,	1.94,	3.07,	2.44,	1.75
13 ,	99.99,	99.99,	99.99,	99.99,	99.99,	2.62,	2.34,	1.26,	1.14

Age ,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
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 ,	-.12,	-.40,	-.84,	-.54,	-.45,	.02,	-1.08,	1.65,	.82,	.08
9 ,	-2.42,	-2.14,	-.55,	.06,	.17,	.30,	-.03,	2.01,	1.16,	-.53
10 ,	.75,	-3.82,	-1.02,	.29,	-.45,	.94,	.20,	1.22,	-.37,	.37
11 ,	.53,	-2.03,	-3.03,	-1.52,	.18,	-.24,	.31,	1.44,	1.21,	-.64
12 ,	.92,	.59,	.05,	.37,	.40,	1.21,	.12,	.87,	1.07,	-.30
13 ,	-1.01,	-.60,	.18,	-.72,	.16,	1.27,	99.99,	1.49,	.88,	.34

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,	-1.8039,	-2.2869,	-2.0656,	-2.4207,	-2.4207,	-2.4207,
S.E(Log q),	.8100,	1.4305,	1.3147,	1.4843,	1.2448,	1.1892,

Table 4.11 (Continued)

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,	1.03,	-.185,	1.60,	.78,	14,	.88,	-1.80,
9,	.80,	.789,	3.30,	.61,	14,	1.16,	-2.29,
10,	.78,	.965,	3.02,	.67,	14,	1.03,	-2.07,
11,	.72,	1.429,	3.32,	.73,	14,	1.01,	-2.42,
12,	1.01,	-.067,	1.53,	.77,	14,	.93,	-1.57,
13,	.91,	.541,	2.04,	.80,	13,	.97,	-1.85,

Fleet : FLT06: Norway bottom

Age	, 1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988
1	, 99.99,	99.99,	.24,	.68,	.75,	.04,	.56,	-.11,	-.28
2	, 99.99,	99.99,	.48,	1.36,	.80,	-.11,	.76,	.08,	.47
3	, 99.99,	99.99,	.06,	.22,	1.38,	-.17,	.23,	.47,	.35
4	, 99.99,	99.99,	.49,	.23,	.35,	-.40,	-.11,	.12,	.37
5	, 99.99,	99.99,	.64,	.44,	.88,	.70,	99.99,	.03,	-.01
6	, 99.99,	99.99,	.30,	-1.62,	-.35,	-.22,	99.99,	-1.22,	.88
7	, 99.99,	99.99,	.52,	-.73,	-.88,	.59,	99.99,	99.99,	-.58
8	, 99.99,	99.99,	99.99,	-.32,	.50,	.32,	99.99,	99.99,	99.99
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	, 1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
1	, -.48,	.38,	.33,	.04,	.19,	-.30,	-.19,	-.21,	-.30,	.14
2	, -.87,	-.40,	.02,	-.15,	.32,	-.03,	-.18,	.14,	-.05,	-.31
3	, -.49,	-.39,	-.40,	-.05,	-.05,	.03,	.30,	.10,	-.07,	-.23
4	, -.15,	.35,	-.36,	-.44,	-.18,	-.02,	.33,	.16,	.21,	-.27
5	, .11,	.03,	-.31,	-.47,	-.35,	.26,	.22,	.09,	-.25,	-.07
6	, .70,	-.60,	-.72,	-.47,	-1.16,	.65,	.99,	1.13,	.29,	-.33
7	, 1.27,	.30,	.05,	-.86,	-1.13,	99.99,	.53,	.84,	.12,	-.35
8	, 99.99,	99.99,	.63,	-.34,	-.25,	-.02,	99.99,	-.11,	.59,	-.67
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,	8
Mean Log q,		-6.3722,	-6.5645,	-7.0459,
S.E(Log q),		.8404,	.7482,	.4703,

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,	.81,	1.975,	6.48,	.92,	17,	.34,	-4.78,
2,	.86,	1.240,	6.04,	.88,	17,	.44,	-5.03,
3,	.85,	1.627,	6.07,	.92,	17,	.38,	-5.11,
4,	.75,	3.595,	6.84,	.95,	17,	.31,	-5.44,
5,	.68,	4.184,	7.39,	.95,	16,	.34,	-5.90,

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,	.68,	3.534,	7.52,	.93,	16,	.40,	-6.37,
7,	.87,	.744,	6.93,	.81,	14,	.67,	-6.56,
8,	1.07,	-.376,	6.91,	.83,	10,	.54,	-7.05,

Table 4.11 (Continued)

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1997

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: Russian botto,	92593.,	.538,	.000,	.00,	1,	.157,	.000
FLT04: Norway acoust,	72187.,	.412,	.000,	.00,	1,	.268,	.000
FLT05: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: Norway bottom,	69727.,	.356,	.000,	.00,	1,	.360,	.000
P shrinkage mean ,	175560.,	1.19,,,,				.032,	.000
F shrinkage mean ,	20730.,	.50,,,,				.182,	.000

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
60767.,	.21,	.29,	5,	1.350,	.000

1

Age 2 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: Russian botto,	107340.,	.393,	.183,	.47,	2,	.168,	.015
FLT04: Norway acoust,	114279.,	.260,	.078,	.30,	2,	.384,	.014
FLT05: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: Norway bottom,	93275.,	.282,	.002,	.01,	2,	.326,	.017
P shrinkage mean ,	89658.,	1.23,,,,				.017,	.018
F shrinkage mean ,	660169.,	.50,,,,				.105,	.002

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
126700.,	.16,	.23,	8,	1.430,	.013

Age 3 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: Russian botto,	25117.,	.343,	.170,	.50,	3,	.152,	.086
FLT04: Norway acoust,	29929.,	.204,	.267,	1.30,	3,	.428,	.073
FLT05: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: Norway bottom,	25544.,	.232,	.051,	.22,	3,	.332,	.085
P shrinkage mean ,	60243.,	1.31,,,,				.011,	.037
F shrinkage mean ,	99973.,	.50,,,,				.077,	.022

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
30580.,	.13,	.15,	11,	1.088,	.071

1

Age 4 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: Russian botto,	24338.,	.286,	.130,	.46,	4,	.154,	.423
FLT04: Norway acoust,	37556.,	.175,	.076,	.43,	4,	.409,	.293
FLT05: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: Norway bottom,	29733.,	.188,	.082,	.44,	4,	.357,	.358
P shrinkage mean ,	36570.,	1.41,,,,				.009,	.300

Table 4.11 (Continued)

F shrinkage mean , 85148., .50,,,,, .071, .140

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
34233.,	.11,	.09,	14,	.823,	.318

Age 5 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian botto,	9174.,	.261,	.094,	.36,	5,	.155,	.616
FLT04: Norway acoust,	15873.,	.166,	.110,	.66,	5,	.374,	.400
FLT05: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: Norway bottom,	13306.,	.166,	.094,	.57,	5,	.385,	.462

P shrinkage mean , 19032., 1.45,,,,, .009, .344

F shrinkage mean , 16242., .50,,,,, .078, .392

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
13674.,	.11,	.07,	17,	.642,	.452

1

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

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian botto,	5880.,	.258,	.101,	.39,	6,	.151,	.779
FLT04: Norway acoust,	8493.,	.165,	.092,	.56,	6,	.360,	.597
FLT05: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: Norway bottom,	8447.,	.165,	.096,	.58,	6,	.364,	.600

F shrinkage mean , 9036., .50,,,,, .124, .570

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
8079.,	.11,	.06,	19,	.509,	.620

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

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian botto,	17607.,	.275,	.162,	.59,	7,	.146,	.499
FLT04: Norway acoust,	16706.,	.176,	.140,	.80,	7,	.348,	.520
FLT05: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT06: Norway bottom,	19068.,	.177,	.085,	.48,	7,	.343,	.469

F shrinkage mean , 14049., .50,,,,, .163, .594

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
17125.,	.13,	.07,	22,	.525,	.511

Table 4.11 (Continued)

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

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian botto,	25901.,	.282,	.283,	1.00,	7,	.109,	.503
FLT04: Norway acoust,	28595.,	.182,	.085,	.47,	7,	.257,	.465
FLT05: Norwegian tra,	26667.,	.845,	.000,	.00,	1,	.043,	.492
FLT06: Norway bottom,	21843.,	.202,	.168,	.83,	8,	.383,	.574
F shrinkage mean ,	23861.,	.50,,,,,				.209,	.536

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
24498.,	.15,	.08,	24,	.555,	.525

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

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian botto,	4089.,	.291,	.144,	.50,	7,	.081,	.231
FLT04: Norway acoust,	3139.,	.187,	.087,	.47,	7,	.190,	.291
FLT05: Norwegian tra,	3432.,	.777,	.656,	.84,	2,	.070,	.269
FLT06: Norway bottom,	3724.,	.224,	.128,	.57,	8,	.316,	.251
F shrinkage mean ,	1363.,	.50,,,,,				.343,	.576

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2559.,	.20,	.13,	25,	.657,	.347

1

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

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian botto,	257.,	.303,	.147,	.49,	7,	.042,	.608
FLT04: Norway acoust,	207.,	.194,	.117,	.60,	7,	.098,	.712
FLT05: Norwegian tra,	570.,	.794,	.394,	.50,	3,	.084,	.320
FLT06: Norway bottom,	195.,	.234,	.117,	.50,	8,	.167,	.744
F shrinkage mean ,	215.,	.50,,,,,				.610,	.694

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
230.,	.32,	.08,	26,	.242,	.660

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

Year class = 1987

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Russian botto,	43.,	.306,	.248,	.81,	7,	.030,	.604
FLT04: Norway acoust,	29.,	.199,	.129,	.65,	7,	.071,	.798
FLT05: Norwegian tra,	26.,	.862,	.449,	.52,	4,	.084,	.850
FLT06: Norway bottom,	25.,	.198,	.106,	.53,	6,	.062,	.879
F shrinkage mean ,	46.,	.50,,,,,				.754,	.570

Table 4.11 (Continued)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
41.,	.38,	.10,	25,	.268,	.624

1

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

Year class = 1986

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT01: Russian botto,	51.,	.305,	.265,	.87,	7,	.036,	.496
FLT04: Norway acoust,	28.,	.200,	.162,	.81,	7,	.083,	.764
FLT05: Norwegian tra,	45.,	.802,	.318,	.40,	5,	.095,	.546
FLT06: Norway bottom,	35.,	.196,	.155,	.79,	8,	.119,	.660
F shrinkage mean ,	41.,	.50,,,,,				.667,	.589

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
39.,	.34,	.06,	28,	.182,	.603

Age 13 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
FLT01: Russian botto,	72.,	.311,	.288,	.92,	7,	.034,	.488
FLT04: Norway acoust,	47.,	.201,	.154,	.77,	7,	.079,	.670
FLT05: Norwegian tra,	112.,	.708,	.222,	.31,	6,	.126,	.340
FLT06: Norway bottom,	60.,	.193,	.136,	.71,	8,	.111,	.561
F shrinkage mean ,	61.,	.50,,,,,				.650,	.556

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
65.,	.34,	.07,	29,	.206,	.530

Table 4.12

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Table 4	Natural Mortality (M) at age									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
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,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
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,

1

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Table 4	Natural Mortality (M) at age									
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
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 4.12 (Continued)

Table 4	Natural Mortality (M) at age									
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.2000,	.2000,	.2000,	.2000,	.2000,	1.0490,	1.5654,	2.5259,	3.6419,	.5973,
2,	.2000,	.2000,	.2000,	.2000,	.2000,	.2508,	.2082,	1.4669,	.2000,	.2000,
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.6325,	.2000,	.4482,
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,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	1.1166,	.5554,	.5016,	1.6690,	2.2123,	1.8682,	2.4651,	3.0585,	1.9140,	2.6152,
2,	.2000,	.5277,	.2524,	.3520,	.5904,	.8160,	1.0960,	1.0617,	.7847,	.5381,
3,	.2000,	.3917,	.2000,	.2048,	.2512,	.2920,	.3694,	.7744,	.5319,	.2276,
4,	.2000,	.2000,	.2000,	.2000,	.2202,	.2147,	.3591,	.3061,	.2536,	.2212,
5,	.2000,	.2000,	.2000,	.2000,	.2984,	.2109,	.2815,	.2258,	.2367,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2137,	.2164,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
13,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4.13

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age									
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
AGE										
1,	.0000,	.0029,	.0000,	.0054,	.0074,	.0000,	.0010,	.0019,	.0005,	
2,	.0072,	.0032,	.0118,	.0571,	.0084,	.0052,	.0494,	.0032,	.0063,	
3,	.0540,	.1391,	.1117,	.0710,	.0604,	.0245,	.1125,	.0436,	.0278,	
4,	.5944,	.2170,	.5481,	.3746,	.2425,	.1322,	.1686,	.2466,	.1685,	
5,	.8100,	.6364,	.5793,	.5365,	.2890,	.4826,	.2714,	.3578,	.5703,	
6,	.7984,	.8779,	.9018,	.4810,	.4126,	.4265,	.7948,	.3922,	.4863,	
7,	1.1610,	.7745,	.9030,	.7349,	.5963,	1.0196,	.5346,	.7777,	.9076,	
8,	.9333,	1.0096,	1.1367,	.5316,	.9212,	.5890,	.9484,	.3494,	.7795,	
9,	.5316,	1.1412,	1.4150,	.4134,	.8324,	.4853,	.3640,	.6457,	.4881,	
10,	.5264,	.7171,	.6437,	.6784,	.6358,	.2521,	.8279,	.5522,	.9233,	
11,	.9273,	.8398,	.8642,	1.2578,	.6430,	.1864,	.3286,	.1436,	.8476,	
12,	1.7941,	.4932,	.5194,	1.0062,	.7594,	.3043,	.3572,	.0000,	2.0912,	
13,	.9530,	.8490,	.9258,	.7853,	.7659,	.3658,	.5700,	.3403,	1.0378,	
+gp,	.9530,	.8490,	.9258,	.7853,	.7659,	.3658,	.5700,	.3403,	1.0378,	
0 FBAR 4- 7,	.8409,	.6264,	.7331,	.5318,	.3851,	.5152,	.4423,	.4436,	.5332,	

Table 8	Fishing mortality (F) at age									
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	.0011,	.0069,	.0010,	.0000,	.0000,	.0004,	.0000,	.0000,	.0000,	.0000,
2,	.0089,	.0293,	.0203,	.0147,	.0060,	.0074,	.0129,	.0079,	.0024,	.0017,
3,	.0708,	.1991,	.1677,	.1981,	.1209,	.0793,	.0668,	.1270,	.0619,	.0369,
4,	.1694,	.3774,	.4801,	.5926,	.6799,	.3147,	.2341,	.3865,	.3032,	.4022,
5,	.3210,	.5030,	.6885,	1.0469,	.9355,	.6899,	.4587,	.5758,	.4252,	.5648,
6,	.5437,	.6081,	.7067,	1.0438,	.9880,	.8586,	.6910,	.7177,	.4945,	.4642,
7,	.5353,	.5007,	.7182,	.6208,	.9557,	.7584,	.6516,	.8034,	.5020,	.6417,
8,	.3810,	.5712,	.8165,	.6579,	.5226,	.8442,	.4816,	.4908,	.5559,	.6438,
9,	.6651,	.9054,	.6295,	.9733,	.6435,	.8221,	.7633,	.4138,	.3452,	.4586,
10,	.3099,	.4990,	.5160,	.4008,	.6233,	.2288,	.2597,	.3489,	.2901,	.5453,
11,	.7905,	1.4865,	.7028,	.4887,	.2210,	.7568,	.9566,	.8032,	.5455,	.2708,
12,	.7171,	.3943,	.8287,	.6297,	.3035,	2.1824,	1.7436,	.2743,	.9342,	1.0711,
13,	.5776,	.7790,	.7054,	.6358,	.4662,	.9777,	.8498,	.4697,	.5385,	.6031,
+gp,	.5776,	.7790,	.7054,	.6358,	.4662,	.9777,	.8498,	.4697,	.5385,	.6031,
0 FBAR 4- 7,	.3924,	.4973,	.6484,	.8260,	.8898,	.6554,	.5088,	.6208,	.4313,	.5182,

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Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age									
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	.0000,	.0003,	.0000,	.0017,	.0000,	.0034,	.0080,	.0136,	.0010,	.0018,
2,	.0058,	.0026,	.0031,	.0307,	.0943,	.0662,	.0673,	.0571,	.0928,	.0135,
3,	.1015,	.1663,	.0229,	.2844,	.3356,	.2202,	.2562,	.3192,	.7674,	.3629,
4,	.1474,	.2316,	.2666,	.3824,	.6008,	.3415,	.5756,	.6501,	1.2862,	.6422,
5,	.5076,	.2043,	.1817,	1.0680,	.9527,	.4194,	.5172,	.6149,	.9486,	.8953,
6,	.5550,	.5092,	.1460,	.9646,	.4686,	.6388,	.4447,	.7088,	.5010,	.4530,
7,	.4099,	.4780,	.4188,	.4095,	.3011,	.5790,	.5110,	.8009,	.6379,	.6922,
8,	.4261,	.4129,	.3394,	.6184,	.1777,	.4964,	.3371,	.6458,	.5335,	.4521,
9,	.4136,	.3020,	.3028,	.5529,	.3023,	.4262,	.2096,	.7652,	.3236,	.6627,
10,	.4182,	.3281,	.2575,	.6333,	.1985,	.7422,	.1480,	.9099,	.5166,	.2785,
11,	.2348,	.4068,	.2758,	.4158,	.1947,	.6492,	.3989,	.5389,	2.3190,	.7971,
12,	.1764,	.2175,	.6543,	.8336,	.2432,	.6789,	.1930,	1.5179,	.3775,	.4305,
13,	.3359,	.3355,	.3683,	.6162,	.2243,	.6038,	.2587,	.8849,	.8224,	.5284,
+gp,	.3359,	.3355,	.3683,	.6162,	.2243,	.6038,	.2587,	.8849,	.8224,	.5284,
0 FBAR 4- 7,	.4050,	.3558,	.2533,	.7061,	.5808,	.4947,	.5121,	.6937,	.8434,	.6707,

Table 4.13 (Continued)

Table 8	Fishing mortality (F) at age									
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
1,	.0000,	.0000,	.0002,	.0002,	.0000,	.0000,	.0000,	.0005,	.0001,	.0000,
2,	.0023,	.0000,	.0076,	.0055,	.0156,	.0009,	.0038,	.0039,	.0032,	.0023,
3,	.1546,	.0371,	.0995,	.1298,	.1780,	.0557,	.1344,	.0676,	.0522,	.0232,
4,	.5086,	.3096,	.2091,	.2702,	.4622,	.3346,	.1949,	.4547,	.4554,	.1632,
5,	.9741,	.6932,	.5598,	.4684,	.4654,	.3723,	.3784,	.2625,	.9211,	.5207,
6,	.9679,	.8256,	.9134,	.7041,	.3528,	.2895,	.6371,	.4893,	.2384,	1.1496,
7,	.5261,	.4289,	.7886,	.5941,	.4091,	.3393,	.5485,	.7479,	.5523,	.2412,
8,	.5266,	.7443,	.5515,	.6690,	.4187,	.5503,	.5258,	.5220,	.6598,	.3324,
9,	.5013,	.4410,	.5688,	.5380,	.1934,	.4304,	.7394,	.4995,	.5625,	.3927,
10,	.5564,	.6099,	.2382,	.6200,	.5611,	.4319,	.7934,	.6796,	.3845,	.7948,
11,	.5767,	.7159,	.5145,	.5363,	.4785,	.9704,	.6373,	.5078,	.5617,	1.1500,
12,	.6973,	.8780,	.8091,	1.5938,	.2232,	2.6672,	.5115,	1.4362,	.9881,	1.2385,
13,	.5765,	.6841,	.5408,	.7995,	.3774,	1.0216,	.6063,	.6721,	.5930,	.7356,
+gp,	.5765,	.6841,	.5408,	.7995,	.3774,	1.0216,	.6063,	.6721,	.5930,	.7356,
0 FBAR 4- 7,	.7442,	.5643,	.6177,	.5092,	.4224,	.3339,	.4397,	.4886,	.5418,	.5187,

Table 8	Fishing mortality (F) at age										
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
1,	.0000,	.0000,	.0000,	.0010,	.0002,	.0000,	.0000,	.0002,	.0001,	.0000,	.0001,
2,	.0064,	.0027,	.0014,	.0032,	.0011,	.0031,	.0013,	.0024,	.0043,	.0128,	.0065,
3,	.0678,	.0250,	.0533,	.0675,	.0220,	.0125,	.0195,	.0278,	.0296,	.0713,	.0429,
4,	.1765,	.1007,	.1385,	.2397,	.1999,	.1013,	.0765,	.1265,	.1932,	.3177,	.2125,
5,	.3496,	.1184,	.2330,	.2516,	.4483,	.4512,	.2507,	.3383,	.4607,	.4517,	.4169,
6,	.4746,	.1886,	.2691,	.3505,	.5167,	.6592,	.5689,	.4532,	.6280,	.6201,	.5671,
7,	.6223,	.2453,	.3176,	.3167,	.3378,	.7076,	.6158,	.6496,	.6358,	.5105,	.5986,
8,	.2426,	.3040,	.2514,	.3136,	.3357,	.4302,	.3329,	.8751,	.6853,	.5253,	.6952,
9,	.0850,	.7513,	.2268,	.2435,	.4559,	.5993,	.3478,	.7962,	.6553,	.3470,	.5995,
10,	.9270,	.6784,	.0767,	.2086,	.2842,	.9428,	.4974,	.6604,	1.0544,	.6599,	.7916,
11,	.5182,	.1689,	.0240,	.0572,	.4606,	.4012,	.4418,	.5469,	.9774,	.6237,	.7160,
12,	.5250,	.2324,	.7432,	.1263,	.4002,	1.0202,	.2593,	.5972,	.6436,	.6027,	.6145,
13,	.4730,	.4231,	.2395,	.2137,	.4620,	.6985,	.3577,	.6079,	.7542,	.5305,	.6308,
+gp,	.4730,	.4231,	.2395,	.2137,	.4620,	.6985,	.3577,	.6079,	.7542,	.5305,	.6308,
0 FBAR 4- 7,	.4057,	.1632,	.2396,	.2896,	.3757,	.4798,	.3780,	.3919,	.4794,	.4750,	

Table 4.14

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)					Numbers*10** ⁻³				
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
AGE										
1,	94088,	1576057,	195449,	79864,	257987,	84277,	104398,	494195,	369893,	
2,	687388,	77033,	1286685,	160020,	65032,	209660,	69000,	85386,	403864,	
3,	67033,	558763,	62868,	1041076,	123747,	52798,	170760,	53767,	69689,	
4,	93590,	51996,	398080,	46032,	793973,	95377,	42183,	124934,	42144,	
5,	70365,	42287,	34266,	188389,	25914,	510076,	68416,	29178,	79934,	
6,	37880,	25629,	18322,	15718,	90194,	15891,	257750,	42702,	16703,	
7,	46451,	13958,	8722,	6088,	7955,	48880,	8493,	95318,	23619,	
8,	16756,	11910,	5268,	2895,	2390,	3588,	14437,	4074,	35857,	
9,	5304,	5395,	3553,	1384,	1393,	779,	1630,	4579,	2352,	
10,	2952,	2552,	1411,	707,	749,	496,	393,	927,	1965,	
11,	1560,	1428,	1020,	607,	294,	325,	316,	140,	437,	
12,	1149,	505,	505,	352,	141,	126,	221,	186,	100,	
13,	1281,	156,	253,	246,	105,	54,	76,	126,	152,	
+gp,	964,	675,	41,	579,	607,	18,	38,	479,	348,	
0 TOTAL,	1126760,	2368345,	2016444,	1543956,	1370481,	1022345,	738111,	935993,	1047056,	

Table 10	Stock number at age (start of year)					Numbers*10** ⁻³				
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
AGE										
1,	169908,	373299,	420264,	485077,	152014,	366510,	441000,	30003,	26006,	248982,
2,	302704,	138956,	303533,	343755,	397148,	124456,	299938,	361060,	24564,	21292,
3,	328564,	245639,	110481,	243507,	277339,	323211,	101143,	242417,	293296,	20063,
4,	55494,	250621,	164813,	76492,	163532,	201217,	244440,	77460,	174806,	225728,
5,	29153,	38353,	140694,	83490,	34625,	67840,	120259,	158363,	43088,	105683,
6,	36998,	17315,	18988,	57866,	23994,	11124,	27862,	62237,	72901,	23058,
7,	8409,	17588,	7718,	7669,	16681,	7314,	3859,	11430,	24860,	36400,
8,	7803,	4031,	8728,	3081,	3375,	5252,	2805,	1647,	4191,	12321,
9,	13464,	4364,	1864,	3158,	1307,	1639,	1849,	1419,	825,	1968,
10,	1182,	5668,	1445,	813,	977,	562,	590,	705,	768,	479,
11,	639,	710,	2818,	706,	446,	429,	366,	372,	407,	470,
12,	153,	237,	131,	1142,	355,	293,	165,	115,	137,	193,
13,	10,	61,	131,	47,	498,	214,	27,	24,	72,	44,
+gp,	271,	24,	43,	19,	129,	120,	869,	64,	37,	125,
0 TOTAL,	954752,	1096866,	1181651,	1306824,	1072418,	1110179,	1245171,	947317,	665958,	696806,

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)					Numbers*10** ⁻³				
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
1,	144593,	1538669,	418692,	88926,	78221,	90591,	183798,	285028,	204882,	28484,
2,	203849,	118383,	1259322,	342783,	72686,	64042,	73915,	149286,	230217,	167577,
3,	17402,	165940,	96674,	1027847,	272169,	54158,	49073,	56576,	115442,	171786,
4,	15832,	12872,	115046,	77360,	633221,	159309,	35578,	31096,	33663,	43875,
5,	123614,	11186,	8360,	72150,	43209,	284290,	92698,	16381,	13290,	7615,
6,	49186,	60918,	7466,	5707,	20303,	13644,	153030,	45247,	7252,	4214,
7,	11868,	23118,	29973,	5282,	1781,	10404,	5898,	80310,	18234,	3597,
8,	15687,	6449,	11736,	16144,	2872,	1079,	4774,	2897,	29519,	7888,
9,	5299,	8387,	3494,	6843,	7121,	1968,	538,	2790,	1243,	14176,
10,	1019,	2869,	5077,	2113,	3223,	4309,	1052,	357,	1063,	737,
11,	227,	549,	1692,	3213,	918,	2164,	1680,	743,	118,	519,
12,	294,	147,	299,	1051,	1736,	619,	926,	923,	355,	9,
13,	54,	202,	97,	127,	374,	1114,	257,	625,	166,	199,
+gp,	35,	169,	28,	159,	148,	487,	1128,	630,	190,	173,
0 TOTAL,	588960,	1949859,	1957956,	1649707,	1137982,	688178,	604343,	672887,	655633,	450850,

Table 4.14 (Continued)

Table 10		Stock number at age (start of year)					Numbers*10** ⁻³				
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
1,	8457,	12049,	7157,	14086,	408033,	1895860,	1776462,	662812,	827349,	56940,	
2,	23279,	6924,	9865,	5859,	11531,	334069,	664097,	371288,	52989,	21677,	
3,	135361,	19016,	5669,	8015,	4770,	9294,	259743,	537214,	85302,	43244,	
4,	97838,	94953,	15001,	4201,	5763,	3269,	7197,	185923,	266745,	66285,	
5,	18900,	48171,	57040,	9965,	2625,	2972,	1915,	4849,	96601,	138498,	
6,	2547,	5842,	19719,	26682,	5107,	1350,	1677,	1074,	3053,	31486,	
7,	2193,	792,	2095,	6476,	10804,	2938,	827,	726,	539,	1970,	
8,	1474,	1061,	422,	779,	2927,	5876,	1714,	391,	281,	254,	
9,	4110,	713,	413,	199,	327,	1577,	2775,	829,	190,	119,	
10,	5983,	2038,	375,	191,	95,	221,	839,	1085,	412,	89,	
11,	456,	2808,	907,	242,	84,	44,	117,	311,	450,	230,	
12,	192,	210,	1124,	444,	116,	43,	14,	51,	153,	210,	
13,	5,	78,	71,	410,	74,	76,	2,	7,	10,	47,	
+gp,	132,	33,	110,	67,	317,	314,	137,	16,	46,	23,	
0	TOTAL,	300926,	194688,	119968,	77618,	452575,	2257902,	2717516,	1766576,	1334122,	361072,

Table 10		Stock number at age (start of year)					Numbers*10** ⁻³					GMST 50-96	AMST 50-96
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,		
AGE													
1,	438771,	470590,	1643875,	2867380,	1737027,	1775194,	3508154,	1933204,	1490506,	830728,	0,	241294,	618608,
2,	31334,	143650,	270040,	995450,	539770,	190076,	274088,	298185,	90765,	219805,	60767,	133949,	261440,
3,	17706,	25491,	84522,	209513,	697843,	298751,	83793,	91483,	102889,	41232,	126700,	96908,	192127,
4,	26989,	13547,	16804,	65610,	159573,	531012,	220331,	56794,	41015,	58681,	30580,	68689,	134438,
5,	46098,	18522,	10029,	11978,	42269,	104833,	387145,	142522,	36850,	26236,	34233,	40069,	78470,
6,	67365,	26608,	13471,	6504,	7625,	20033,	54071,	227369,	81074,	18346,	13674,	18832,	37483,
7,	8166,	34314,	18041,	8427,	3751,	3724,	8484,	25063,	116704,	34848,	8079,	8308,	15558,
8,	1267,	3588,	21983,	10751,	5026,	2191,	1503,	3752,	10717,	50597,	17125,	3759,	6696,
9,	149,	814,	2168,	13997,	6432,	2942,	1166,	882,	1281,	4422,	24498,	1817,	3189,
10,	66,	112,	314,	1415,	8983,	3338,	1323,	674,	326,	544,	2559,	905,	1590,
11,	33,	21,	47,	238,	940,	5535,	1065,	659,	285,	93,	230,	459,	840,
12,	60,	16,	15,	37,	184,	486,	3034,	560,	312,	88,	41,	211,	415,
13,	50,	29,	10,	6,	27,	101,	143,	1917,	252,	134,	39,	82,	210,
+gp,	44,	48,	36,	6,	18,	4,	7,	55,	302,	300,	209,		
0	TOTAL,	638098,	737349,	2081354,	4191312,	3209469,	2938220,	4544308,	2783118,	1973277,	1286054,	318734,	

Table 4.15

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 14		Stock biomass at age with SOP (start of year)								Tonnes	
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,		
AGE											
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	19835,	238520,	21224,	392286,	48990,	16483,	62281,	20115,	28143,		
4,	43219,	34639,	209727,	27069,	490536,	46469,	24010,	72942,	26561,		
5,	56470,	48957,	31374,	192524,	27823,	431885,	67676,	29606,	87549,		
6,	40419,	39452,	22305,	21358,	128761,	17890,	339001,	57608,	24324,		
7,	59562,	25819,	12760,	9941,	13647,	66127,	13423,	154526,	41333,		
8,	25015,	25652,	8972,	5503,	4775,	5651,	26568,	7690,	73061,		
9,	8799,	12910,	6725,	2923,	3091,	1363,	3332,	9603,	5325,		
10,	5836,	7279,	3183,	1779,	1982,	1035,	957,	2318,	5304,		
11,	3776,	4986,	2817,	1871,	951,	830,	942,	430,	1444,		
12,	3452,	2189,	1730,	1346,	568,	400,	817,	707,	408,		
13,	4249,	749,	956,	1038,	468,	189,	312,	530,	690,		
+gp,	3456,	3493,	169,	2643,	2912,	68,	167,	2173,	1702,		
0 TOTALBIO,	274089,	444645,	321941,	660282,	724503,	588392,	539487,	358249,	295843,		

Table 14		Stock biomass at age with SOP (start of year)								Tonnes	
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	
AGE											
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	173021,	135709,	58460,	119544,	135846,	131306,	46209,	105570,	153116,	10475,	
4,	45605,	216083,	136099,	58604,	125006,	127573,	174283,	52644,	142418,	183917,	
5,	41637,	57467,	201909,	111163,	45997,	74747,	149011,	187043,	61008,	149644,	
6,	70257,	34496,	36232,	102440,	42380,	16296,	45902,	97738,	137241,	43411,	
7,	19189,	42106,	17696,	16314,	35407,	12876,	7641,	21570,	56240,	82350,	
8,	20731,	11236,	23302,	7632,	8341,	10765,	6466,	3619,	11038,	32455,	
9,	39747,	13517,	5530,	8692,	3588,	3732,	4734,	3464,	2416,	5760,	
10,	4159,	20925,	5109,	2668,	3197,	1526,	1800,	2053,	2679,	1669,	
11,	2754,	3208,	12199,	2836,	1787,	1426,	1369,	1327,	1740,	2010,	
12,	820,	1331,	706,	5693,	1764,	1207,	764,	509,	724,	1025,	
13,	59,	380,	777,	259,	2736,	976,	138,	115,	419,	257,	
+gp,	1733,	162,	276,	110,	768,	591,	4810,	339,	233,	794,	
0 TOTALBIO,	419711,	536620,	498294,	435955,	406817,	383022,	443126,	475992,	569272,	513766,	

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 14		Stock biomass at age with SOP (start of year)								Tonnes	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
AGE											
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	9215,	82480,	64278,	581078,	148506,	30728,	26213,	23255,	58499,	107447,	
4,	13083,	9985,	119375,	68252,	539205,	141063,	29658,	19947,	26621,	42827,	
5,	177521,	15079,	15076,	110625,	63943,	437470,	134291,	18262,	18265,	12918,	
6,	93918,	109188,	17901,	11635,	39949,	27917,	294766,	67066,	13252,	9505,	
7,	27230,	49793,	86357,	12940,	4211,	25580,	13651,	143044,	40040,	9750,	
8,	41909,	16173,	39370,	46048,	7905,	3089,	12866,	6007,	75471,	24894,	
9,	15729,	23370,	13023,	21689,	21784,	6261,	1610,	6429,	3532,	49707,	
10,	3604,	9528,	22555,	7982,	11751,	16338,	3756,	981,	3598,	3078,	
11,	984,	2232,	9204,	14861,	4100,	10045,	7341,	2499,	488,	2656,	
12,	1579,	742,	2019,	6034,	9614,	3565,	5019,	3851,	1826,	60,	
13,	322,	1124,	722,	807,	2288,	7089,	1539,	2880,	941,	1397,	
+gp,	222,	1021,	229,	1090,	977,	3348,	7303,	3137,	1169,	1313,	
0 TOTALBIO,	385316,	320715,	390110,	883042,	854232,	712491,	538012,	297356,	243702,	265554,	

Table 4.15 (Continued)

Table 14		Stock biomass at age with SOP (start of year)						Tonnes			
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
1,	0,	0,	0,	0,	19323,	62145,	61737,	25090,	30888,	1300,	
2,	0,	0,	0,	0,	1397,	59620,	85264,	34468,	4581,	2517,	
3,	100481,	12953,	3677,	4939,	2085,	2446,	109073,	143320,	17515,	9183,	
4,	113342,	100942,	15186,	4040,	5474,	2869,	5370,	130036,	109806,	25389,	
5,	38051,	88994,	100349,	16655,	3924,	4899,	3465,	6687,	87219,	85209,	
6,	6817,	14350,	46125,	59293,	9679,	3080,	3976,	2190,	6720,	35118,	
7,	7056,	2338,	5888,	17294,	25502,	5993,	2146,	1481,	1515,	3067,	
8,	5521,	3647,	1382,	2423,	8877,	17815,	5508,	1175,	857,	839,	
9,	17102,	2722,	1501,	688,	1101,	5312,	9910,	2765,	691,	437,	
10,	29674,	9277,	1627,	788,	382,	886,	3574,	4311,	1785,	388,	
11,	2772,	15650,	4813,	1222,	414,	219,	611,	1513,	2387,	1231,	
12,	1443,	1452,	7399,	2776,	708,	261,	89,	306,	1008,	1397,	
13,	42,	596,	520,	2830,	497,	512,	17,	45,	72,	343,	
+gp,	1190,	273,	864,	502,	2312,	2285,	1058,	113,	365,	183,	
0 TOTALBIO,	323490,	253194,	189331,	113451,	81676,	168341,	291800,	353500,	265409,	166600,	

Table 14		Stock biomass at age with SOP (start of year)						Tonnes			
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
1,	16458,	19349,	81896,	128810,	57302,	49588,	101894,	55996,	47635,	19091,	
2,	3496,	17444,	36478,	134154,	54498,	17256,	24431,	27996,	8702,	25037,	
3,	4751,	6435,	30204,	71530,	207886,	69742,	18043,	19006,	20963,	9640,	
4,	11447,	9456,	12461,	53708,	128891,	286069,	79883,	25413,	15893,	26912,	
5,	30103,	16736,	13816,	18163,	60424,	110756,	311358,	97512,	25173,	21705,	
6,	65113,	32846,	21037,	12739,	15260,	30598,	78199,	255486,	89715,	21850,	
7,	11112,	51087,	30990,	18844,	8493,	7204,	16570,	46186,	171103,	50905,	
8,	4058,	6876,	47028,	24900,	15300,	5483,	4384,	9107,	26137,	99390,	
9,	531,	2114,	5672,	35881,	21805,	6967,	3428,	2479,	4116,	13939,	
10,	279,	473,	931,	4978,	30531,	8729,	4018,	2239,	1084,	1741,	
11,	170,	110,	241,	1285,	3947,	17449,	3373,	2288,	1324,	334,	
12,	384,	102,	95,	249,	737,	1938,	12155,	2239,	1247,	351,	
13,	355,	204,	74,	42,	118,	444,	632,	8424,	1110,	590,	
+gp,	335,	364,	277,	46,	89,	22,	37,	275,	1510,	1500,	
0 TOTALBIO,	148591,	163597,	281199,	505330,	605282,	612245,	658403,	554648,	415713,	292984,	

Table 4.16

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 15		Spawning stock biomass with SOP (spawning time)							Tonnes	
YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	
4,	2161,	1732,	10486,	1353,	24527,	2323,	1201,	3647,	1328,	
5,	12988,	11260,	7216,	44280,	6399,	99334,	15566,	6809,	20136,	
6,	21422,	20910,	11822,	11320,	68243,	9482,	179670,	30532,	12892,	
7,	52415,	22721,	11228,	8748,	12009,	58192,	11812,	135983,	36373,	
8,	24515,	25139,	8793,	5393,	4679,	5538,	26037,	7536,	71600,	
9,	8799,	12910,	6725,	2923,	3091,	1363,	3332,	9603,	5325,	
10,	5836,	7279,	3183,	1779,	1982,	1035,	957,	2318,	5304,	
11,	3776,	4986,	2817,	1871,	951,	830,	942,	430,	1444,	
12,	3452,	2189,	1730,	1346,	568,	400,	817,	707,	408,	
13,	4249,	749,	956,	1038,	468,	189,	312,	530,	690,	
+gp,	3456,	3493,	169,	2643,	2912,	68,	167,	2173,	1702,	
0 TOTSPIO,	143069,	113368,	65125,	82696,	125829,	178755,	240812,	200270,	157201,	

Table 15		Spawning stock biomass with SOP (spawning time)							Tonnes	
YEAR,	1959,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,
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,	2280,	10804,	6805,	2930,	6250,	6379,	8714,	2632,	7121,	9196,
5,	9576,	13217,	46439,	25567,	10579,	17192,	34272,	43020,	14032,	34418,
6,	37236,	18283,	19203,	54293,	22461,	8637,	24328,	51801,	72738,	23008,
7,	16886,	37053,	15573,	14356,	31158,	11331,	6724,	18982,	49491,	72468,
8,	20317,	11011,	22836,	7479,	8174,	10549,	6336,	3546,	10818,	31806,
9,	39747,	13517,	5530,	8692,	3588,	3732,	4734,	3464,	2416,	5760,
10,	4159,	20925,	5109,	2668,	3197,	1526,	1800,	2053,	2679,	1669,
11,	2754,	3208,	12199,	2836,	1787,	1426,	1369,	1327,	1740,	2010,
12,	820,	1331,	706,	5693,	1764,	1207,	764,	509,	724,	1025,
13,	59,	380,	777,	259,	2736,	976,	138,	115,	419,	257,
+gp,	1733,	162,	276,	110,	768,	591,	4810,	339,	233,	794,
0 TOTSPIO,	135567,	129892,	135452,	124885,	92464,	63546,	93990,	127788,	162410,	182410,

Run title : Arctic Haddock (run: XSATJA04/X04)

At 31/08/1999 10:02

Terminal Fs derived using XSA (With F shrinkage)

Table 15		Spawning stock biomass with SOP (spawning time)							Tonnes	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
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,	654,	499,	5969,	3413,	26960,	7053,	1483,	997,	1331,	2141,
5,	40830,	3468,	3467,	25444,	14707,	100618,	30887,	4200,	4201,	2971,
6,	49777,	57870,	9488,	6167,	21173,	14796,	156226,	35545,	7023,	5038,
7,	23963,	43818,	75994,	11388,	3706,	22510,	12013,	125879,	35235,	8580,
8,	41071,	15849,	38583,	45127,	7747,	3027,	12608,	5887,	73962,	24396,
9,	15729,	23370,	13023,	21689,	21784,	6261,	1610,	6429,	3532,	49707,
10,	3604,	9528,	22555,	7982,	11751,	16338,	3756,	981,	3598,	3078,
11,	984,	2232,	9204,	14861,	4100,	10045,	7341,	2499,	488,	2656,
12,	1579,	742,	2019,	6034,	9614,	3565,	5019,	3851,	1826,	60,
13,	322,	1124,	722,	807,	2288,	7089,	1539,	2880,	941,	1397,
+gp,	222,	1021,	229,	1090,	977,	3348,	7303,	3137,	1169,	1313,
0 TOTSPIO,	178734,	159521,	181254,	144001,	124806,	194650,	239785,	192284,	133306,	101339,

Table 4.16 (Continued)

Table 15		Spawning stock biomass with SOP (spawning time)							Tonnes		
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
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,	37,	445,	354,	171,	2181,	0,	0,	0,	
4,	5667,	5047,	1822,	2222,	3832,	402,	430,	28608,	1098,	762,	
5,	8752,	20469,	64223,	12158,	3924,	1715,	2772,	3544,	18316,	28119,	
6,	3613,	7606,	33671,	55142,	9679,	1447,	3698,	1883,	3561,	17910,	
7,	6209,	2058,	5653,	16603,	25502,	4435,	2061,	1274,	1515,	3067,	
8,	5410,	3574,	1382,	2423,	8877,	17815,	5508,	1175,	857,	839,	
9,	17102,	2722,	1501,	688,	1101,	5312,	9910,	2765,	691,	437,	
10,	29674,	9277,	1627,	788,	382,	886,	3574,	4311,	1785,	388,	
11,	2772,	15650,	4813,	1222,	414,	219,	611,	1513,	2387,	1231,	
12,	1443,	1452,	7399,	2776,	708,	261,	89,	306,	1008,	1397,	
13,	42,	596,	520,	2830,	497,	512,	17,	45,	72,	343,	
+gp,	1190,	273,	864,	502,	2312,	2285,	1058,	113,	365,	183,	
0 TOTSPBIO,	81874,	68722,	123512,	97799,	57584,	35459,	31909,	45536,	31656,	54675,	

Table 15		Spawning stock biomass with SOP (spawning time)							Tonnes		
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
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,	1431,	3118,	0,	0,	0,	0,	0,	
4,	458,	189,	872,	6982,	28227,	4863,	1598,	0,	477,	1346,	
5,	9031,	5021,	4145,	9082,	29608,	14398,	37363,	9751,	2517,	6078,	
6,	41021,	17737,	10518,	7898,	11598,	12545,	32844,	91975,	26017,	10925,	
7,	9112,	39337,	24792,	14510,	6709,	6483,	13422,	36025,	102662,	33597,	
8,	4058,	5982,	43266,	19920,	13464,	4825,	3858,	7832,	21432,	80506,	
9,	531,	1691,	5672,	33728,	19188,	6967,	3428,	2231,	4116,	12684,	
10,	279,	473,	931,	4978,	26562,	8729,	3495,	2082,	900,	1741,	
11,	170,	110,	241,	1285,	3947,	16926,	3373,	2059,	1324,	334,	
12,	384,	102,	95,	249,	737,	1938,	11426,	2239,	1247,	351,	
13,	355,	204,	74,	42,	118,	444,	632,	8424,	1110,	590,	
+gp,	335,	364,	277,	46,	89,	22,	37,	275,	1510,	1500,	
0 TOTSPBIO,	65734,	71211,	90882,	100151,	143367,	78140,	111473,	162895,	163312,	149651,	

Table 4.17

Run title : Arctic Haddock (run: SVPTJA03/V03)

At 31/08/1999 10:12

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,	439080,	111584,	120077,	1.0761,	.6468,		.6273,
1952,	62333,	317969,	64151,	127660,	1.9900,	.5115,		.7325,
1953,	1030188,	652917,	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,	324528,	414699,	133923,	88211,	.6587,	.7979,		.3937,
1960,	242519,	529752,	128196,	155454,	1.2126,	.8371,		.4989,
1961,	109130,	491160,	133522,	193234,	1.4472,	.8017,		.6494,
1962,	240726,	429465,	122878,	187888,	1.5291,	.7438,		.8256,
1963,	274815,	401756,	91083,	146744,	1.6111,	.7422,		.8878,
1964,	320310,	378959,	62714,	98900,	1.5770,	.6155,		.6541,
1965,	100310,	438630,	92977,	118079,	1.2700,	.6922,		.5089,
1966,	240268,	471103,	126355,	160621,	1.2712,	.6598,		.6198,
1967,	290555,	563800,	160796,	136486,	.8488,	.7910,		.4316,
1968,	19930,	508650,	180578,	181726,	1.0064,	.7910,		.5179,
1969,	17204,	381506,	177038,	130502,	.7371,	.8023,		.4051,
1970,	163906,	317335,	157970,	86601,	.5482,	.7531,		.3565,
1971,	95473,	385513,	179359,	78908,	.4399,	1.0074,		.2548,
1972,	1017665,	873230,	142238,	265317,	1.8653,	.8566,		.7047,
1973,	269594,	844787,	123371,	320065,	2.5943,	.8267,		.5806,
1974,	53612,	704820,	192463,	221138,	1.1490,	.8597,		.4951,
1975,	48488,	531759,	237013,	175758,	.7416,	.8093,		.5129,
1976,	55634,	293404,	189764,	137218,	.7231,	.6228,		.6933,
1977,	113796,	240425,	131729,	110158,	.8362,	.7678,		.8415,
1978,	169923,	262349,	100108,	95422,	.9532,	.9477,		.6710,
1979,	134081,	319633,	80819,	103623,	1.2822,	1.1247,		.7435,
1980,	18856,	250125,	67790,	87889,	1.2965,	1.0321,		.5649,
1981,	5622,	187006,	121933,	77153,	.6327,	.9828,		.6170,
1982,	7938,	112122,	96630,	46955,	.4859,	.9337,		.5091,
1983,	4732,	60327,	56985,	21607,	.3792,	.9107,		.4231,
1984,	9313,	46087,	35055,	17661,	.5038,	.9105,		.3350,
1985,	256441,	143004,	31522,	41270,	1.3093,	.9654,		.4401,
1986,	534968,	291294,	44938,	96585,	2.1493,	.9013,		.4892,
1987,	84645,	227308,	31199,	150659,	4.8290,	.9825,		.5417,
1988,	43338,	161297,	54067,	91744,	1.6969,	.9923,		.5171,
1989,	17572,	127556,	65166,	55122,	.8459,	.9617,		.4055,
1990,	24835,	126554,	71140,	25816,	.3629,	.9630,		.1638,
1991,	83621,	161350,	90102,	33605,	.3730,	.9581,		.2404,
1992,	209777,	244346,	100693,	53886,	.5352,	1.0132,		.2907,
1993,	713857,	497476,	142474,	77619,	.5448,	1.0016,		.3758,
1994,	300557,	549053,	77552,	121365,	1.5649,	.9991,		.4788,
1995,	83986,	535558,	111417,	138423,	1.2424,	1.0021,		.3769,
1996,	92312,	467639,	161689,	173525,	1.0732,	.9994,		.3919,
1997,	102475,	355482,	161513,	148741,	.9209,	.9995,		.4784,
1998,	41099,	250143,	150175,	94269,	.6277,	1.0113,		.4750,
Arith.								
Mean	186045,	382283,	120524,	123653,	1.1400			.5187,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),				
1								

Table 4.18

September 8, 1999

14:13 Wednesday,

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

Yield per recruit: Summary table

1 January	Spawning time		Stock		Sp.stock		Sp.stock		Sp.stock	
F Factor	Reference F	Catch in numbers	Catch in weight	size	biomass	size	biomass	size	biomass	biomass
0.0000	0.0000	0.000	0.000	5.142	9002.636	2.457	7347.143	2.457	7347.143	
0.0500	0.0238	0.083	151.369	4.734	7493.404	2.090	5893.262	2.090	5893.262	
0.1000	0.0475	0.150	259.935	4.412	6363.088	1.805	4814.523	1.805	4814.523	
0.1500	0.0713	0.203	339.771	4.150	5494.394	1.580	3993.952	1.580	3993.952	
0.2000	0.0950	0.248	399.736	3.934	4812.288	1.397	3356.801	1.397	3356.801	
0.2500	0.1188	0.286	445.615	3.751	4266.852	1.247	2853.415	1.247	2853.415	
0.3000	0.1425	0.319	481.300	3.595	3823.799	1.122	2449.744	1.122	2449.744	
0.3500	0.1663	0.348	509.475	3.460	3458.935	1.016	2121.807	1.016	2121.807	
0.4000	0.1900	0.373	532.029	3.342	3154.791	0.925	1852.335	0.925	1852.335	
0.4500	0.2138	0.395	550.316	3.237	2898.507	0.847	1628.643	0.847	1628.643	
0.5000	0.2375	0.415	565.321	3.144	2680.444	0.780	1441.254	0.780	1441.254	
0.5500	0.2613	0.433	577.771	3.061	2493.267	0.720	1282.984	0.720	1282.984	
0.6000	0.2850	0.449	588.210	2.985	2331.318	0.668	1148.305	0.668	1148.305	
0.6500	0.3088	0.464	597.049	2.917	2190.174	0.622	1032.921	0.622	1032.921	
0.7000	0.3325	0.477	604.601	2.854	2066.342	0.581	933.448	0.581	933.448	
0.7500	0.3563	0.490	611.107	2.797	1957.031	0.544	847.198	0.544	847.198	
0.8000	0.3800	0.502	616.757	2.744	1859.991	0.511	772.016	0.511	772.016	
0.8500	0.4038	0.512	621.696	2.696	1773.392	0.481	706.158	0.481	706.158	
0.9000	0.4275	0.522	626.044	2.650	1695.735	0.454	648.201	0.454	648.201	
0.9500	0.4513	0.532	629.892	2.608	1625.778	0.429	596.978	0.429	596.978	
1.0000	0.4750	0.541	633.317	2.569	1562.492	0.407	551.523	0.407	551.523	
1.0500	0.4988	0.549	636.379	2.532	1505.012	0.386	511.034	0.386	511.034	
1.1000	0.5225	0.557	639.127	2.498	1452.609	0.367	474.838	0.367	474.838	
1.1500	0.5463	0.564	641.604	2.465	1404.668	0.350	442.370	0.350	442.370	
1.2000	0.5700	0.571	643.843	2.435	1360.663	0.334	413.151	0.334	413.151	
1.2500	0.5938	0.577	645.872	2.406	1320.144	0.319	386.775	0.319	386.775	
1.3000	0.6175	0.584	647.717	2.379	1282.723	0.305	362.896	0.305	362.896	
1.3500	0.6413	0.590	649.396	2.353	1248.067	0.293	341.216	0.293	341.216	
1.4000	0.6650	0.595	650.928	2.328	1215.886	0.281	321.480	0.281	321.480	
1.4500	0.6888	0.601	652.327	2.305	1185.927	0.270	303.467	0.270	303.467	
1.5000	0.7125	0.606	653.606	2.282	1157.970	0.259	286.984	0.259	286.984	
1.5500	0.7363	0.611	654.777	2.261	1131.821	0.250	271.868	0.250	271.868	
1.6000	0.7600	0.616	655.850	2.240	1107.309	0.241	257.971	0.241	257.971	
1.6500	0.7838	0.620	656.832	2.221	1084.284	0.232	245.167	0.232	245.167	
1.7000	0.8075	0.625	657.733	2.202	1062.614	0.224	233.345	0.224	233.345	
1.7500	0.8313	0.629	658.558	2.184	1042.181	0.216	222.407	0.216	222.407	
1.8000	0.8550	0.633	659.314	2.167	1022.878	0.209	212.267	0.209	212.267	
1.8500	0.8788	0.637	660.007	2.150	1004.612	0.203	202.848	0.203	202.848	
1.9000	0.9025	0.641	660.641	2.134	987.299	0.196	194.083	0.196	194.083	
1.9500	0.9263	0.644	661.220	2.119	970.864	0.190	185.912	0.190	185.912	
2.0000	0.9500	0.648	661.750	2.104	955.240	0.184	178.280	0.184	178.280	

Notes: Run name : YLDTJA06
 Date and time : 31AUG99:12:55
 Computation of ref. F: Simple mean, age 4 - 7
 F-0.1 factor : 0.4291
 F-max factor : Not found
 F-0.1 reference F : 0.2038
 F-max reference F : Not found
 Recruitment : Single recruit

Table 4.19

September 8, 1999
 North-East Arctic haddock (Sub-areas I and II)

Prediction with management option table: Input data

Year: 1999									
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
3	126700.00	0.2284	0.0000	0.0000	0.0000	0.234	0.0713	0.710	
4	30580.000	0.2340	0.0500	0.0000	0.0000	0.459	0.3177	0.900	
5	34233.000	0.2213	0.2800	0.0000	0.0000	0.828	0.4517	1.270	
6	13674.000	0.2303	0.5000	0.0000	0.0000	1.192	0.6201	1.380	
7	8079.000	0.2000	0.6600	0.0000	0.0000	1.462	0.5105	1.540	
8	17125.000	0.2000	0.8100	0.0000	0.0000	1.966	0.5253	1.790	
9	24498.000	0.2000	0.9100	0.0000	0.0000	3.155	0.3470	2.370	
10	2559.000	0.2000	1.0000	0.0000	0.0000	3.200	0.6599	2.510	
11	230.000	0.2000	1.0000	0.0000	0.0000	3.600	0.6237	2.680	
12	41.000	0.2000	1.0000	0.0000	0.0000	4.000	0.6027	3.430	
13	39.000	0.2000	1.0000	0.0000	0.0000	4.400	0.5305	2.760	
14+	209.000	0.2000	1.0000	0.0000	0.0000	5.000	0.5305	3.150	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Year: 2000									
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
3	33084.000	0.2284	0.0000	0.0000	0.0000	0.234	0.0713	0.710	
4	.	0.2340	0.0500	0.0000	0.0000	0.459	0.3177	0.900	
5	.	0.2213	0.2800	0.0000	0.0000	0.828	0.4517	1.270	
6	.	0.2303	0.5000	0.0000	0.0000	1.192	0.6201	1.380	
7	.	0.2000	0.6600	0.0000	0.0000	1.462	0.5105	1.540	
8	.	0.2000	0.8100	0.0000	0.0000	1.966	0.5253	1.790	
9	.	0.2000	0.9100	0.0000	0.0000	3.155	0.3470	2.370	
10	.	0.2000	1.0000	0.0000	0.0000	3.200	0.6599	2.510	
11	.	0.2000	1.0000	0.0000	0.0000	3.600	0.6237	2.680	
12	.	0.2000	1.0000	0.0000	0.0000	4.000	0.6027	3.430	
13	.	0.2000	1.0000	0.0000	0.0000	4.400	0.5305	2.760	
14+	.	0.2000	1.0000	0.0000	0.0000	5.000	0.5305	3.150	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Year: 2001									
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
3	152000.00	0.2284	0.0000	0.0000	0.0000	0.234	0.0713	0.710	
4	.	0.2340	0.0500	0.0000	0.0000	0.459	0.3177	0.900	
5	.	0.2213	0.2800	0.0000	0.0000	0.828	0.4517	1.270	
6	.	0.2303	0.5000	0.0000	0.0000	1.192	0.6201	1.380	
7	.	0.2000	0.6600	0.0000	0.0000	1.462	0.5105	1.540	
8	.	0.2000	0.8100	0.0000	0.0000	1.966	0.5253	1.790	
9	.	0.2000	0.9100	0.0000	0.0000	3.155	0.3470	2.370	
10	.	0.2000	1.0000	0.0000	0.0000	3.200	0.6599	2.510	
11	.	0.2000	1.0000	0.0000	0.0000	3.600	0.6237	2.680	
12	.	0.2000	1.0000	0.0000	0.0000	4.000	0.6027	3.430	
13	.	0.2000	1.0000	0.0000	0.0000	4.400	0.5305	2.760	
14+	.	0.2000	1.0000	0.0000	0.0000	5.000	0.5305	3.150	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Notes: Run name : MANTJA04
 Date and time: 31AUG99:12:53

Table 4.20

14:13 Wednesday, September 8, 1999

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

Prediction with management option table

Year: 1999						Year: 2000					Year: 2001		
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight		F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass	
1.1016	0.5233	221496	132587	75000		0.0000	0.0000	173222	98359	0	228083	119773	
.		0.0500	0.0238	.	98359	4063	223858	116729	
.		0.1000	0.0475	.	98359	8032	219739	113769	
.		0.1500	0.0713	.	98359	11910	215723	110890	
.		0.2000	0.0950	.	98359	15699	211807	108089	
.		0.2500	0.1188	.	98359	19401	207990	105364	
.		0.3000	0.1425	.	98359	23019	204267	102713	
.		0.3500	0.1663	.	98359	26554	200636	100134	
.		0.4000	0.1900	.	98359	30009	197096	97625	
.		0.4500	0.2138	.	98359	33385	193643	95184	
.		0.5000	0.2375	.	98359	36686	190275	92808	
.		0.5500	0.2613	.	98359	39912	186990	90497	
.		0.6000	0.2850	.	98359	43065	183785	88247	
.		0.6500	0.3088	.	98359	46148	180659	86058	
.		0.7000	0.3325	.	98359	49163	177610	83928	
.		0.7500	0.3563	.	98359	52110	174635	81855	
.		0.8000	0.3800	.	98359	54992	171732	79837	
.		0.8500	0.4038	.	98359	57810	168900	77873	
.		0.9000	0.4275	.	98359	60566	166136	75962	
.		0.9500	0.4513	.	98359	63262	163439	74101	
.		1.0000	0.4750	.	98359	65898	160807	72289	
.		1.0500	0.4988	.	98359	68477	158239	70526	
.		1.1000	0.5225	.	98359	71000	155732	68809	
.		1.1500	0.5463	.	98359	73468	153285	67138	
.		1.2000	0.5700	.	98359	75882	150896	65511	
.		1.2500	0.5938	.	98359	78245	148565	63926	
.		1.3000	0.6175	.	98359	80557	146289	62384	
.		1.3500	0.6413	.	98359	82819	144066	60881	
.		1.4000	0.6650	.	98359	85032	141897	59418	
.		1.4500	0.6888	.	98359	87199	139778	57994	
.		1.5000	0.7125	.	98359	89320	137710	56606	
.		1.5500	0.7363	.	98359	91396	135689	55255	
.		1.6000	0.7600	.	98359	93428	133717	53939	
.		1.6500	0.7838	.	98359	95417	131790	52657	
.		1.7000	0.8075	.	98359	97364	129908	51408	
.		1.7500	0.8313	.	98359	99271	128070	50192	
.		1.8000	0.8550	.	98359	101138	126275	49007	
.		1.8500	0.8788	.	98359	102967	124521	47852	
.		1.9000	0.9025	.	98359	104757	122808	46727	
.		1.9500	0.9263	.	98359	106511	121134	45631	
.		2.0000	0.9500	.	98359	108229	119498	44564	

Notes: Run name : MANTJA04
 Date and time : 31AUG99:12:53
 Computation of ref. F: Simple mean, age 4 - 7
 Basis for 1999 : TAC constraints

Table 4.21

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	1.1016	0.5233	53547	75000	257967	221496	62526	132587	62526	132587
2000	0.2500	0.1188	14324	19401	192070	173222	46527	98359	46527	98359
2001	0.2500	0.1188	16327	22693	292482	207990	55900	105364	55900	105364
2002	0.2500	0.1188	21489	28122	316224	238848	63708	116007	63708	116007
2003	0.2500	0.1188	22926	30642	329789	270546	78504	134543	78504	134543
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRTJA05
 Date and time : 31AUG99:12:10
 Computation of ref. F: Simple mean, age 4 - 7
 Prediction basis : F factors

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	1.1016	0.5233	53547	75000	257967	221496	62526	132587	62526	132587
2000	0.5000	0.2375	27240	36686	192070	173222	46527	98359	46527	98359
2001	0.5000	0.2375	28765	39066	281025	190275	49948	92808	49948	92808
2002	0.5000	0.2375	36488	45637	295929	204824	52040	90936	52040	90936
2003	0.5000	0.2375	37773	48120	300204	219872	61130	96916	61130	96916
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRTJA05
 Date and time : 31AUG99:12:10
 Computation of ref. F: Simple mean, age 4 - 7
 Prediction basis : F factors

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	1.1016	0.5233	53547	75000	257967	221496	62526	132587	62526	132587
2000	0.7500	0.3563	38907	52110	192070	173222	46527	98359	46527	98359
2001	0.7500	0.3563	38232	50713	270721	174635	44692	81855	44692	81855
2002	0.7500	0.3563	47181	56485	279253	178015	42830	71622	42830	71622
2003	0.7500	0.3563	47718	58179	277409	183538	48590	71033	48590	71033
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRTJA05
 Date and time : 31AUG99:12:10
 Computation of ref. F: Simple mean, age 4 - 7
 Prediction basis : F factors

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January		Spawning time	
							Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1999	1.1016	0.5233	53547	75000	257967	221496	62526	132587	62526	132587
2000	1.0000	0.4750	49462	65898	192070	173222	46527	98359	46527	98359
2001	1.0000	0.4750	45432	58836	261442	160807	40047	72289	40047	72289
2002	1.0000	0.4750	55010	63184	265446	156783	35531	56700	35531	56700
2003	1.0000	0.4750	54625	64035	259492	157063	39414	53071	39414	53071
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRTJA05
 Date and time : 31AUG99:12:10
 Computation of ref. F: Simple mean, age 4 - 7

Table 4.22

September 8, 1999

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

14:13 Wednesday,

Single option prediction: Detailed tables

Year: 1999		F-factor: 1.1016	Reference F: 0.5233		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	0.0785	8569	6084	126700	29648	0	0	0	0
4	0.3500	8106	7296	30580	14036	1529	702	1529	702
5	0.4976	12149	15429	34233	28345	9585	7937	9585	7937
6	0.6831	6124	8451	13674	16299	6837	8150	6837	8150
7	0.5624	3179	4896	8079	11811	5332	7796	5332	7796
8	0.5787	6885	12324	17125	33668	13871	27271	13871	27271
9	0.3823	7098	16823	24498	77291	22293	70335	22293	70335
10	0.7269	1213	3044	2559	8189	2559	8189	2559	8189
11	0.6871	105	281	230	828	230	828	230	828
12	0.6639	18	63	41	164	41	164	41	164
13	0.5844	16	44	39	172	39	172	39	172
14+	0.5844	85	267	209	1045	209	1045	209	1045
Total		53547	75000	257967	221496	62526	132587	62526	132587
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2000		F-factor: 1.0000	Reference F: 0.4750		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	0.0713	2038	1447	33084	7742	0	0	0	0
4	0.3177	22761	20485	93212	42784	4661	2139	4661	2139
5	0.4517	5607	7120	17054	14120	4775	3954	4775	3954
6	0.6201	6967	9614	16681	19884	8341	9942	8341	9942
7	0.5105	2005	3087	5485	8020	3620	5293	3620	5293
8	0.5253	1408	2521	3769	7411	3053	6003	3053	6003
9	0.3470	2101	4979	7861	24800	7153	22568	7153	22568
10	0.6599	6058	15205	13685	43794	13685	43794	13685	43794
11	0.6237	430	1153	1013	3646	1013	3646	1013	3646
12	0.6027	39	135	95	379	95	379	95	379
13	0.5305	7	18	17	76	17	76	17	76
14+	0.5305	43	134	113	566	113	566	113	566
Total		49462	65898	192070	173222	46527	98359	46527	98359
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001		F-factor: 1.0000	Reference F: 0.4750		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	0.0713	9364	6649	152000	35568	0	0	0	0
4	0.3177	5986	5388	24517	11253	1226	563	1226	563
5	0.4517	17650	22416	53687	44453	15032	12447	15032	12447
6	0.6201	3634	5014	8700	10371	4350	5185	4350	5185
7	0.5105	2604	4011	7127	10420	4704	6877	4704	6877
8	0.5253	1007	1803	2696	5299	2183	4293	2183	4293
9	0.3470	488	1156	1825	5758	1661	5240	1661	5240
10	0.6599	2013	5054	4549	14556	4549	14556	4549	14556
11	0.6237	2461	6596	5792	20850	5792	20850	5792	20850
12	0.6027	184	632	444	1778	444	1778	444	1778
13	0.5305	16	44	42	187	42	187	42	187
14+	0.5305	24	75	63	314	63	314	63	314
Total		45432	58836	261442	160807	40047	72289	40047	72289
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 4.22 (Continued)

14:13 Wednesday,

September 8, 1999

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

Single option prediction: Detailed tables

(cont.)

2

Year: 2002		F-factor: 1.0000		Reference F: 0.4750		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	0.0713	5976	4243	97000	22698	0	0	0	0
4	0.3177	27504	24754	112638	51701	5632	2585	5632	2585
5	0.4517	4642	5896	14121	11692	3954	3274	3954	3274
6	0.6201	11439	15786	27390	32649	13695	16324	13695	16324
7	0.5105	1358	2092	3717	5435	2453	3587	2453	3587
8	0.5253	1308	2342	3502	6885	2837	5577	2837	5577
9	0.3470	349	827	1305	4118	1188	3747	1188	3747
10	0.6599	467	1173	1056	3380	1056	3380	1056	3380
11	0.6237	818	2192	1925	6930	1925	6930	1925	6930
12	0.6027	1053	3612	2541	10166	2541	10166	2541	10166
13	0.5305	75	207	199	876	199	876	199	876
14+	0.5305	19	60	51	254	51	254	51	254
Total		55010	63184	265446	156783	35531	56700	35531	56700
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2003		F-factor: 1.0000		Reference F: 0.4750		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	0.0713	5976	4243	97000	22698	0	0	0	0
4	0.3177	17552	15797	71881	32993	3594	1650	3594	1650
5	0.4517	21329	27087	64876	53717	18165	15041	18165	15041
6	0.6201	3009	4152	7204	8587	3602	4294	3602	4294
7	0.5105	4276	6586	11702	17109	7723	11292	7723	11292
8	0.5253	682	1221	1827	3591	1480	2909	1480	2909
9	0.3470	453	1074	1696	5350	1543	4868	1543	4868
10	0.6599	334	839	755	2417	755	2417	755	2417
11	0.6237	190	509	447	1609	447	1609	447	1609
12	0.6027	350	1201	845	3379	845	3379	845	3379
13	0.5305	429	1183	1139	5011	1139	5011	1139	5011
14+	0.5305	45	143	120	602	120	602	120	602
Total		54625	64035	259492	157063	39414	53071	39414	53071
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

0

Notes: Run name : SPRTJA05
 Date and time : 31AUG99:12:10
 Computation of ref. F: Simple mean, age 4 - 7
 Prediction basis : F factors

Figure 4.1 A-B Fish Stock Summary. North-east Arctic Haddock (Sub-areas I and II)

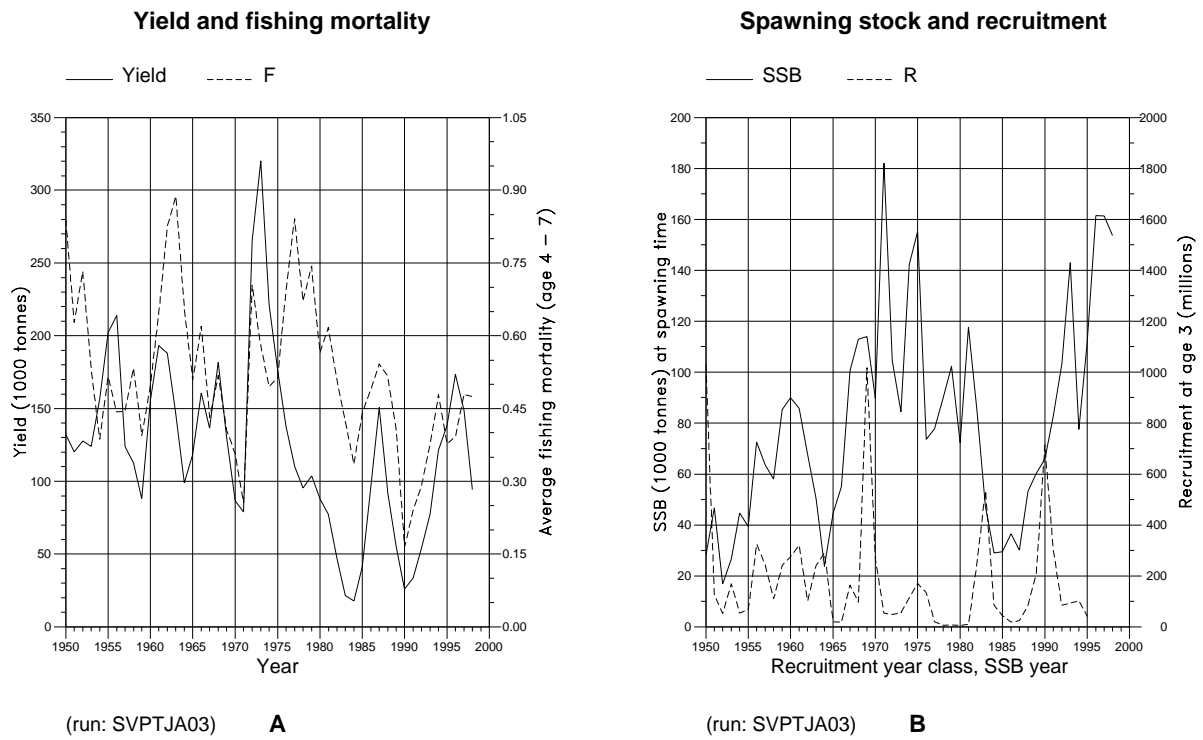


Figure 4.1 C-D Fish Stock Summary. North-east Arctic Haddock (Sub-areas I and II)

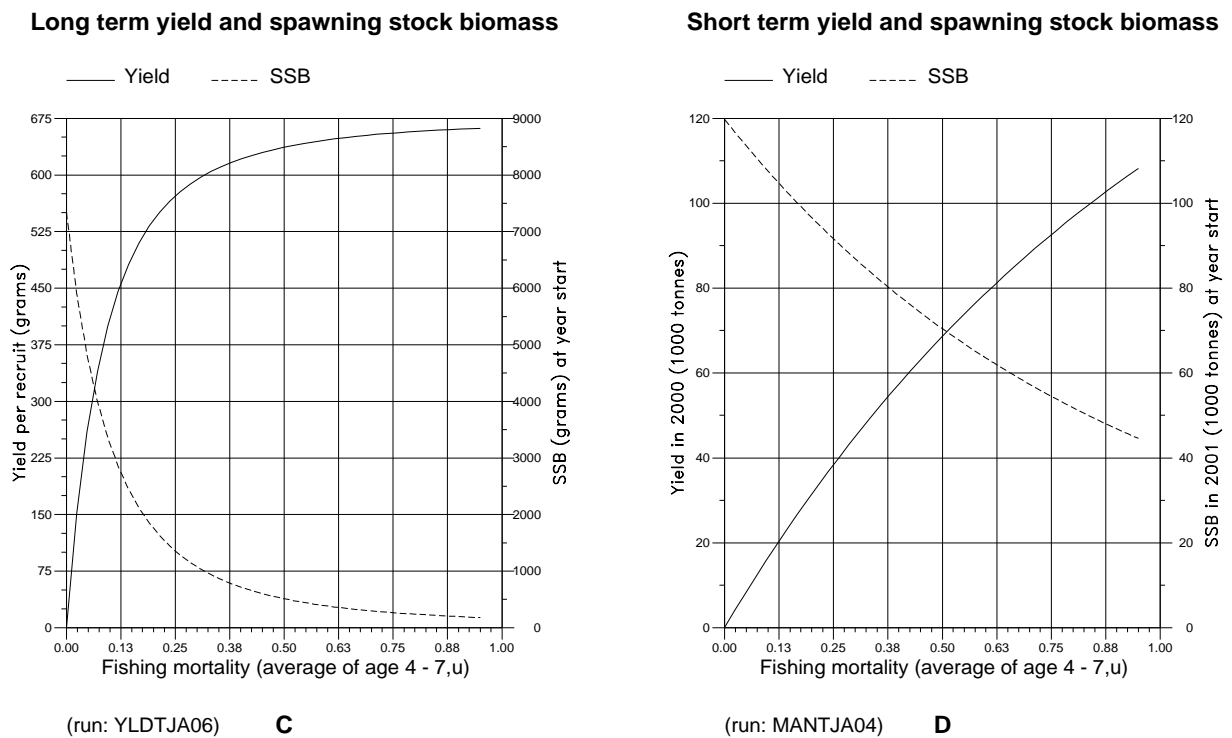


Figure 4.2

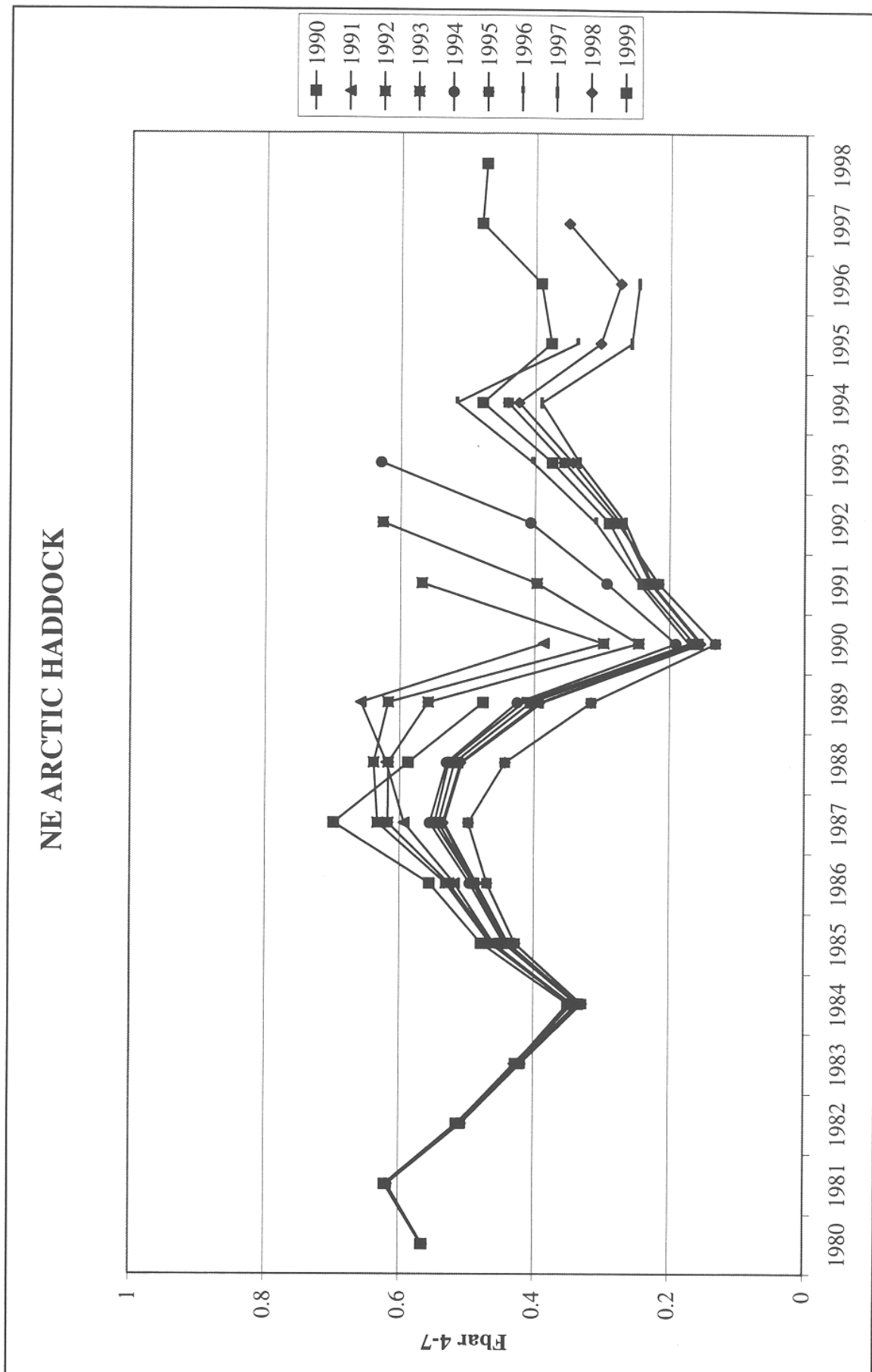
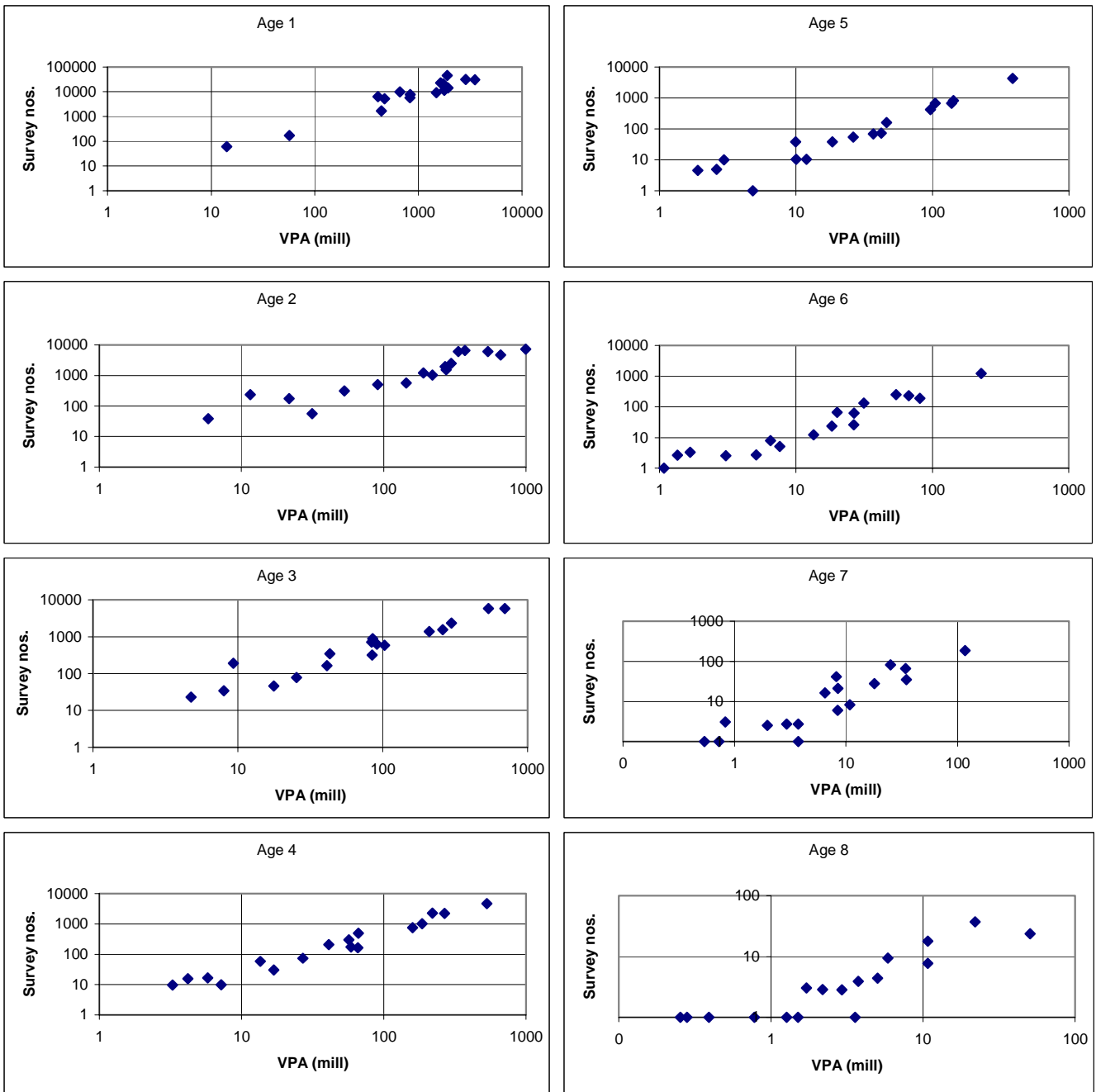
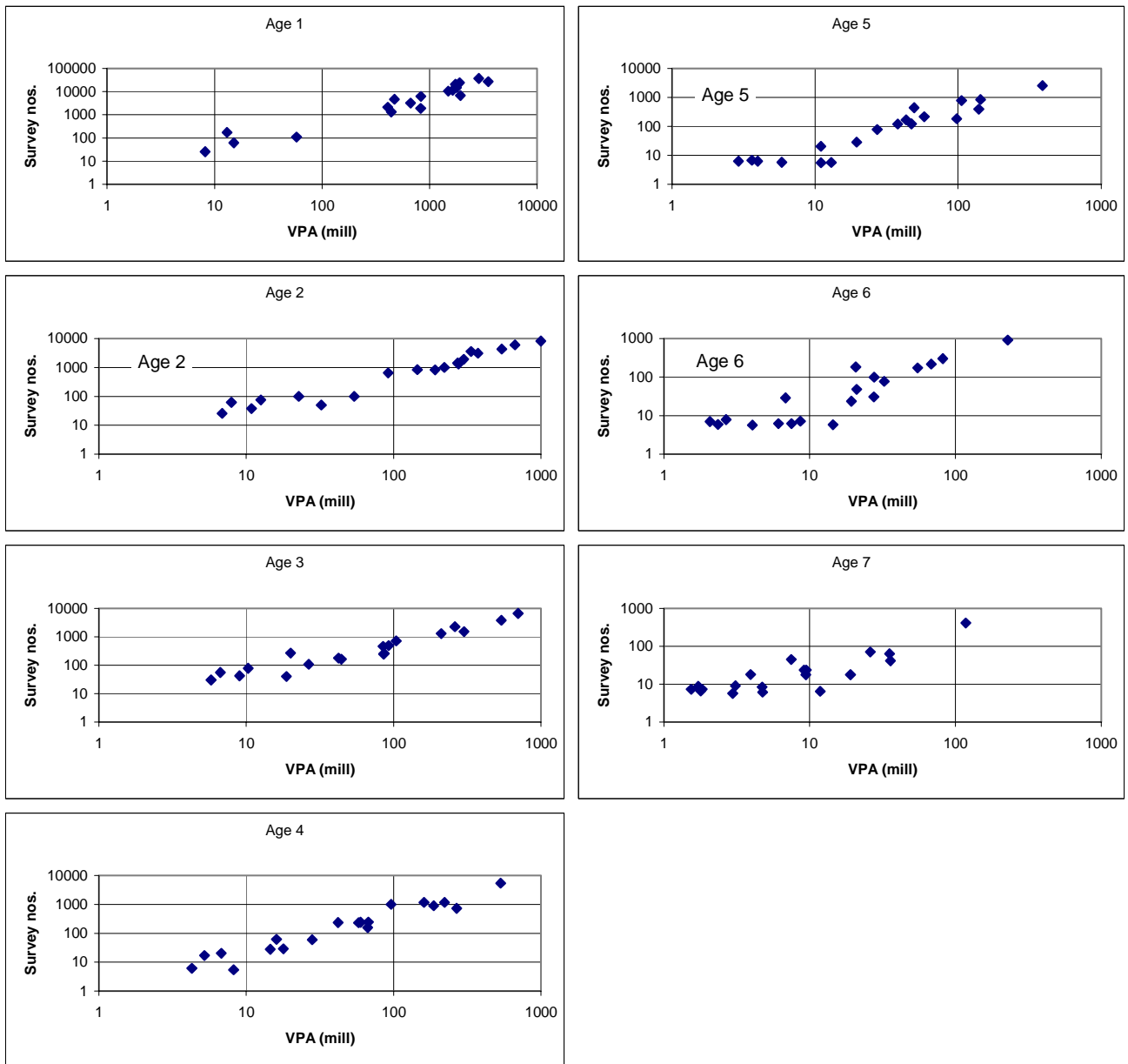


Figure 4.3 A



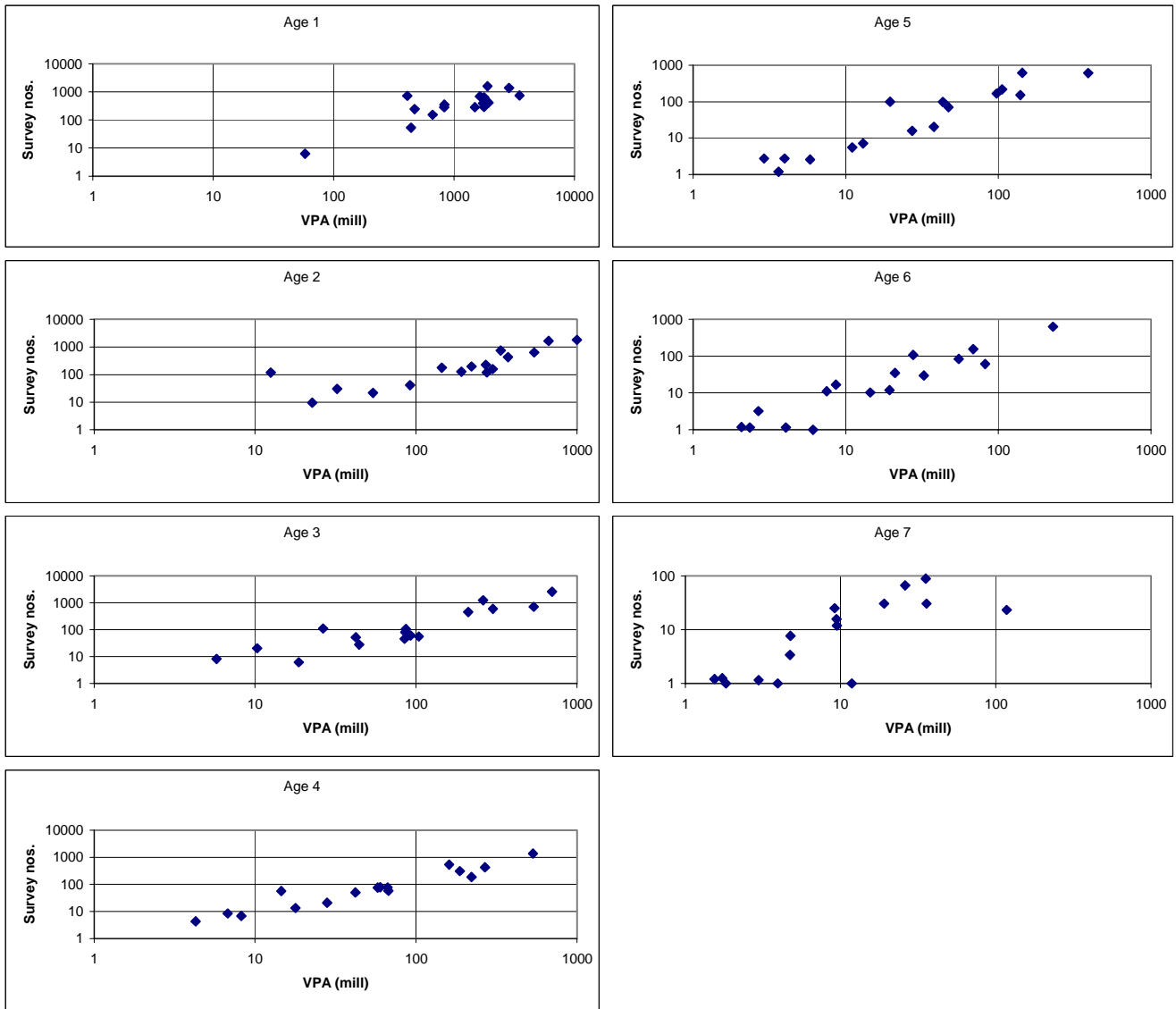
NE Arctic Haddock abundance index from the Norwegian bottom trawl survey plotted against VPA results on stock number at age

Figure 4.3 B



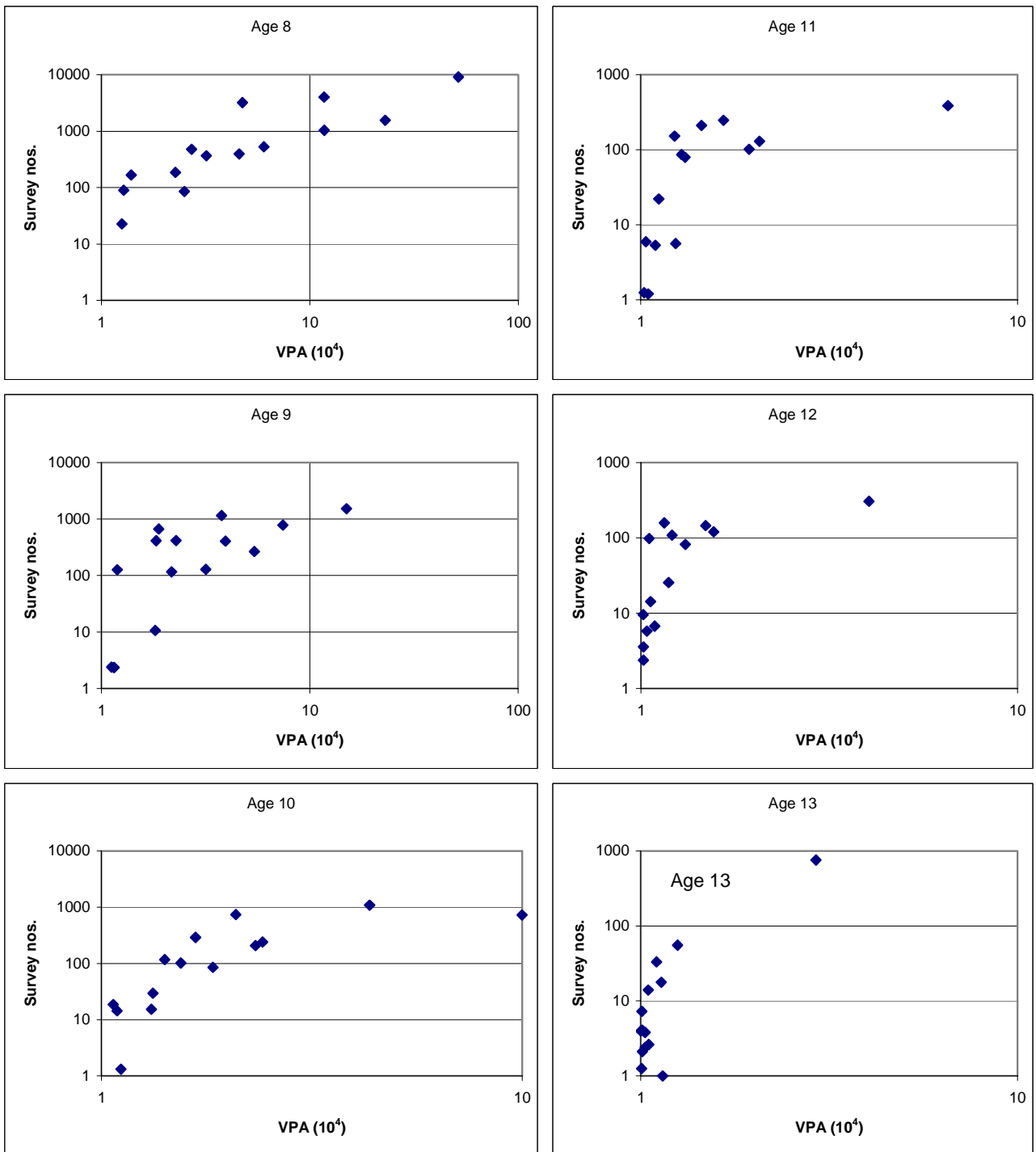
NE Arctic Haddock abundance index from the Norwegian acoustic survey plotted again VPA results on stock number at age

Figure 4.3 C



NE Arctic Haddock abundance index from the Russian bottom trawl survey plotted against VPA results on stock number at age

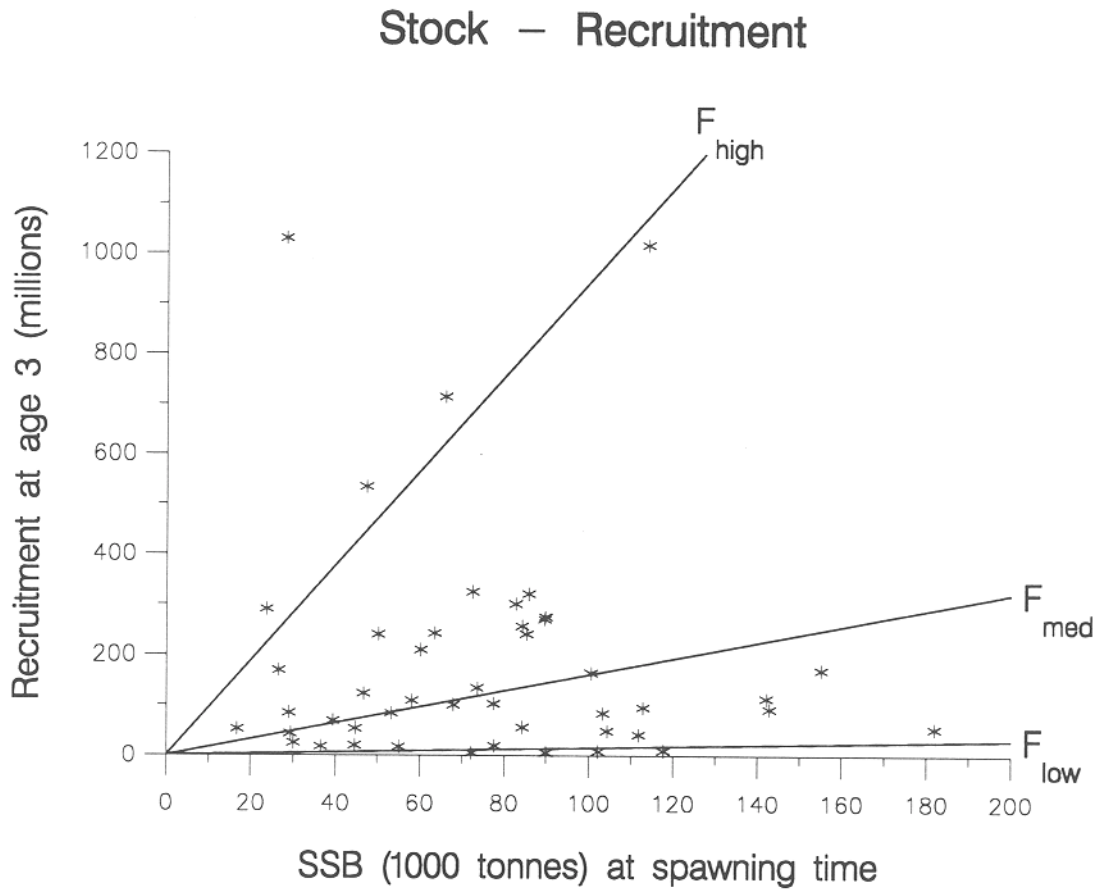
Figure 4.3 D



NE Arctic Haddock abundance index from the Norwegian bottom trawl commercial fleet plotted against VPA results on stock number at age

Figure 4.4

North – East Arctic haddock (Sub – areas I and II)
31 – 8 – 1999



(run: SVPTJA03)

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. Indices for 1983-1998 revised August 1999.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10+	
1981	3.1	7.3	2.3	7.8	1.8	5.3	0.5	0.2			45.0
1982	3.9	1.5	1.7	1.8	1.9	4.8	2.4	0.2			28.3
1983	2919.3	4.8	3.1	2.4	0.9	1.9	2.5	0.7	-	-	12.8
1984	3832.6	514.6	18.9	1.5	0.8	0.2	0.1	0.4	0.1	-	11.4
1985	1901.1	1593.8	475.9	14.7	0.5	0.5	0.1	0.1	0.4	0.3	22.1
1986	665.0	370.3	384.6	110.8	0.6	0.2	0.1	0.1	0.1	0.1	492.7
1987	163.8	79.9	154.4	290.2	52.9	-	-	-	-	0.3	2028.4
1988	35.4	15.3	25.3	68.9	116.4	13.8	0.1	-	-	-	1239.5
1989	81.2	9.5	14.1	21.6	34.0	32.7	3.4	0.1	-	-	499.3
1990	644.1	54.6	4.5	3.4	5.0	9.2	11.8	1.8	0.0	0.0	302.4
1991	2006.0	300.3	33.4	5.1	4.2	2.7	1.7	4.2	0.0	-	770.3
1992	1659.4	1375.5	150.5	24.4	2.1	0.6	0.7	1.6	2.3	0.0	2409.1
1993	727.9	599.0	507.7	105.6	10.5	0.6	0.4	0.3	0.4	1.1	3399.1
1994	603.2	228.0	339.5	436.6	49.7	3.4	0.2	0.1	0.2	0.6	2579.8
1995	1463.6	179.3	53.6	171.1	339.5	34.5	2.8	0.0	0.1	0.0	2491.7
1996	309.5	263.6	52.5	48.1	148.6	252.8	11.6	0.9	-	0.1	2846.3
1997 ¹	1268.0	67.9	86.1	28.0	19.4	46.7	62.2	3.5	0.1	-	1602.0
1998 ¹	212.9	137.9	22.7	33.2	13.2	3.4	8.0	8.1	0.7	0.1	1827.8
1999	1244.9	57.6	59.8	12.2	10.2	2.8	1.0	1.7	1.1	0.0	529.3

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

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

Year	Age											Total	
	0	1	2	3	4	5	6	7	8	9	Older		
	<u>Sub-area I</u>												
1983	39.9	97.3	16.5	0.8	0.7	+						1.1	156.3
1984	9.7	100.2	110.6	2.8	0.4	0.2	+					0.7	224.6
1985	3.9	19.1	213.4	168.8	0.8	0.2	0.1	-				0.3	406.6
1986	0.2	2.3	16.6	58.1	27.6	0.1	+	+	+			-	105.0
1987	0.4	1.4	2.5	12.5	34.2	8.6	+	+	-	+			59.8
1988	1.9	0.4	1.1	2.8	6.2	11.6	1.1	+	+	+			25.2
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
1998	10.5	2.9	17.2	6.7	7.8	0.6	0.9	2.1	0.7	+			49.4
	<u>Division IIa</u>												
1983	5.4	5.5	0.1	0.2	0.3	0.1						1.0	12.6
1984	4.9	14.4	5.6	0.1	0.1	0.1	-					0.2	25.4
1985	3.8	7.0	11.7	4.1	0.1	-	+	-				0.1	26.8
1986	0.4	0.3	3.5	10.4	2.9	0.1	+	+	-			-	17.6
1987	-	-	-	-	0.3	0.3	-	-	-	-			0.6
1988	1.0	0.1	-	+	0.2	0.5	0.2	-	-	-			2.1
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
1998	23.2	7.8	15.5	1.1	2.4	3.2	0.5	2.8	0.8	0.1			57.3

Table B2 (continued)

Year	Age										Total	
	0	1	2	3	4	5	6	7	8	9		Older
	<u>Division IIb</u>											
1983	22.1	9.9	0.2	0.1	+	+					0.1	32.4
1984	2.2	14.3	1.8	-	-	-	-				+	18.3
1985	1.4	10.2	61.4	5.1	+	+	+	-			+	78.1
1986	+	0.2	3.1	7.2	1.4	-	-	+	+		-	12.0
1987	-	-	0.1	0.7	1.4	0.5	+	-	-	-		2.8
1988	0.2	-	-	+	0.3	1.1	0.2	-	+	-		1.8
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	+	+	-	+	+		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	+	+	+		4.3
1996 ¹	4.3	0.6	0.5	0.3	0.2	0.4	0.5	0.3	-	-		7.1
1997	0.4	1.1	0.1	0.1	0.1	0.1	0.1	0.1	+	+		2.1
1998	5.8	1.1	0.2	+	0.1	0.1	+	0.1	+	-		7.5
	<u>Total - Sub-area I and Divisions IIa and IIb</u>											
1983	29.8	59.2	9.5	0.5	0.4	+					0.8	100.2
1984	6.4	58.6	58.4	1.5	0.2	0.1	+				0.3	125.5
1985	3.0	14.4	134.3	90.0	0.4	0.1	0.1	-			0.2	242.7
1986	0.2	1.4	10.7	36.3	16.4	0.1	+	+	+		+	65.1
1987	0.3	0.9	1.7	8.3	22.5	5.7	+	+	-	+		39.4
1988	1.3	0.3	0.7	1.7	4.0	7.6	0.8	+	+	+		16.4
1989	2.2	1.8	2.4	0.4	1.4	4.1	8.1	1.1	0.1	+		21.6
1990	44.8	14.3	10.6	7.3	4.2	7.3	7.4	5.7	0.3	0.1		102.0
1991	16.7	42.9	17.6	6.2	0.9	0.3	0.6	1.8	1.5	0.2		88.7
1992	16.4	28.2	128.6	34.6	5.0	0.4	0.6	0.9	0.8	0.1		215.6
1993	3.5	4.8	35.7	198.5	35.6	4.8	0.8	0.4	0.4	-		284.5
1994	9.1	4.9	5.8	44.2	101.4	11.6	1.5	0.1	0.1	0.5		179.2
1995	6.4	7.2	4.2	3.1	12.3	37.0	4.0	0.5	0.1	0.3		75.1
1996 ¹	6.0	2.3	5.7	2.8	4.9	36.2	33.4	2.9	0.3	0.3		94.8
1997 ¹	1.8	4.6	1.9	3.2	3.2	1.0	2.7	1.0	0.8	-		20.2
1998	10.7	2.9	11.5	3.8	4.6	0.8	0.5	1.5	0.5	+		36.8

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

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

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

Table B4 North-East Arctic HADDOCK. Results from the Russian trawl-acoustic survey in the Barents Sea and adjacent waters in late autumn 1985-1998. Index of number of fish at age.

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

¹ October-December
² September-October
³ November-January

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			
Norway	1983	16.8	25.2	34.9	44.7	52.5	58.0	62.4			
	1984	16.6	27.5	32.7	-	56.6	62.4	61.8			
	1985	15.7	23.9	35.6	41.9	58.5	61.9	63.9			
	1986	15.1	22.4	31.5	43.0	54.6	-	-			
	1987	15.4	22.4	29.2	37.3	46.5	-	-			
	1988	13.5	24.0	28.7	34.7	41.5	47.9	54.6			
	1989	16.0	23.2	31.1	36.5	41.7	46.4	52.9			
	1990	15.7	24.7	32.7	43.4	46.1	50.1	52.4			
	1991	16.8	24.0	35.7	44.4	52.4	54.8	55.6			
	1992	15.1	23.9	33.9	45.5	53.1	59.2	60.6			
	1993	14.5	21.4	31.8	42.4	50.6	56.1	59.4			
	1994	14.7	21.0	29.7	38.5	47.8	54.2	56.9			
	1995	15.4	20.1	28.7	34.2	42.8	51.2	55.8			
	1996	15.4	21.6	28.6	37.8	42.0	46.7	55.3			
	1997 ¹	16.1	21.1	27.7	35.4	39.7	47.5	50.1			
	1998 ¹	14.4	22.9	29.2	35.8	41.3	48.4	50.9			
	1999	14.7	20.8	32.3	39.4	45.5	52.3	54.6			
Russia		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	
1998	15.0	22.0	29.0	38.3	47.7	52.1	54.5	57.8	63.4	-	

¹ Lengths adjusted to account for limited area coverage.

² Limited area 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						
Norway	1983	52	133	480	1,043	1,641	2,081	2,592						
	1984	36	196	289	964	1,810	2,506	2,240						
	1985	35	138	432	731	1,970	2,517	-						
	1986	47	100	310	734	-	-	-						
	1987	-	-	-	-	-	-	-						
	1988	23	139	232	442	743	1,193	1,569						
	1989	43	125	309	484	731	1,012	1,399						
	1990	34	148	346	854	986	1,295	1,526						
	1991	41	138	457	880	1,539	1,726	1,808						
	1992	32	136	392	949	1,467	2,060	2,274						
	1993	26	93	317	766	1,318	1,805	2,166						
	1994	25	86	250	545	1,041	1,569	1,784						
	1995	30	71	224	386	765	1,286	1,644						
	1996	30	93	220	551	741	1,016	1,782						
	1997 ¹	35	88	200	429	625	1,063	1,286						
1998 ¹	25	112	241	470	746	1,169	1,341							
1999	27	85	333	614	947	1,494	1,616							
Russia		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 ²	30	103	209	347	743	1,152	1,650	2,442	3,218	3,333	4,648		
	1997 ²	22	115	227	447	911	1,216	1,583	1,966	3,155	2,815	-		
1998	27	94	230	569	1,087	1,482	1,690	1,914	2,539	-	-			

¹ Lengths adjusted to account for limited area coverage.

² Limited area coverage.

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 are from mixed fisheries. Catches declined sharply after 1976 (Table 5.1). This was partly caused by the introduction of national economic 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 concentrates 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 first half of the 1990s trawlers took the biggest share while purse seine landings 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 appeared to have been caused predominantly by changing market conditions. However, purse seine landings have about doubled since 1995 and now make up almost 30% of the total, while trawl landings have had a corresponding decline and have made up 30 - 40% of the total in the last three years.

5.1.2 Landings prior to 1999 (Table 5.1, Figure 5.1A, 5.2A)

Landings of saithe were highest in 1970-1976 with an average of 238,000 t and a maximum of 265,000 t in 1970. This period 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 was seen after 1990 to 171,498 t in 1996. The stock predictions again showed a decreasing trend and in order to reduce the exploitation rate to a sustainable level the TAC for 1997 was set at 125,000 t. Due to overfishing the total catch closed at 143,760 t. The TAC for 1998 was also first set at 125,000 t. After 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., WD 1998). The reason behind this request was reports from Norwegian fishermen of high saithe abundance with extremely good catchabilities. This suggested that the previous assessment underestimated the stock and that the quota had been set too low. Based on this assessment IMR advised that the catch for 1998 should not exceed 150,000 t. Norwegian authorities increased the TAC for 1998 to 145,000 t. Provisional reports of landings in 1998 indicate overfishing to a total of 153,811 t, which is slightly more than the 146,500 t expected by last years working group (ICES 1999/ACFM:3).

5.1.3 Expected landings in 1999

Norwegian authorities set quotas for other countries and for Norwegian conventional (primarily gillnet), purse seine and trawl fisheries. Based on the stock assessment made in August 1998 and a suggested precautionary fishing mortality (F_{pa}) of 0.26 ACFM advised a TAC of less than 87,000 t. Due to continuing reports from Norwegian fishermen of high saithe abundance and the increased abundance indices in the most recent acoustic saithe survey, IMR again conducted an inter-sessional stock assessment on Northeast Arctic saithe in December 1998 (Mehl, WD 22 1999). In this assessment preliminary catch at age data for Norwegian catches up to November 13 1998 (133,400 t) were scaled to an assumed total catch of 152,500 t (144,000 t Norwegian and 8,500 t others). Acoustic abundance indices from the latest survey and updated fishing effort and CPUE data from the purse seine and trawl fisheries were applied in the tuning. In 1998 there was, however, a large inconsistency between the CPUE in the commercial fishery and the survey data (Table 5.5). The catch rates showed a considerable reduction in 1998 while the survey, as well as reports from the fishery, showed an opposite trend. One explanation may be that the number of vessels participating in the purse seine fishery doubled from 1997 to 1998, while the quota was slightly higher in 1998 than in 1997. The trawlers, on the other side, were perhaps looking for cod but ended up with saithe, spending more time than they really needed for catching this amount of saithe. It was therefore decided to run two analyses, one standard with tuning data from both the commercial fishery (Option 1) and the acoustic survey and one with tuning data from the acoustic survey only (Option 2).

Based on this assessment IMR advised that, depending on how quickly the fishing mortality could be reduced to the F_{pa} level, the TAC for 1999 ought to be between 120,000 t and 145,000 t (1998 TAC). Norwegian authorities set the TAC for 1999 to 144,000 t. However, there is basis for assuming overfishing of about 4,000 t in the saithe fishery in 1999. Therefore, the total catch is expected to be approximately 148,000 t.

In the present report both options of the December 1998 assessment have been revised with updated catch at age data and commercial catch effort and CPUE data. Also the management option tables (catch options) for 1999, which were the basis for the new advice to the Norwegian authorities, are updated and presented in the report. Since there will be a new assessment at IMR, Bergen, Norway, in November 1999, including both data from the acoustic survey in October and commercial catch data from 1999, no short term predictions (catch options for 2000) or medium-term forecasts are given in this report. Some management scenarios based on the present assessment are, however, presented.

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% and from 1997 to 1998 by over 70% to the same level as around 1980 (Table C3). The number of vessels taking part in the fishery almost doubled from 1997 to 1998, but due to regulations the catches were almost the same as in 1997. In such a situation the number of vessels participating in a fishery is perhaps not a good measure of effort.

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. From 1997 to 1998 the effort increased by more than 50%, but due to regulations the catches were slightly lower in 1998 and the CPUE decreased by almost 40% from 1997 to 1998 (Table C2). This may at least partly be explained by the increasing problem with bycatch of saithe in the declining cod fishery. It is uncertain whether hauls from days with more than 50% saithe and trips with more than 50% saithe in the catch were directed only towards saithe.

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 by more than 50%, then decreased by more than 40% from 1995 to 1997 and again increased by more than 60% from 1997 to 1998. As mentioned above the latter increase was not accompanied by higher catches.

5.2.2 Survey results (Tables C4-C5)

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 where 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. In 1997 and 1998 there was a large increase in the abundance of age 5 and older saithe, confirming reports from the fishery. Abundance indices for ages 2-5 from 1988 and onwards are presently used for tuning, but including older ages will be considered at the next assessment.

Since 1995 a Norwegian acoustic survey 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. Because saithe is also acoustically registered, this survey may provide supplementary information, especially about 2- and 3 year old saithe which have not yet 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 is too short to be used for tuning.

5.3 Data used in the Assessment

5.3.1 Catch numbers at age (Table 5.3)

The age composition of Norwegian landings in 1997 was revised, resulting in only minor changes. Age composition data for 1998 was available from Norway and Germany, accounting for 96% 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 (Table 5.4)

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 5.23)

Traditionally, knife-edge maturity at age 6 has been used for this stock. In 1995, 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 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 5.5)

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. Especially in 1998 the effort data do not seem to reflect the actual effort required to account for the catches. Therefore two analyses were performed in the present assessment, one with standard tuning (Option 1, three data series) and one with only indices from the Norwegian acoustic survey (Option 2, one data series).

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. In a few years (1992 – 1993) acoustic survey data showed promise for improving the estimate of year class strength at age 2. It may, however, vary from year to year to what extent the 2 year old saithe have migrated out from the near coast areas and are available for the acoustic saithe survey on the banks. In recent years there are conflicting results between the catch and survey data, especially for the 1993 year class.

5.3.7 Prediction data (Tables 5.23, 5.25)

Two short-term predictions were performed: Options 1 and 2. The input data to the predictions based on results from the two XSA-analyses are given in Tables 5.23 and 5.25, respectively. The stock number at age in 1999 was taken from the XSA for age 5 and older. The recruitment at age 2 and 3 in 1998 (1995 and 1996 year classes) was estimated using RCT3 (Section 5.5.2). The corresponding numbers at age 3 and 4 in 1999 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 1997 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 1996-1998 has been used, scaled to the 1998 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.

5.4 Methods used in the Assessment

5.4.1 VPA and tuning (Tables 5.6, 5.12, Figures 5.2A-C, 5.4)

Extended Survivors Analysis (XSA) was used for the assessment with the same settings as last year in both analyses. Catchability was assumed to be independent of stock size for all ages. The tuning diagnostics are given in Tables 5.6 and 5.12 for Options 1 and 2, respectively. Figures 5.3A-C show plots of the tuning indices versus stock numbers from the VPA for Option 1, Figure 5.4 shows acoustic indices versus stock numbers for Option 2.

5.4.2 Recruitment (Tables 5.3, 5.5, Figures 5.5 B-C)

Estimates of the recruiting year classes up to the 1994 year class from the XSA were accepted. The 1995 and 1996 year classes were poorly represented both in the Norwegian acoustic surveys and in the purse seine fishery at age 2 in 1997 and 1998. Retrospective analysis show that estimates of recruitment at age 2 and 3 in the last VPA year have been unreliable in recent years (Figures 5.5B-C). RCT3-runs were therefore conducted to estimate these year classes for both options, with 2 and 3 year olds from the survey as input for the estimation of the 1996 and 1995 year classes, respectively.

5.5 Results of the Assessment

5.5.1 Fishing mortalities and VPA (Tables 5.7-5.17, Figures 5.1A-B, 5.2A-B, 5.5A-C)

For Option 1 (Table 5.7) the fishing mortality (F_{3-6}) in 1997 was 0.35 which is a little lower than the value of 0.38 from last years assessment (Figure 5.5A). Using the RCT3 estimation of the 1995 year class gives a fishing mortality (F_{3-6}) in 1998 of 0.39. For Option 2 (Table 5.13) the fishing mortality (F_{3-6}) in 1997 was 0.29. F_{3-6} in 1998 was 0.28 using the RCT3 estimation of the 1995 year class.

The XSA-estimates of the 1995-1997 year classes are not considered to be valid and these estimates are therefore put in brackets (Tables 5.8-5.9 and 5.14-5.15 for Options 1 and 2, respectively). In Tables 5.11 and 5.17 the long-term average recruitment and recalculated total biomass are presented for the two alternatives. 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 strength of the 1993 year class, however, is still uncertain. It has been weakly represented as 2-5 year olds in the landings (Tables 5.3 and 5.5), as well as 6 year olds in preliminary catch data for 1999. The 1994 year class also seems to be below average. In the acoustic survey, however, the 1993 and 1994 year classes come out as above average.

The SOP corrected stock biomass tables are included (Tables 5.9-5.11 and 5.15-5.17 for the two alternatives). There are considerable SOP discrepancies in the early part of the time series which are caused by the fixed weights in the database 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 5.11, 5.17, 5.18A-B, 5.19A-B)

For Option 1 the RCT3 estimate (with 3 year olds as input and backcalculating the strength as 2 year olds, Table 5.18A) of the 1995 year class gives 202 million individuals, while the RCT3 estimates (with 2 year olds as input, Table 5.18B) of the 1996 year class is 174 million individuals. For Option 2 the RCT3 estimates of the 1995 and 1996 year classes were 220 and 193 million individuals, respectively, using the same approach as for Option 1 (Tables 5.19A-B). It was decided to use the RCT3 estimates and the long-term geometric mean of 210 million individuals for the 1997 and subsequent year classes in the predictions.

5.6 Reference points

5.6.1 Biomass reference points

In 1995 MBAL for Northeast Arctic saithe was set at 170,000 t. (ICES 1996/Assess:4). This was also proposed as a suitable level for B_{pa} by The Study Group on the Precautionary Approach to Fisheries Management (SGPAFM, ICES 1998/ACFM:10). Based on a examination of the stock-recruitment plot ACFM reduced the B_{pa} to 150,000 t (ICES 1998A).

5.6.2 Fishing mortality reference points (Tables 5.20-5.21, Figures 5.1C, 5.2C, 5.6- 5.7)

Yield and SSB per recruit were based on the parameters in Tables 5.23 and 5.25 (1999 data columns) and are presented in Tables 5.20 and 5.21 for Options 1 and 2, respectively. For both options $F_{0.1}$ and F_{max} were estimated to be 0.08 and 0.14, respectively, which is the same as the values obtained last year. The plots of SSB versus recruitment in the two options are shown in Figures 5.6 and 5.7. F_{low} , F_{med} and F_{high} were not recalculated. The values obtained in 1998 were 0.17, 0.32 and 0.58, respectively.

The SGPAFM (ICES 1998/ACFM:10) has suggested the limit reference point $F_{lim} = F_{med}$ for Northeast Arctic cod, haddock and saithe. A precautionary fishing mortality (F_{pa}) was defined as $F_{pa} = F_{lim} \cdot e^{-1.645\sigma}$ ($\sigma = 0.2-0.3$). The 1998 WG, however, found that setting $F_{lim} = F_{med}$ did not correspond very well with the exploitation history for those fish stocks (Jakobsen, WD 1998). It was therefore decided to estimate F_{pa} and other reference points by the PASoft program package (MRAG 1997). Data input and analysis were performed as described in Motos (WD 1998). The estimates for $F_{0.1}$, F_{max} , F_{med} and F_{high} were exactly the same as the values already estimated (see above). The median value for F_{loss} was estimated at 0.43. F_{lim} can be set at F_{loss} (ICES 1998/ACFM:10) The probability of exceeding F_{lim} should be no more than 5 % (ICES 1997/Assess: 7). The 5th percentile of the F_{loss} estimated here was 0.30 and the 1998 WG recommended using this value for F_{pa} . ACFM considered the 5th percentile calculated from the PASoft program package to be too unstable for long term use and re-estimated F_{pa} using the formula $F_{pa} = F_{lim} \cdot e^{-1.645\sigma}$ with $\sigma = 0.3$ giving a $F_{pa} = 0.26$ (ICES 1998B). An updated version of the PASoft program package is now available (CEFAS 1999) and the present WG again re-estimated F_{pa} and also arrived at a value of 0.26 (Table 5.22). The WG therefore agreed to recommend using this value for a precautionary fishing mortality for saithe ($F_{pa} = 0.26$).

5.7 Catch options for 1999 (short term predictions) (Tables 5.24, 5.26)

Catch options for 1999 (management option tables) for the two alternatives are presented in Tables 5.24 and 5.26, respectively, and Table 5.27 summarises the two options. Both alternatives show an increase in predicted catch and SSB compared to the August 1998 assessment, which was the basis for ACFM's recommendations. This was both due to one more year with catch and survey data (Option 1) and the exclusion of commercial tuning data (Option 2). Neither of the two alternatives give a SSB below the B_{pa} of 150,000 t in year 2000 with a catch in 1999 at the same level as in 1998 (153,800 t). For both alternatives the SSB decreases from 1998 to 1999 and continues to decrease in 1999 at F_{sq} , while at F_{pa} the SSB increases slightly from 1999 to 2000 for Option 1 and is at about the same level in 2000 as in 1999 for Option 2. A catch at *status quo* level in 1999 is 142,000 t for Option 1 ($F = 0.39$) and 155,000 t for Option 2 ($F = 0.28$). A catch in 1999 at F_{pa} level is about 102,000 t for Option 1 and about 146,000 t for Option 2 (Table 5.26).

5.8 Management scenarios and risk analyses (Figs. 5.1D, 5.2D, 5.8A-D, 5.9A-D)

5.8.1 Input data and methods

Medium-term risk analyses were performed for both assessment options, the standard assessment with both commercial and survey CPUE tuning data (Option 1) and the assessment with only survey tuning data (Option 2). The input data were the same as used for the short term predictions (Tables 5.23, 5.25). A spreadsheet doing single option prediction was run under the program @RISK, Latin Hypercubed, 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 447 million, respectively.

5.8.2 Results

Figures 5.8A-D show the SSB distributions with quantiles from the @RISK simulations for the period 1999-2003. For Option 1 the SSB will approach B_{pa} at F_{sq} and remain close to B_{pa} in the whole period. At F_{pa} the SSB will start to increase from year 2000 and reach levels well above B_{pa} at the end of the period. For Option 2 the SSB will remain almost constant through the period at a level about 80% above B_{pa} . Corresponding catch distributions are presented in Figures 5.9A-D. For Option 1 the catch will be reduced to about 120,000 t at F_{sq} and remain at that level for the rest of the period, while at F_{pa} the catch will be reduced somewhat more in the beginning of the period and end up at the same level as for F_{sq} at the end of the period. For Option 2 the catch will remain at about 1999 level for both F_{pa} and F_{sq} .

In the @RISK simulations the probability of getting below B_{pa} (150,000 t) was analyzed using the “set target value” option. The text table below presents the probability of getting a SSB at or below the B_{pa} level.

Fishing mortality	% chance of going below B_{pa} in the period	
	Option 1	Option 2
$F_{pa} = 0.26$	3	0
$F_{sq} = 0.39 / 0.28$	40	0

For Option 1 the chances of going below B_{pa} are quite high at F_{sq} , while if the fishing mortality is reduced to F_{pa} from year 2000 the chances of falling below B_{pa} are small. For Option 2 there is no risk of going below B_{pa} in the period for fishing mortalities at F_{pa} or F_{sq} .

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 somewhat better than in the past. The current state of the stock is, however, uncertain due to a large inconsistency between commercial and survey CPUE data. Therefore two XSA analyses were made; one standard with both commercial and survey CPUE tuning data and one with only survey data in the tuning. In the standard assessment the fishing mortality decreased slightly in 1996 and 1997, while it increased again in 1998 to levels well above F_{pa} . SSB will decrease in the short term at the current fishing mortality and approach B_{pa} . The alternative assessment gave a fishing mortality in 1998 very close to F_{pa} and a SSB well above B_{pa} .

Prediction of growth has been a small problem in some periods, especially for abundant year classes. In the last years, however, the prediction of the weight at age the next year has been reasonably close to the actual weights later used in the assessment ($\pm 1-18\%$). 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.

Table 5.1 Northeast Arctic saithe. Nominal catch (t) by countries as officially reported to ICES. (Sub-area I and Divisions IIa and IIb combined.)

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	141,589	-	1	1,640	655	548	9	6	146,544
1995	172 ²	222 ²	53	872	165,001	-	4	1,144	-	589	99	18	168,174
1996	248 ²	365 ²	176 ²	2,615	166,149	-	24	1,159	9 ²	690 ²	16	47 ²	171,498
1997	193 ²	560	363 ²	2,915	137,054	-	12	1,774	45 ²	676	123	45	143,760
1998 ¹	366 ²	932	437 ²	2936	144457	-	49 ²	3836	407 ²	355	-	36 ²	153,811

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 Northeast 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 ³
1994	30.2	81.7	21.1	13.5	146.5 ⁴
1995	21.8	103.5	26.9	15.9	168.2 ⁵
1996	46.9	72.7	31.6	20.3	171.5
1997	44.4	56.1	24.4	19.0	143.8
1998 ¹	44.4	58.3	27.5	23.6	153.8

¹ Preliminary.

² Unresolved discrepancy between Norwegian catch by gear figures and the total reported to ICES for these years.

³ As reported by Working Group members

⁴ Includes 4,300 tonnes not categorized by gear, proportionally adjusted.

⁵ Reduced by 1,200 tonnes not categorized by gear, proportionally adjusted.

Table 5.3

Run title : Arctic Saithe (run: XSASME07/X07)

At 27/08/1999 10:54

Table 1	Catch numbers at age				Numbers*10** ⁻³					
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	
AGE										
2,	7381,	4936,	1246,	2815,	20308,	30430,	7450,	6952,	5297,	
3,	10509,	17824,	37266,	42050,	9001,	37115,	22392,	29664,	25196,	
4,	13083,	9131,	11131,	28925,	59601,	5001,	54537,	24836,	18384,	
5,	13545,	12506,	4421,	5888,	13154,	26300,	13124,	35956,	5101,	
6,	5064,	3799,	8290,	4650,	2718,	10142,	12899,	4125,	8282,	
7,	4883,	1332,	2427,	3861,	3472,	2861,	4652,	5616,	787,	
8,	2401,	968,	1024,	1099,	2655,	2110,	1374,	2916,	1913,	
9,	1315,	520,	938,	1075,	1251,	2733,	933,	1413,	900,	
10,	743,	405,	451,	697,	1221,	699,	965,	1397,	577,	
+sp,	1525,	1229,	1728,	1777,	3559,	3593,	2900,	3493,	1166,	
TOTALNUM,	60449,	52650,	68922,	92837,	116940,	120984,	121226,	116368,	67603,	
TONSLAND,	136006,	109821,	122841,	148036,	198110,	184548,	201860,	191191,	107181,	
SOPCOF %,	128,	144,	125,	120,	117,	107,	110,	100,	113,	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
2,	4090,	25952,	19842,	11608,	13829,	21159,	81601,	54151,	31662,	45758,
3,	77333,	43540,	77019,	65178,	76296,	36782,	60832,	125030,	99049,	48969,
4,	11949,	62846,	59280,	52389,	25206,	44027,	11691,	30576,	34317,	27685,
5,	16939,	13987,	26961,	29146,	26911,	15671,	16366,	7947,	10140,	12476,
6,	4747,	16189,	9556,	10186,	16031,	20419,	4436,	8712,	2062,	4534,
7,	4798,	5122,	9592,	5616,	7114,	12148,	7808,	3435,	4332,	1468,
8,	1126,	7959,	2901,	3547,	3935,	4802,	6789,	3212,	1456,	1848,
9,	1711,	2504,	4352,	1865,	2871,	3258,	2914,	2679,	1606,	938,
10,	675,	3697,	2195,	2140,	2610,	2505,	2350,	1724,	963,	976,
+sp,	511,	2799,	5490,	3149,	3924,	3821,	4140,	2880,	1134,	2150,
TOTALNUM,	123879,	184586,	217188,	184824,	178727,	164592,	198927,	240346,	186721,	146802,
TONSLAND,	140379,	260404,	244732,	210508,	215659,	262301,	233453,	242486,	182808,	154465,
SOPCOF %,	98,	96,	80,	82,	82,	97,	102,	100,	101,	103,
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
2,	28334,	18226,	10467,	17225,	11638,	14624,	2216,	3311,	3867,	5017,
3,	61963,	40796,	83954,	34733,	17244,	41466,	48917,	22115,	17869,	8126,
4,	23328,	36644,	21822,	65052,	23768,	33233,	11974,	12895,	49829,	35847,
5,	14122,	9211,	21528,	13060,	32700,	12064,	7189,	6062,	4339,	32827,
6,	4400,	6379,	3619,	8212,	3226,	11204,	5279,	4525,	3118,	4560,
7,	2901,	3200,	2550,	1054,	3008,	1135,	3740,	2805,	3490,	2328,
8,	963,	1338,	2008,	1251,	1177,	1772,	775,	1399,	755,	1219,
9,	1356,	147,	369,	461,	760,	560,	878,	351,	620,	966,
10,	438,	730,	279,	263,	247,	557,	134,	454,	257,	320,
+sp,	1192,	1629,	629,	448,	760,	897,	701,	285,	797,	102,
TOTALNUM,	138997,	118300,	147225,	141759,	94528,	117512,	81803,	54202,	84941,	91312,
TONSLAND,	164234,	154379,	175516,	170903,	155405,	158796,	107147,	70458,	91679,	114508,
SOPCOF %,	114,	100,	100,	100,	100,	100,	99,	99,	102,	99,
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
2,	11157,	11543,	6135,	14333,	3379,	1432,	70,	961,	326,	49,
3,	12378,	21002,	73878,	49750,	26933,	9369,	16402,	10225,	14827,	3639,
4,	19915,	13463,	11619,	26640,	63451,	38499,	48351,	57448,	13295,	18968,
5,	32643,	8996,	5395,	4865,	26254,	48587,	37268,	18667,	43309,	13386,
6,	18751,	9152,	5066,	5594,	3427,	17617,	32240,	17805,	13029,	32917,
7,	1939,	7735,	2988,	4850,	1636,	1772,	4842,	17861,	11219,	8323,
8,	377,	1126,	2009,	3353,	1263,	517,	572,	2765,	5837,	5232,
9,	191,	154,	272,	1480,	950,	305,	139,	485,	755,	2618,
10,	179,	121,	81,	291,	650,	275,	280,	202,	63,	543,
+sp,	149,	253,	132,	267,	106,	697,	305,	443,	160,	339,
TOTALNUM,	97679,	73545,	107575,	111423,	128049,	119070,	140469,	126862,	102820,	86014,
TONSLAND,	122664,	95393,	107326,	127606,	153584,	146544,	168174,	171498,	143760,	153811,
SOPCOF %,	100,	100,	99,	100,	100,	100,	100,	100,	100,	100,

Table 5.4

Run title : Arctic Saithe (run: XSASME07/X07)

At 27/08/1999 10:54

Table 2		Catch weights at age (kg)									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,		
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,	
+sp,	8.0300,	8.0390,	7.9240,	7.8510,	7.7810,	7.9590,	8.1060,	7.9940,	7.7160,		
SOPCOFAC,	1.2793,	1.4354,	1.2489,	1.2026,	1.1684,	1.0721,	1.0963,	.9990,	1.1338,		
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
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,	
+sp,	7.4790,	7.4040,	7.0520,	7.4770,	7.3850,	7.2170,	7.1270,	7.3200,	7.3940,	7.5270,	
SOPCOFAC,	.9756,	.9575,	.7953,	.8212,	.8167,	.9694,	1.0155,	1.0020,	1.0061,	1.0278,	
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
2,	.3400,	.4500,	.4300,	.5100,	.6000,	.5300,	.3800,	.3200,	.3400,	.3300,	
3,	.7100,	.7900,	.7300,	.7700,	1.0500,	.7100,	.7500,	.5900,	.5300,	.6200,	
4,	1.1100,	1.2700,	1.4000,	1.1200,	1.3300,	1.2600,	1.3300,	1.2200,	.8400,	.8700,	
5,	1.6300,	2.0300,	2.0500,	2.0200,	1.8600,	2.0200,	2.0700,	1.9700,	1.6600,	1.3100,	
6,	2.3300,	2.5500,	2.7600,	2.6100,	2.8000,	2.7000,	2.6300,	2.3000,	2.3200,	2.4300,	
7,	3.1600,	3.2900,	3.3000,	3.2700,	4.0000,	3.8800,	3.2800,	2.8700,	2.9700,	3.8700,	
8,	4.0300,	4.3400,	4.3800,	3.9100,	4.1800,	4.4700,	3.9600,	3.7200,	4.0000,	5.3800,	
9,	4.8700,	5.1500,	5.9500,	4.6900,	5.3300,	5.3600,	4.5400,	4.3000,	4.7200,	5.8300,	
10,	5.6300,	5.7500,	6.3900,	5.6300,	5.6800,	6.0600,	5.5500,	4.6900,	5.4400,	5.3600,	
+sp,	7.8090,	6.9370,	6.8410,	7.5580,	8.6650,	7.1900,	8.0120,	6.5970,	6.9040,	7.4480,	
SOPCOFAC,	1.1388,	.9991,	.9975,	.9961,	.9991,	.9997,	.9930,	.9929,	1.0154,	.9902,	
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
2,	.4500,	.5400,	.4000,	.4500,	.4600,	.3500,	.5000,	.4000,	.3800,	.3700,	
3,	.7400,	.7600,	.7200,	.7000,	.6300,	.5200,	.5600,	.5900,	.6200,	.7000,	
4,	.9700,	1.0800,	1.1900,	1.1000,	1.0200,	.7400,	.7800,	.8200,	.9200,	.9900,	
5,	1.3900,	1.5600,	1.7800,	1.9800,	1.7000,	1.2200,	1.2100,	1.3200,	1.1900,	1.4400,	
6,	1.8100,	2.1200,	2.2400,	2.3400,	2.5000,	2.1600,	1.7400,	1.8300,	1.6600,	1.8400,	
7,	3.0200,	2.4000,	2.8600,	2.8100,	2.8800,	3.1900,	2.8000,	2.4700,	2.3100,	2.5000,	
8,	3.7600,	3.6500,	3.3200,	3.2500,	3.0900,	3.9700,	3.7400,	3.7200,	3.1000,	2.9800,	
9,	4.6400,	3.6000,	4.5300,	4.0600,	3.7000,	4.6200,	4.4000,	4.4900,	4.3400,	4.0700,	
10,	4.7500,	6.3700,	5.7000,	6.1900,	6.1900,	5.2800,	5.2800,	5.3000,	6.0400,	5.4800,	
+sp,	7.5000,	4.7950,	7.1250,	7.3760,	8.1750,	6.0720,	7.4510,	7.0160,	7.6200,	6.8590,	
SOPCOFAC,	.9978,	1.0001,	.9912,	1.0000,	1.0008,	1.0038,	.9999,	.9999,	1.0011,	1.0018,	

Table 5.7 (option 1)

Run title : Arctic Saithe (run: XSASME07/X07)

At 24/08/1999 18:34

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,		
AGE											
2,	.0694,	.0259,	.0039,	.0259,	.0628,	.1742,	.0347,	.0409,	.0160,		
3,	.1412,	.2383,	.2772,	.1747,	.1080,	.1562,	.1876,	.1886,	.2042,		
4,	.1843,	.1755,	.2297,	.3606,	.4012,	.0805,	.3616,	.3278,	.1709,		
5,	.5007,	.2695,	.1204,	.1825,	.2760,	.3093,	.3131,	.4319,	.1024,		
6,	.2407,	.2519,	.2882,	.1797,	.1198,	.3558,	.2448,	.1522,	.1649,		
7,	.3847,	.0915,	.2530,	.2108,	.1978,	.1786,	.2736,	.1595,	.0391,		
8,	.4184,	.1206,	.0943,	.1734,	.2195,	.1772,	.1219,	.2757,	.0747,		
9,	.3585,	.1479,	.1645,	.1355,	.3055,	.3690,	.1106,	.1777,	.1274,		
10,	.3832,	.1770,	.1849,	.1771,	.2248,	.2795,	.2138,	.2406,	.1020,		
+sp,	.3832,	.1770,	.1849,	.1771,	.2248,	.2795,	.2138,	.2406,	.1020,		
FBAR 3- 6,	.2667,	.2338,	.2289,	.2244,	.2262,	.2254,	.2768,	.2751,	.1606,		
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
AGE											
2,	.0131,	.0785,	.1052,	.0472,	.1396,	.1204,	.2763,	.2182,	.2178,	.1964,	
3,	.3402,	.1880,	.3511,	.5893,	.4906,	.6671,	.5963,	.9054,	.7870,	.6157,	
4,	.1406,	.5146,	.4216,	.4300,	.4767,	.5913,	.4592,	.6944,	.6808,	.5253,	
5,	.2354,	.2432,	.4348,	.3782,	.4111,	.6232,	.4559,	.6615,	.5209,	.5677,	
6,	.1307,	.3709,	.2610,	.2895,	.3693,	.6371,	.3553,	.4708,	.3526,	.4674,	
7,	.1356,	.2034,	.3930,	.2409,	.3374,	.5335,	.5381,	.5166,	.4544,	.4583,	
8,	.0721,	.3480,	.1697,	.2451,	.2655,	.4018,	.6562,	.4434,	.4310,	.3563,	
9,	.0885,	.2271,	.3262,	.1569,	.3211,	.3674,	.4565,	.5923,	.4166,	.5516,	
10,	.1330,	.2801,	.3188,	.2635,	.3430,	.5167,	.4962,	.5413,	.4383,	.4839,	
+sp,	.1330,	.2801,	.3188,	.2635,	.3430,	.5167,	.4962,	.5413,	.4383,	.4839,	
FBAR 3- 6,	.2118,	.3292,	.3671,	.4217,	.4369,	.6297,	.4667,	.6830,	.5854,	.5440,	
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
2,	.2067,	.0582,	.0788,	.1460,	.1145,	.1249,	.0091,	.0181,	.0426,	.0735,	
3,	.4447,	.5172,	.4110,	.4038,	.2134,	.7506,	.7844,	.1177,	.1283,	.1183,	
4,	.6835,	.5184,	.5843,	.6561,	.5376,	.8211,	.5015,	.4837,	.4213,	.4087,	
5,	.5629,	.6406,	.6683,	.8679,	.8425,	.5822,	.4100,	.5153,	.2952,	.5474,	
6,	.3993,	.5395,	.5635,	.5853,	.5395,	.8058,	.5486,	.4937,	.5509,	.5813,	
7,	.6266,	.5726,	.4295,	.3136,	.4400,	.3672,	.7031,	.6430,	.9196,	1.1088,	
8,	.6269,	.6750,	.8974,	.3879,	.6980,	.5069,	.4621,	.6274,	.3519,	1.0313,	
9,	.4838,	.1774,	.3926,	.5235,	.4333,	.8838,	.5101,	.3929,	.6395,	1.0759,	
10,	.5444,	.5262,	.5978,	.5423,	.5981,	.6644,	.5362,	.5452,	.5628,	.8313,	
+sp,	.5444,	.5262,	.5978,	.5423,	.5981,	.6644,	.5362,	.5452,	.5628,	.8313,	
FBAR 3- 6,	.5226,	.5539,	.5568,	.6283,	.5333,	.7399,	.5611,	.4026,	.3489,	.4139,	
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	FBAR 96-98
AGE											
2,	.1501,	.0456,	.0151,	.0535,	.0176,	.0044,	.0007,	.0089,	.0076,	.0060,	.0075,
3,	.2612,	.4659,	.4540,	.1630,	.1347,	.0621,	.0629,	.1384,	.1834,	.1102,	.1440,
4,	.4716,	.5049,	.5125,	.2918,	.3227,	.2900,	.5177,	.3257,	.2687,	.3777,	.3240,
5,	.8245,	.4041,	.3879,	.4191,	.5239,	.4403,	.5071,	.3853,	.4377,	.4767,	.4332,
6,	.7102,	.5773,	.4193,	.9166,	.5940,	.8310,	.5948,	.4869,	.5121,	.7128,	.5706,
7,	.5267,	.7363,	.3733,	.9395,	.7680,	.7181,	.5708,	.7982,	.6591,	.7378,	.7317,
8,	.5137,	.6768,	.4235,	.9679,	.6847,	.5906,	.5347,	.7698,	.6685,	.7582,	.7322,
9,	.4237,	.4079,	.3361,	.6433,	.8322,	.3425,	.3070,	1.13172,	.4888,	.7364,	.8475,
10,	.5752,	.5247,	.3910,	.7383,	.6622,	.6145,	.6125,	1.0158,	.5685,	.8068,	.7970,
+sp,	.5752,	.5247,	.3910,	.7383,	.6622,	.6145,	.6125,	1.0158,	.5685,	.8068,	.7970,
FBAR 3- 6,	.5669,	.4881,	.4434,	.4476,	.3938,	.4059,	.4206,	.3341,	.3505,	.4193,	

Table 5.8 (option 1)

Run title : Arctic Saithe (run: XSASME07/X07)

At 24/08/1999 18:34

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)				Numbers*10** ⁻³								
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,				
AGE													
2,	121648,	213267,	355500,	121812,	368894,	210348,	241196,	191863,	367832,				
3,	88172,	92919,	170142,	289931,	97184,	283650,	144684,	190734,	150794,				
4,	85920,	62681,	59947,	105581,	199327,	71423,	198650,	98196,	129319,				
5,	38001,	58507,	43056,	39009,	60270,	109266,	53951,	113293,	57924,				
6,	26165,	18857,	36586,	31251,	26610,	37443,	65662,	32296,	60223,				
7,	16897,	16840,	12001,	22453,	21379,	19327,	21479,	42088,	22710,				
8,	7761,	9416,	12582,	7630,	14889,	14362,	13235,	13376,	29377,				
9,	4823,	4181,	6833,	9375,	5252,	9788,	9849,	9593,	8313,				
10,	2580,	2759,	2953,	4746,	6703,	3168,	5541,	7220,	6575,				
+sp,	5253,	8334,	11260,	12044,	19432,	16183,	16564,	17950,	13243,				
TOTAL,	397220,	487760,	710861,	643831,	819940,	774957,	770812,	716609,	846308,				
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,			
AGE													
2,	347419,	379802,	219513,	278429,	117280,	206199,	373532,	305259,	178767,	283565,			
3,	296362,	280742,	287473,	161768,	217455,	83508,	149676,	231986,	200927,	117713,			
4,	100661,	172667,	190456,	165673,	73469,	109002,	35089,	67501,	76803,	74882,			
5,	89243,	71602,	84503,	102293,	88238,	37344,	49406,	18150,	27599,	31829,			
6,	42808,	57739,	45967,	44789,	57378,	47893,	16395,	25641,	7669,	13421,			
7,	41812,	30753,	32624,	28988,	27454,	32472,	20736,	9409,	13111,	4413,			
8,	17881,	29891,	20544,	18031,	18652,	16040,	15594,	9912,	4596,	6814,			
9,	22321,	13621,	17280,	14195,	11553,	11710,	8788,	6624,	5209,	2445,			
10,	5992,	16727,	8886,	10210,	9935,	6861,	6640,	4558,	2999,	2812,			
+sp,	4518,	12584,	22071,	14933,	14827,	10359,	11582,	7534,	3500,	6134,			
TOTAL,	969018,	1066128,	929316,	839310,	636241,	561389,	687437,	686576,	521180,	544028,			
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,			
AGE													
2,	167691,	356379,	152684,	140148,	118891,	137634,	271270,	203943,	102571,	78241,			
3,	190760,	111656,	275287,	115536,	99158,	86809,	99453,	220092,	163978,	80479,			
4,	52066,	100114,	54502,	149421,	63165,	65580,	33553,	37163,	160186,	118086,			
5,	36258,	21520,	48810,	24877,	63474,	30209,	23622,	16637,	18759,	86062,			
6,	14771,	16907,	9285,	20483,	8551,	22380,	13817,	12835,	8136,	11432,			
7,	6886,	8112,	8071,	4327,	9339,	4082,	8185,	6536,	6414,	3840,			
8,	2285,	3013,	3746,	4300,	2589,	4925,	2315,	3318,	2813,	2094,			
9,	3907,	999,	1256,	1250,	2389,	1055,	2429,	1194,	1450,	1620,			
10,	1153,	1972,	685,	694,	606,	1268,	357,	1194,	660,	626,			
+sp,	3105,	4355,	1527,	1170,	1845,	2017,	1847,	742,	2024,	197,			
TOTAL,	478881,	625027,	555853,	462207,	370007,	355958,	456848,	503653,	466991,	382676,			
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	GMST 60-96	AMST 60-96
AGE													
2,	88454,	286047,	453276,	304335,	213648,	364489,	106893,	120497,	(47448,)	(8983,)	(0,)	207577,	231060,
3,	59519,	62325,	223751,	365560,	236199,	171863,	297123,	87453,	97785,	(38552,)	(7311,)	156130,	175211,
4,	58538,	37530,	32024,	116344,	254279,	169014,	132232,	228423,	62349,	66644,	(28272,)	91138,	106472,
5,	64245,	29907,	18545,	15705,	71150,	150774,	103541,	64513,	135035,	39017,	37400,	46690,	55732,
6,	40758,	23062,	16346,	10302,	8456,	34497,	79480,	51051,	35928,	71370,	19832,	24028,	29658,
7,	5234,	16403,	10601,	8799,	3373,	3823,	12303,	35900,	25686,	17626,	28648,	12473,	16194,
8,	1037,	2531,	6431,	5976,	2815,	1281,	1526,	5692,	13211,	10879,	6900,	6331,	9169,
9,	611,	508,	1053,	3448,	1858,	1162,	581,	732,	2158,	5551,	4173,	3392,	5656,
10,	452,	328,	277,	616,	1483,	662,	676,	350,	161,	1084,	2176,	1968,	3565,
+sp,	372,	678,	447,	557,	239,	1658,	727,	754,	403,	667,	640,		
TOTAL,	319220,	459319,	762750,	831642,	793503,	899223,	735082,	595365,	(420186,)	(260374,)	(35352,)		

Table 5.9 (option 1)

Run title : Arctic Saithe (run: XSASME07/X07)

At 24/08/1999 18:34

Terminal Fs derived using XSA (With F shrinkage)										
Table 14	Stock biomass at age with SOP (start of year)									
YEAR,	1960,	1961,	1962,	SOP (start of year) 1963,	1964,	1965,	Tonnes 1966,	1967,	1968,	
AGE										
2,	52914,	104084,	150960,	49809,	146545,	76676,	89900,	65169,	141796,	
3,	80090,	94698,	150874,	247567,	80620,	215914,	112614,	135287,	121388,	
4,	122012,	99870,	83107,	140944,	258512,	84997,	241726,	108890,	162749,	
5,	79244,	136892,	87653,	76470,	114783,	190947,	96405,	184486,	107048,	
6,	77993,	63067,	106467,	87572,	72443,	93533,	167720,	75176,	159093,	
7,	68310,	76384,	47364,	85329,	78934,	65479,	74405,	132867,	81364,	
8,	40011,	54468,	63328,	36978,	70108,	62053,	58471,	53851,	134231,	
9,	30051,	29229,	41562,	54907,	29885,	51105,	52584,	46670,	45899,	
10,	18581,	22298,	20763,	32133,	44091,	19123,	34197,	40607,	41972,	
+gp,	53961,	96171,	111438,	113716,	176660,	138085,	147195,	143351,	115853,	
TOTALBIO,	623167,	777161,	863515,	925424,	1072582,	997911,	1075218,	986355,	1111394,	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
2,	115244,	123640,	59359,	77742,	32566,	67961,	128972,	103993,	61152,	99091,
3,	205289,	190849,	162331,	94323,	126093,	57476,	107919,	165036,	143529,	85899,
4,	109011,	183509,	168137,	151022,	66603,	117288,	39553,	75074,	85771,	85429,
5,	141920,	111748,	109548,	136930,	117465,	59007,	81781,	29643,	45261,	53324,
6,	97313,	128809,	85182,	85703,	109186,	108175,	38793,	59863,	17978,	32140,
7,	128906,	93047,	81992,	75226,	70852,	99470,	66542,	29792,	41682,	14333,
8,	70304,	115339,	65848,	59675,	61389,	62663,	63818,	40025,	18633,	28225,
9,	106055,	63512,	66928,	56772,	45951,	55283,	43460,	32323,	25523,	12238,
10,	32910,	90167,	39789,	47204,	45679,	37445,	37961,	25712,	16989,	16269,
+gp,	32968,	89210,	123789,	91692,	89424,	72474,	83827,	55257,	26041,	47453,
TOTALBIO,	1039921,	1189830,	962903,	876288,	765207,	737242,	692628,	616718,	482559,	474402,
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
2,	64928,	160221,	65492,	71198,	71270,	72927,	102361,	64798,	35410,	25567,
3,	154237,	88126,	200463,	88618,	104021,	61619,	74067,	128932,	88245,	49409,
4,	65815,	127027,	76115,	166702,	83933,	82610,	45313,	45017,	136625,	101730,
5,	67303,	43645,	99813,	50057,	117955,	61007,	49025,	32541,	31618,	111638,
6,	39193,	43073,	25563,	53253,	23920,	60411,	36085,	29311,	19165,	27508,
7,	24779,	26664,	26567,	14095,	37324,	15833,	26660,	18625,	19343,	14714,
8,	10486,	13063,	16368,	16749,	10812,	22008,	9125,	12254,	11425,	11154,
9,	21667,	5142,	7454,	5841,	12721,	5652,	10925,	5098,	6951,	9352,
10,	7393,	11327,	4368,	3894,	3441,	7683,	1963,	5560,	3645,	3325,
+gp,	27611,	30179,	10421,	8811,	15968,	14496,	15022,	4857,	14190,	1450,
TOTALBIO,	483411,	548467,	532624,	479217,	481365,	404245,	370545,	346992,	366619,	355848,
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
2,	39715,	154482,	179724,	136950,	98357,	128056,	53443,	48196,	(18050,)	(3330,)
3,	43946,	47372,	159691,	255890,	148925,	89708,	166378,	51595,	60694,	(27034,)
4,	56655,	40537,	37775,	127978,	259573,	125545,	103134,	187297,	57424,	66093,
5,	89101,	46660,	32721,	31097,	121052,	184642,	125277,	85152,	160870,	56283,
6,	73608,	48898,	36294,	24106,	21158,	74796,	138285,	93419,	59706,	131551,
7,	15771,	39372,	30053,	24725,	9721,	12241,	34447,	88669,	59401,	44143,
8,	3871,	9237,	21164,	19421,	8707,	5105,	5708,	21172,	41063,	32476,
9,	2829,	1829,	4728,	13997,	6882,	5390,	2557,	3287,	9377,	22634,
10,	2143,	2087,	1563,	3813,	9190,	3509,	3567,	1855,	971,	5950,
+gp,	2786,	3251,	3158,	4112,	1954,	10107,	5419,	5287,	3077,	4580,
TOTALBIO,	330425,	393724,	506871,	642088,	685520,	639099,	638214,	585930,	(470634,)	(394073,)

Table 5.10 (option 1)

Run title : Arctic Saithe (run: XSASME07/X07)

At 24/08/1999 18:34

Terminal Fs derived using XSA (With F shrinkage)

Table 15	Spawning stock biomass with SOP (spawning time) Tonnes									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1220,	999,	831,	1409,	2585,	850,	2417,	1089,	1627,	
5,	43584,	75291,	48209,	42059,	63131,	105021,	53023,	101467,	58877,	
6,	66294,	53607,	90497,	74436,	61576,	79503,	142562,	63900,	135229,	
7,	66944,	74856,	46417,	83623,	77355,	64169,	72917,	130210,	79736,	
8,	40011,	54468,	63328,	36978,	70108,	62053,	58471,	53851,	134231,	
9,	30051,	29229,	41562,	54907,	29885,	51105,	52584,	46670,	45899,	
10,	18581,	22298,	20763,	32133,	44091,	19123,	34197,	40607,	41972,	
+gp,	53961,	96171,	111438,	113716,	176660,	138085,	147195,	143351,	115853,	
TOTSPBIO,	320647,	406918,	423044,	439260,	525392,	519908,	563367,	581146,	613425,	
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1090,	1835,	1681,	1510,	666,	1173,	396,	751,	858,	854,
5,	78056,	61461,	60251,	75311,	64606,	32454,	44980,	16304,	24894,	29328,
6,	82716,	109488,	72405,	72848,	92808,	91949,	32974,	50883,	15282,	27319,
7,	126328,	91186,	80352,	73722,	69435,	97480,	65211,	29196,	40849,	14047,
8,	70304,	115339,	65848,	59675,	61389,	62663,	63818,	40025,	18633,	28225,
9,	106055,	63512,	66928,	56772,	45951,	55283,	43460,	32323,	25523,	12238,
10,	32910,	90167,	39789,	47204,	45679,	37445,	37961,	25712,	16989,	16269,
+gp,	32968,	89210,	123789,	91692,	89424,	72474,	83827,	55257,	26041,	47453,
TOTSPBIO,	530428,	622198,	511043,	478733,	469957,	450921,	372627,	250451,	169067,	175733,
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	658,	1270,	761,	1667,	839,	826,	453,	450,	1366,	1017,
5,	37016,	24005,	54897,	27531,	64875,	33554,	26963,	17898,	17390,	61401,
6,	33314,	36612,	21728,	45265,	20332,	51349,	30672,	24915,	16290,	23382,
7,	24283,	26131,	26036,	13813,	36577,	15516,	26127,	18252,	18956,	14420,
8,	10486,	13063,	16368,	16749,	10812,	22008,	9125,	12254,	11425,	11154,
9,	21667,	5142,	7454,	5841,	12721,	5652,	10925,	5098,	6951,	9352,
10,	7393,	11327,	4368,	3894,	3441,	7683,	1963,	5560,	3645,	3325,
+gp,	27611,	30179,	10421,	8811,	15968,	14496,	15022,	4857,	14190,	1450,
TOTSPBIO,	162429,	147729,	142033,	123570,	165567,	151083,	121251,	89283,	90215,	125502,
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	567,	405,	378,	1280,	2596,	1255,	1031,	1873,	574,	661,
5,	49005,	25663,	17997,	17103,	66578,	101553,	68902,	46834,	88479,	30956,
6,	62567,	41563,	30850,	20490,	17984,	63577,	117542,	79406,	50751,	111818,
7,	15455,	38585,	29452,	24230,	9527,	11996,	33758,	86896,	58213,	43260,
8,	3871,	9237,	21164,	19421,	8707,	5105,	5708,	21172,	41063,	32476,
9,	2829,	1829,	4728,	13997,	6882,	5390,	2557,	3287,	9377,	22634,
10,	2143,	2087,	1563,	3813,	9190,	3509,	3567,	1855,	971,	5950,
+gp,	2786,	3251,	3158,	4112,	1954,	10107,	5419,	5287,	3077,	4580,
TOTSPBIO,	139223,	122620,	109290,	104446,	123419,	202492,	238485,	246610,	252504,	252335,

Table 5.11 (option 1)

Run title : Arctic Saithe (run: XSASME07/X07)

At 24/08/1999 18:34

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,	121648,	623167,	320647,	136006,	.4242,	1.2793,	.2667,
1961,	213267,	777161,	406918,	109821,	.2699,	1.4354,	.2338,
1962,	355500,	863515,	423044,	122841,	.2904,	1.2489,	.2289,
1963,	121812,	925424,	439260,	148036,	.3370,	1.2026,	.2244,
1964,	368894,	1072582,	525392,	198110,	.3771,	1.1684,	.2262,
1965,	210348,	997911,	519908,	184548,	.3550,	1.0721,	.2254,
1966,	241196,	1075218,	563367,	201860,	.3583,	1.0963,	.2768,
1967,	191863,	986355,	581146,	191191,	.3290,	.9990,	.2751,
1968,	367832,	1111394,	613425,	107181,	.1747,	1.1338,	.1606,
1969,	347419,	1039921,	530428,	140379,	.2647,	.9756,	.2118,
1970,	379802,	1189830,	622198,	260404,	.4185,	.9575,	.3292,
1971,	219513,	962903,	511043,	244732,	.4789,	.7953,	.3671,
1972,	278429,	876288,	478733,	210508,	.4397,	.8212,	.4217,
1973,	117280,	765207,	469957,	215659,	.4589,	.8167,	.4369,
1974,	206199,	737242,	450921,	262301,	.5817,	.9694,	.6297,
1975,	373532,	692628,	372627,	233453,	.6265,	1.0155,	.4667,
1976,	305259,	616718,	250451,	242486,	.9682,	1.0020,	.6830,
1977,	178767,	482559,	169067,	182808,	1.0813,	1.0061,	.5854,
1978,	283565,	474402,	175733,	154465,	.8790,	1.0278,	.5440,
1979,	167691,	483411,	162429,	164234,	1.0111,	1.1388,	.5226,
1980,	356379,	548467,	147729,	154379,	1.0450,	.9991,	.5539,
1981,	152684,	532624,	142033,	175516,	1.2357,	.9975,	.5568,
1982,	140148,	479217,	123570,	170903,	1.3830,	.9961,	.6283,
1983,	118891,	481365,	165567,	155405,	.9386,	.9991,	.5333,
1984,	137634,	404245,	151083,	158796,	1.0510,	.9997,	.7399,
1985,	271270,	370545,	121251,	107147,	.8837,	.9930,	.5611,
1986,	203943,	346992,	89283,	70458,	.7892,	.9929,	.4026,
1987,	102571,	366619,	90215,	91679,	1.0162,	1.0154,	.3489,
1988,	78241,	355848,	125502,	114508,	.9124,	.9902,	.4139,
1989,	88454,	330425,	139223,	122664,	.8811,	.9978,	.5669,
1990,	286047,	393724,	122620,	95393,	.7780,	1.0001,	.4881,
1991,	453276,	506871,	109290,	107326,	.9820,	.9912,	.4434,
1992,	304335,	642088,	104446,	127606,	1.2217,	1.0000,	.4476,
1993,	213648,	685520,	123419,	153584,	1.2444,	1.0008,	.3938,
1994,	364489,	639099,	202492,	146544,	.7237,	1.0038,	.4059,
1995,	106893,	638214,	238485,	168174,	.7052,	.9999,	.4206,
1996,	120497,	585930,	246610,	171498,	.6954,	.9999,	.3341,
1997,	201897,	529322,	252504,	143760,	.5693,	1.0011,	.3505,
1998,	174000,	543639,	252335,	153811,	.6096,	1.0018,	.4193,
Arith.							
Mean	228849,	670117,	295753,	161543,	.7125		.4186,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 5.12 (Option 2)

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Arctic Saithe (run: XSASME08/X08)

CPUE data from file fleet

Catch data for 39 years. 1960 to 1998. Ages 2 to 11.

Fleet,	First,	Last,	First,	Last,	Alpha,	Beta
	year,	year,	age,	age		
FLT01: Norway Ac Sur,	1988,	1998,	2,	5,	.750,	.850

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 19 iterations

Regression weights

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

Fishing mortalities

Age,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
2,	.150,	.045,	.015,	.052,	.017,	.004,	.000,	.008,	.004,	.004
3,	.259,	.465,	.450,	.162,	.130,	.061,	.058,	.081,	.163,	.058
4,	.467,	.500,	.511,	.288,	.319,	.278,	.501,	.297,	.144,	.325
5,	.822,	.398,	.382,	.417,	.514,	.433,	.477,	.366,	.382,	.212
6,	.710,	.574,	.411,	.888,	.589,	.799,	.579,	.442,	.473,	.566
7,	.530,	.736,	.369,	.901,	.715,	.707,	.529,	.755,	.557,	.639
8,	.512,	.686,	.423,	.948,	.625,	.516,	.520,	.667,	.598,	.553
9,	.443,	.406,	.343,	.642,	.792,	.296,	.250,	1.227,	.380,	.596
10,	.609,	.565,	.388,	.767,	.659,	.557,	.488,	.703,	.482,	.522

XSA population numbers (Thousands)

YEAR ,	AGE									
	2,	3,	4,	5,	6,	7,	8,	9,	10,	
1989 ,	8.86E+04,	5.99E+04,	5.90E+04,	6.44E+04,	4.08E+04,	5.21E+03,	1.04E+03,	5.90E+02,	4.34E+02,	
1990 ,	2.88E+05,	6.24E+04,	3.78E+04,	3.03E+04,	2.32E+04,	1.64E+04,	2.51E+03,	5.10E+02,	3.10E+02,	
1991 ,	4.57E+05,	2.25E+05,	3.21E+04,	1.88E+04,	1.66E+04,	1.07E+04,	6.44E+03,	1.03E+03,	2.78E+02,	
1992 ,	3.13E+05,	3.69E+05,	1.18E+05,	1.58E+04,	1.05E+04,	9.03E+03,	6.05E+03,	3.45E+03,	6.01E+02,	
1993 ,	2.19E+05,	2.44E+05,	2.57E+05,	7.22E+04,	8.50E+03,	3.54E+03,	3.00E+03,	1.92E+03,	1.49E+03,	
1994 ,	3.93E+05,	1.76E+05,	1.75E+05,	1.53E+05,	3.54E+04,	3.86E+03,	1.42E+03,	1.32E+03,	7.11E+02,	
1995 ,	1.77E+05,	3.20E+05,	1.36E+05,	1.09E+05,	8.11E+04,	1.30E+04,	1.56E+03,	6.94E+02,	8.02E+02,	
1996 ,	1.34E+05,	1.45E+05,	2.47E+05,	6.73E+04,	5.51E+04,	3.72E+04,	6.28E+03,	7.58E+02,	4.42E+02,	
1997 ,	8.72E+04,	1.09E+05,	1.09E+05,	1.51E+05,	3.82E+04,	2.90E+04,	1.43E+04,	2.64E+03,	1.82E+02,	
1998 ,	1.26E+04,	7.11E+04,	7.55E+04,	7.75E+04,	8.41E+04,	1.95E+04,	1.36E+04,	6.45E+03,	1.48E+03,	

Estimated population abundance at 1st Jan 1999

, 0.00E+00, 1.02E+04, 5.50E+04, 4.47E+04, 5.14E+04, 3.91E+04, 8.43E+03, 6.41E+03, 2.91E+03,

Table 5.12 (Option 2) Continued

Taper weighted geometric mean of the VPA populations:

, 1.47E+05, 1.44E+05, 9.76E+04, 5.29E+04, 2.50E+04, 9.75E+03, 3.73E+03, 1.45E+03, 5.87E+02,

Standard error of the weighted Log(VPA populations) :

, .9614, .6126, .7044, .8192, .8329, .7929, .8355, .7446, .6528,

Log catchability residuals.

Fleet : FLT01: Norway Ac Sur

Age , 1988
 2 , -.33
 3 , -.79
 4 , -1.22
 5 , -1.20

Age	, 1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
2	, .07,	.20,	-.42,	.61,	.52,	-1.21,	-.30,	-.06,	-1.62,	2.47
3	, -.15,	.09,	-.02,	.22,	.43,	-.25,	-.22,	.26,	-.56,	.74
4	, -.59,	-.26,	-1.25,	-.20,	-.37,	.06,	.24,	.38,	.93,	1.52
5	, -.34,	-.61,	-.39,	.26,	-.47,	-.15,	.40,	.41,	.53,	.92

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	,	-7.9688,	-7.1400,	-7.0291,	-7.6043,
S.E(Log q)	,	1.1128,	.4379,	.8335,	.6007,

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	, 2.53,	-1.970,	1.97,	.17,	11,	2.45,	-7.97,
3	, .96,	.162,	7.31,	.71,	11,	.45,	-7.14,
4	, .77,	.732,	8.08,	.55,	11,	.66,	-7.03,
5	, .86,	.612,	8.09,	.70,	11,	.54,	-7.60,

Terminal year survivor and F summaries :

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1996

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F	
FLT01: Norway Ac Sur,	120932.,	1.167,	.000,	.00,	1,	.154,	.000
F shrinkage mean	,	6524.,	.50,,,,			.846,	.007

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
10242.,	.46,	2.68,	2,	5.841,	.004

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1995

Table 5.12 (Option 2) Continued

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	84353.,	.427,	.802,	1.88,	2,	.563,	.038
F shrinkage mean ,	31614.,	.50,,,,				.437,	.099

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
54951.,	.33,	.63,	3,	1.925,	.058

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1994

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	42397.,	.385,	.599,	1.56,	3,	.518,	.340
F shrinkage mean ,	47295.,	.50,,,,				.482,	.310

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
44692.,	.31,	.35,	4,	1.134,	.325

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	86601.,	.330,	.228,	.69,	4,	.618,	.131
F shrinkage mean ,	22058.,	.50,,,,				.382,	.438

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
51369.,	.28,	.45,	5,	1.611,	.212

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

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	41016.,	.334,	.281,	.84,	4,	.413,	.546
F shrinkage mean ,	37778.,	.50,,,,				.587,	.581

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
39084.,	.32,	.16,	5,	.492,	.566

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

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	9480.,	.343,	.186,	.54,	4,	.265,	.585

Table 5.12 (Option 2) Continued

F shrinkage mean , 8076., .50,,,,, .735, .659

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
8427.,	.38,	.11,	5,	.284,	.639

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

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	9344.,	.340,	.079,	.23,	4,	.185,	.410

F shrinkage mean , 5885., .50,,,,, .815, .590

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
6409.,	.41,	.21,	5,	.511,	.553

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	2793.,	.347,	.138,	.40,	4,	.077,	.614

F shrinkage mean , 2919., .50,,,,, .923, .594

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2909.,	.46,	.04,	5,	.085,	.596

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 8

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT01: Norway Ac Sur,	568.,	.366,	.129,	.35,	4,	.044,	.623

F shrinkage mean , 725., .50,,,,, .956, .517

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
718.,	.48,	.12,	5,	.255,	.522

Table 5.13 (option 2)

Run title : Arctic Saithe (run: XSASME08/X08)

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Terminal Fs derived using XSA (With F shrinkage)

Table 8	Fishing mortality (F) at age									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	
AGE										
2,	.0694,	.0259,	.0039,	.0259,	.0628,	.1742,	.0347,	.0409,	.0160,	
3,	.1412,	.2383,	.2772,	.1747,	.1080,	.1562,	.1876,	.1886,	.2041,	
4,	.1843,	.1755,	.2297,	.3606,	.4012,	.0805,	.3616,	.3278,	.1709,	
5,	.5007,	.2695,	.1204,	.1825,	.2760,	.3093,	.3131,	.4319,	.1024,	
6,	.2407,	.2519,	.2882,	.1797,	.1198,	.3557,	.2447,	.1522,	.1649,	
7,	.3847,	.0915,	.2530,	.2108,	.1978,	.1786,	.2736,	.1595,	.0391,	
8,	.4184,	.1206,	.0942,	.1734,	.2195,	.1772,	.1219,	.2757,	.0747,	
9,	.3585,	.1479,	.1645,	.1355,	.3055,	.3690,	.1106,	.1777,	.1274,	
10,	.3832,	.1770,	.1849,	.1771,	.2248,	.2795,	.2138,	.2406,	.1020,	
+sp,	.3832,	.1770,	.1849,	.1771,	.2248,	.2795,	.2138,	.2406,	.1020,	
FBAR 3- 6,	.2667,	.2338,	.2289,	.2244,	.2262,	.2254,	.2767,	.2751,	.1606,	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
2,	.0131,	.0785,	.1052,	.0472,	.1396,	.1204,	.2763,	.2181,	.2178,	.1964,
3,	.3402,	.1880,	.3511,	.5893,	.4905,	.6669,	.5962,	.9054,	.7860,	.6157,
4,	.1406,	.5146,	.4216,	.4299,	.4766,	.5911,	.4590,	.6942,	.6807,	.5240,
5,	.2354,	.2432,	.4348,	.3782,	.4110,	.6231,	.4556,	.6609,	.5207,	.5675,
6,	.1307,	.3709,	.2610,	.2894,	.3693,	.6370,	.3552,	.4704,	.3522,	.4670,
7,	.1356,	.2034,	.3929,	.2409,	.3373,	.5334,	.5379,	.5163,	.4538,	.4574,
8,	.0721,	.3480,	.1697,	.2451,	.2654,	.4017,	.6560,	.4431,	.4306,	.3556,
9,	.0885,	.2271,	.3262,	.1569,	.3210,	.3673,	.4563,	.5920,	.4163,	.5508,
10,	.1330,	.2800,	.3188,	.2635,	.3429,	.5166,	.4960,	.5409,	.4378,	.4833,
+sp,	.1330,	.2800,	.3188,	.2635,	.3429,	.5166,	.4960,	.5409,	.4378,	.4833,
FBAR 3- 6,	.2117,	.3292,	.3671,	.4217,	.4369,	.6295,	.4665,	.6827,	.5849,	.5435,
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
2,	.2067,	.0582,	.0788,	.1461,	.1145,	.1250,	.0091,	.0181,	.0423,	.0731,
3,	.4446,	.5172,	.4112,	.4042,	.2136,	.7505,	.7851,	.1177,	.1282,	.1175,
4,	.6834,	.5183,	.5843,	.6567,	.5383,	.8222,	.5014,	.4845,	.4212,	.4080,
5,	.5606,	.6404,	.6681,	.8679,	.8439,	.5835,	.4110,	.5152,	.2960,	.5473,
6,	.3990,	.5356,	.5631,	.5849,	.5395,	.8090,	.5508,	.4956,	.5505,	.5837,
7,	.6257,	.5720,	.4246,	.3133,	.4395,	.3671,	.7090,	.6477,	.9272,	1.1073,
8,	.6249,	.6730,	.8954,	.3812,	.6969,	.5060,	.4620,	.6377,	.3560,	1.0545,
9,	.4824,	.1765,	.3907,	.5211,	.4220,	.8807,	.5084,	.3928,	.6596,	1.1035,
10,	.5429,	.5237,	.5935,	.5380,	.5934,	.6349,	.5325,	.5422,	.5625,	.8887,
+sp,	.5429,	.5237,	.5935,	.5380,	.5934,	.6349,	.5325,	.5422,	.5625,	.8887,
FBAR 3- 6,	.5219,	.5529,	.5567,	.6284,	.5338,	.7413,	.5621,	.4032,	.3490,	.4141,
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
2,	.1499,	.0453,	.0150,	.0519,	.0172,	.0040,	.0004,	.0080,	.0041,	.0055,
3,	.2593,	.4651,	.4499,	.1616,	.1303,	.0606,	.0582,	.0812,	.1635,	.0582,
4,	.4673,	.4996,	.5110,	.2880,	.3191,	.2784,	.5009,	.2965,	.1442,	.3250,
5,	.8218,	.3985,	.3816,	.4172,	.5138,	.4331,	.4773,	.3661,	.3825,	.2117,
6,	.7099,	.5736,	.4106,	.8877,	.5894,	.7995,	.5786,	.4415,	.4730,	.5665,
7,	.5304,	.7357,	.3695,	.9005,	.7147,	.7075,	.5294,	.7553,	.5573,	.6385,
8,	.5121,	.6857,	.4228,	.9483,	.6249,	.5155,	.5203,	.6670,	.5985,	.5531,
9,	.4431,	.4060,	.3434,	.6416,	.7923,	.2957,	.2504,	1.2271,	.3803,	.5958,
10,	.6087,	.5646,	.3882,	.7666,	.6588,	.5573,	.4875,	.7033,	.4822,	.5216,
+sp,	.6087,	.5646,	.3882,	.7666,	.6588,	.5573,	.4875,	.7033,	.4822,	.5216,
FBAR 3- 6,	.5646,	.4842,	.4383,	.4386,	.3881,	.3929,	.4037,	.2963,	.2908,	.2904,
										FBAR 96-98

Table 5.14 (option 2)

Run title : Arctic Saithe (run: XSASME08/X08)

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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,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,				
AGE													
2,	121650,	213269,	355505,	121815,	368899,	210354,	241202,	191872,	367843,				
3,	88173,	92920,	170143,	289935,	97186,	283654,	144689,	190738,	150801,				
4,	85921,	62681,	59948,	105582,	199330,	71425,	198653,	98200,	129322,				
5,	38001,	58508,	43057,	39010,	60271,	109269,	53953,	113296,	57927,				
6,	26165,	18857,	36586,	31252,	26611,	37443,	65664,	32298,	60225,				
7,	16897,	16840,	12001,	22453,	21379,	19328,	21479,	42090,	22711,				
8,	7761,	9416,	12582,	7630,	14890,	14362,	13236,	13376,	29379,				
9,	4823,	4181,	6833,	9375,	5252,	9788,	9850,	9593,	8313,				
10,	2580,	2759,	2953,	4746,	6703,	3168,	5541,	7220,	6576,				
+sp,	5253,	8334,	11260,	12044,	19432,	16183,	16565,	17951,	13243,				
TOTAL,	397223,	487765,	710869,	643841,	819953,	774974,	770831,	716635,	846340,				
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,			
AGE													
2,	347431,	379815,	219524,	278465,	117299,	206220,	373549,	305465,	178776,	283589,			
3,	296372,	280751,	287484,	161778,	217485,	83523,	149693,	232001,	201096,	117720,			
4,	100667,	172675,	190463,	165682,	73477,	109026,	35101,	67515,	76814,	75020,			
5,	89246,	71608,	84509,	102299,	88246,	37350,	49426,	18160,	27610,	31839,			
6,	42811,	57741,	45971,	44795,	57383,	47899,	16400,	25658,	7677,	13430,			
7,	41814,	30755,	32626,	28992,	27458,	32476,	20741,	9413,	13124,	4420,			
8,	17882,	29893,	20546,	18033,	18655,	16044,	15597,	9916,	4599,	6825,			
9,	22322,	13622,	17281,	14197,	11554,	11713,	8790,	6627,	5212,	2848,			
10,	5992,	16728,	8887,	10210,	9936,	6862,	6642,	4560,	3002,	2414,			
+sp,	4518,	12585,	22073,	14934,	14828,	10361,	11585,	7538,	3503,	6140,			
TOTAL,	969055,	1066173,	929364,	839384,	636320,	561474,	687524,	686853,	521413,	544246,			
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,			
AGE													
2,	167692,	356251,	152593,	140061,	118899,	137558,	271296,	204187,	103197,	78697,			
3,	190780,	111657,	275182,	115461,	99086,	86816,	99390,	220113,	164178,	80991,			
4,	52072,	100131,	54503,	149335,	63104,	65522,	33559,	37112,	160203,	118249,			
5,	36371,	21525,	48823,	24878,	63404,	30159,	23574,	16641,	18717,	86076,			
6,	14779,	17000,	9289,	20494,	8551,	22323,	13776,	12796,	8139,	11398,			
7,	6893,	8118,	8146,	4330,	9348,	4082,	8138,	6502,	6382,	3843,			
8,	2290,	3019,	3751,	4362,	2592,	4932,	2315,	3279,	2786,	2067,			
9,	3916,	1004,	1261,	1254,	2440,	1057,	2435,	1194,	1419,	1598,			
10,	1155,	1979,	689,	699,	610,	1310,	359,	1199,	660,	601,			
+sp,	3111,	4371,	1535,	1177,	1855,	2084,	1857,	745,	2025,	188,			
TOTAL,	479059,	625054,	555773,	462052,	369889,	355842,	456699,	503769,	467706,	383709,			
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	GMST 60-96	AMST 60-96
AGE													
2,	88560,	287993,	456903,	313403,	218717,	392854,	177076,	133783,	(87248,)	(12564,)	(0,)	211918,	234656,
3,	59892,	62411,	225344,	368530,	243624,	176013,	320346,	144915,	108663,	(71137,)	(10242,)	158962,	177861,
4,	58957,	37836,	32095,	117648,	256711,	175092,	135630,	247436,	109394,	75549,	(54951,)	91583,	107370,
5,	64379,	30250,	18795,	15764,	72218,	152764,	108518,	67294,	150603,	77534,	44692,	46876,	56047,
6,	40770,	23172,	16627,	10507,	8504,	35371,	81110,	55126,	38205,	84115,	51369,	24138,	29854,
7,	5206,	16413,	10691,	9029,	3541,	3862,	13019,	37235,	29022,	19491,	39084,	16264,	16264,
8,	1040,	2508,	6439,	6049,	3004,	1418,	1558,	6278,	14324,	13610,	8427,	6380,	9198,
9,	590,	510,	1034,	3454,	1919,	1317,	694,	758,	2638,	6446,	6409,	3423,	5666,
10,	434,	310,	278,	601,	1489,	711,	802,	442,	182,	1477,	2909,	1989,	3573,
+sp,	357,	641,	450,	543,	240,	1783,	865,	957,	458,	912,	1161,		
TOTAL,	320184,	462044,	768657,	845528,	809965,	941186,	839618,	694223,	(540736,)	(362836,)	(219243,)		

Table 5.15 (option 2)

Run title : Arctic Saithe (run: XSASME08/X08)

At 24/08/1999 18:37

Terminal Fs derived using XSA (With F shrinkage)

Table 14	Stock biomass at age with SOP (start of year) Tonnes									
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	
AGE										
2,	52915,	104084,	150962,	49810,	146547,	76678,	89902,	65172,	141800,	
3,	80090,	94699,	150875,	247570,	80622,	215917,	112618,	135290,	121395,	
4,	122013,	99871,	83108,	140946,	258516,	84999,	241730,	108895,	162754,	
5,	79245,	136893,	87655,	76472,	114785,	190952,	96408,	184490,	107054,	
6,	77994,	63067,	106468,	87573,	72445,	93534,	167725,	75179,	159098,	
7,	68310,	76385,	47365,	85331,	78936,	65480,	74407,	132873,	81368,	
8,	40011,	54469,	63329,	36979,	70110,	62054,	58473,	53853,	134238,	
9,	30051,	29229,	41562,	54907,	29886,	51106,	52585,	46672,	45901,	
10,	18581,	22298,	20763,	32134,	44091,	19123,	34198,	40609,	41974,	
+gp,	53962,	96172,	111439,	113718,	176663,	138088,	147200,	143356,	115858,	
TOTALBIO,	623172,	777168,	863525,	925438,	1072600,	997933,	1075247,	986389,	1111440,	
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
2,	115248,	123645,	59362,	77752,	32571,	67968,	128978,	104063,	61155,	99100,
3,	205296,	190855,	162338,	94328,	126110,	57486,	107932,	165046,	143650,	85904,
4,	109018,	183517,	168144,	151030,	66610,	117314,	39567,	75090,	85784,	85586,
5,	141925,	111756,	109556,	136938,	117475,	59017,	81814,	29659,	45280,	53339,
6,	97319,	128814,	85190,	85713,	109195,	108189,	38805,	59900,	17997,	32163,
7,	128912,	93054,	81997,	75235,	70863,	99482,	66559,	29805,	41724,	14355,
8,	70308,	115345,	65853,	59680,	61398,	62677,	63832,	40041,	18647,	28269,
9,	106061,	63516,	66933,	56778,	45956,	55294,	43474,	32337,	25539,	12252,
10,	32912,	90172,	39792,	47208,	45684,	37451,	37972,	25725,	17002,	16285,
+gp,	32970,	89215,	123798,	91700,	89434,	72486,	83851,	55285,	26060,	47501,
TOTALBIO,	1039967,	1189888,	962962,	876363,	765297,	737364,	692784,	616952,	482839,	474755,
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
2,	64928,	160164,	65453,	71154,	71275,	72887,	102370,	64876,	35626,	25716,
3,	154253,	88127,	200387,	88560,	103946,	61623,	74021,	128944,	88353,	49724,
4,	65822,	127047,	76116,	166607,	83852,	82537,	45320,	44955,	136640,	101871,
5,	67512,	43655,	99840,	50059,	117824,	60906,	48925,	32550,	31548,	111657,
6,	39213,	43309,	25574,	53281,	23922,	60256,	35978,	29222,	19174,	27426,
7,	24806,	26685,	26816,	14106,	37359,	15835,	26507,	18529,	19247,	14726,
8,	10511,	13090,	16390,	16990,	10824,	22040,	9127,	12112,	11314,	11014,
9,	21716,	5165,	7484,	5860,	12991,	5664,	10951,	5099,	6800,	9222,
10,	7408,	11369,	4391,	3917,	3461,	7935,	1973,	5583,	3647,	3188,
+gp,	27667,	30292,	10478,	8864,	16061,	14978,	15101,	4877,	14195,	1389,
TOTALBIO,	483837,	548902,	532931,	479398,	481515,	404660,	370274,	346746,	366543,	355933,
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
2,	39763,	155532,	181162,	141031,	100690,	138021,	88532,	53510,	(33191,)	(4657,)
3,	44221,	47438,	160828,	257969,	153606,	91874,	179382,	85495,	67445,	(49884,)
4,	57061,	40867,	37858,	129413,	262055,	130060,	105784,	202887,	100754,	74925,
5,	89287,	47196,	33163,	31212,	122868,	187080,	131298,	88824,	179416,	111845,
6,	73629,	49130,	36919,	24586,	21277,	76692,	141121,	100875,	63491,	155043,
7,	15686,	39395,	30308,	25372,	10205,	12366,	36450,	91965,	67116,	48812,
8,	3880,	9154,	21190,	19660,	9290,	5653,	5828,	23352,	44454,	40629,
9,	2730,	1836,	4644,	14023,	7105,	6106,	3051,	3405,	11461,	26281,
10,	2056,	1975,	1572,	3718,	9222,	3770,	4234,	2343,	1100,	8106,
+gp,	2671,	3074,	3177,	4008,	1962,	10870,	6446,	6711,	3492,	6269,
TOTALBIO,	330985,	395597,	510821,	650990,	698281,	662492,	702127,	659367,	(571921,)	(526452,)

Table 5.16 (option 2)

Run title : Arctic Saithe (run: XSASME08/X08)

At 24/08/1999 18:37

Terminal Fs derived using XSA (With F shrinkage)

Table 15		Spawning stock biomass with SOP (spawning time)								Tonnes	
YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,		
AGE											
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1220,	999,	831,	1409,	2585,	850,	2417,	1089,	1628,		
5,	43585,	75291,	48210,	42059,	63132,	105024,	53025,	101470,	58880,		
6,	66295,	53607,	90498,	74437,	61578,	79504,	142566,	63903,	135234,		
7,	66944,	74857,	46417,	83624,	77357,	64171,	72919,	130215,	79741,		
8,	40011,	54469,	63329,	36979,	70110,	62054,	58473,	53853,	134238,		
9,	30051,	29229,	41562,	54907,	29886,	51106,	52585,	46672,	45901,		
10,	18581,	22298,	20763,	32134,	44091,	19123,	34198,	40609,	41974,		
+gp,	53962,	96172,	111439,	113718,	176663,	138088,	147200,	143356,	115858,		
TOTSPBIO,	320649,	406922,	423049,	439267,	525401,	519920,	563384,	581166,	613453,		
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
AGE											
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	1090,	1835,	1681,	1510,	666,	1173,	396,	751,	858,	856,	
5,	78059,	61466,	60256,	75316,	64611,	32459,	44998,	16313,	24904,	29337,	
6,	82721,	109492,	72412,	72856,	92816,	91961,	32985,	50915,	15298,	27338,	
7,	126334,	91192,	80357,	73731,	69446,	97493,	65227,	29209,	40890,	14068,	
8,	70308,	115345,	65853,	59680,	61398,	62677,	63832,	40041,	18647,	28269,	
9,	106061,	63516,	66933,	56778,	45956,	55294,	43474,	32337,	25539,	12252,	
10,	32912,	90172,	39792,	47208,	45684,	37451,	37972,	25725,	17002,	16285,	
+gp,	32970,	89215,	123798,	91700,	89434,	72486,	83851,	55285,	26060,	47501,	
TOTSPBIO,	530453,	622233,	511082,	478779,	470012,	450994,	372735,	250576,	169198,	175907,	
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	658,	1270,	761,	1666,	839,	825,	453,	450,	1366,	1019,	
5,	37132,	24010,	54912,	27532,	64803,	33498,	26909,	17902,	17351,	61411,	
6,	33331,	36813,	21738,	45289,	20333,	51217,	30581,	24839,	16298,	23312,	
7,	24310,	26151,	26280,	13824,	36612,	15518,	25977,	18159,	18862,	14431,	
8,	10511,	13090,	16390,	16990,	10824,	22040,	9127,	12112,	11314,	11014,	
9,	21716,	5165,	7484,	5860,	12991,	5664,	10951,	5099,	6800,	9222,	
10,	7408,	11369,	4391,	3917,	3461,	7935,	1973,	5583,	3647,	3188,	
+gp,	27667,	30292,	10478,	8864,	16061,	14978,	15101,	4877,	14195,	1389,	
TOTSPBIO,	162734,	148160,	142435,	123943,	165924,	151676,	121073,	89019,	89833,	124987,	
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	571,	409,	379,	1294,	2621,	1301,	1058,	2029,	1008,	749,	
5,	49108,	25958,	18240,	17167,	67578,	102894,	72214,	48853,	98679,	61515,	
6,	62585,	41761,	31381,	20898,	18086,	65188,	119953,	85743,	53967,	131787,	
7,	15373,	38607,	29702,	24864,	10001,	12118,	35721,	90126,	65774,	47836,	
8,	3880,	9154,	21190,	19660,	9290,	5653,	5828,	23352,	44454,	40629,	
9,	2730,	1836,	4644,	14023,	7105,	6106,	3051,	3405,	11461,	26281,	
10,	2056,	1975,	1572,	3718,	9222,	3770,	4234,	2343,	1100,	8106,	
+gp,	2671,	3074,	3177,	4008,	1962,	10870,	6446,	6711,	3492,	6269,	
TOTSPBIO,	138973,	122774,	110284,	105631,	125863,	207900,	248505,	262562,	279935,	323173,	

Table 5.17 (option 2)

Run title : Arctic Saithe (run: XSASME08/X08)

At 24/08/1999 18:37

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,	121650,	623172,	320649,	136006,	.4242,	1.2793,	.2667,
1961,	213269,	777168,	406922,	109821,	.2699,	1.4354,	.2338,
1962,	355505,	863525,	423049,	122841,	.2904,	1.2489,	.2289,
1963,	121815,	925438,	439267,	148036,	.3370,	1.2026,	.2244,
1964,	368899,	1072600,	525401,	198110,	.3771,	1.1684,	.2262,
1965,	210354,	997933,	519920,	184548,	.3550,	1.0721,	.2254,
1966,	241202,	1075247,	563384,	201860,	.3583,	1.0963,	.2767,
1967,	191872,	986389,	581166,	191191,	.3290,	.9990,	.2751,
1968,	367843,	1111440,	613453,	107181,	.1747,	1.1338,	.1606,
1969,	347431,	1039967,	530453,	140379,	.2646,	.9756,	.2117,
1970,	379815,	1189888,	622233,	260404,	.4185,	.9575,	.3292,
1971,	219524,	962962,	511082,	244732,	.4789,	.7953,	.3671,
1972,	278465,	876363,	478779,	210508,	.4397,	.8212,	.4217,
1973,	117299,	765297,	470012,	215659,	.4588,	.8167,	.4369,
1974,	206220,	737364,	450994,	262301,	.5816,	.9694,	.6295,
1975,	373549,	692784,	372735,	233453,	.6263,	1.0155,	.4665,
1976,	305465,	616952,	250576,	242486,	.9677,	1.0020,	.6827,
1977,	178776,	482839,	169198,	182808,	1.0804,	1.0061,	.5849,
1978,	283589,	474755,	175907,	154465,	.8781,	1.0278,	.5435,
1979,	167692,	483837,	162734,	164234,	1.0092,	1.1388,	.5219,
1980,	356251,	548902,	148160,	154379,	1.0420,	.9991,	.5529,
1981,	152593,	532931,	142435,	175516,	1.2323,	.9975,	.5567,
1982,	140061,	479398,	123943,	170903,	1.3789,	.9961,	.6284,
1983,	118899,	481515,	165924,	155405,	.9366,	.9991,	.5338,
1984,	137558,	404660,	151676,	158796,	1.0469,	.9997,	.7413,
1985,	271296,	370274,	121073,	107147,	.8850,	.9930,	.5621,
1986,	204187,	346746,	89019,	70458,	.7915,	.9929,	.4032,
1987,	103197,	366543,	89833,	91679,	1.0206,	1.0154,	.3490,
1988,	78697,	335933,	124987,	114508,	.9162,	.9902,	.4141,
1989,	88560,	330985,	138973,	122664,	.8826,	.9978,	.5646,
1990,	287993,	395597,	122774,	95393,	.7770,	1.0001,	.4842,
1991,	456903,	510821,	110284,	107326,	.9732,	.9912,	.4383,
1992,	313403,	650990,	105631,	127606,	1.2080,	1.0000,	.4386,
1993,	218717,	698281,	125863,	153584,	1.2202,	1.0008,	.3881,
1994,	392854,	662492,	207900,	146544,	.7049,	1.0038,	.3929,
1995,	177076,	702127,	248505,	168174,	.6767,	.9999,	.4037,
1996,	133783,	659367,	262562,	171498,	.6532,	.9999,	.2963,
1997,	220212,	622447,	279935,	143760,	.5135,	1.0011,	.2908,
1998,	193000,	669417,	323173,	153811,	.4759,	1.0018,	.2904,
Arith.							
Mean	232217,	680649,	299245,	161543,	.7040		.4114,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 5.18A (Option 1)

NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds (standard tuning)
 1,14,2 (No. of surveys, No. of years, VPA Column No.)
 1982, 99, 4.9
 1983, 220, 40.8
 1984, 164, 22.0
 1985, 80, 22.5
 1986, 60, 28.4
 1987, 62, 31.9
 1988, 224, 104.0
 1989, 366, 273.6
 1990, 236, 227.7
 1991, 172, 87.8
 1992, 297, 165.2
 1993, 87, 118.9
 1994, 98, 36.7
 1995, -11, 96.5

Analysis by RCT3 ver3.1 of data from file :

a:\rct3opt1.in

NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds (standard tuning)

Data for 1 surveys over 14 years : 1982 - 1995

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

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

Forecast/Hindcast variance correction used.

Year	Weighted	Log	Int	Ext	Var	VPA	Log
Class	Average	WAP	Std	Std	Ratio		VPA
	Prediction		Error	Error			
1982	No valid surveys						
1983	No valid surveys						
1984	No valid surveys						
1985	168	5.13	.18	.04	.06	81	4.39
1986	137	4.92	.43	.13	.09	60	4.11
1987	115	4.75	.52	.19	.13	62	4.14
1988	104	4.65	.53	.58	1.22	225	5.42
1989	137	4.92	.55	.79	2.04	366	5.91
1990	201	5.30	.58	.69	1.43	236	5.47
1991	169	5.13	.52	.23	.19	173	5.15
1992	203	5.31	.49	.42	.73	298	5.70
1993	198	5.29	.47	.25	.28	88	4.48
1994	126	4.84	.51	.24	.22	99	4.60
1995	165	5.11	.49	.16	.11		

Table 5.18B (Option 1)

NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds (common tuning)
 1,11,2 (No. of surveys, No. of years, VPA Column No.)
 1986, 78, 15.7
 1987, 88, 24.8
 1988, 286, 99.6
 1989, 453, 87.8
 1990, 304, 163.5
 1991, 214, 106.9
 1992, 364, 34.4
 1993, 107, 38.7
 1994, 120, 37.0
 1995, -11, 5.1
 1996, -11, 43.6

Analysis by RCT3 ver3.1 of data from file :

a:\rct2opt1.in

NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds (common tuning)

Data for 1 surveys over 11 years : 1986 - 1996

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

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

Forecast/Hindcast variance correction used.

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1986	No valid surveys						
1987	No valid surveys						
1988	No valid surveys						
1989	223	5.41	.32	.29	.80	454	6.12
1990	398	5.99	.53	.64	1.47	304	5.72
1991	276	5.62	.48	.27	.31	214	5.37
1992	144	4.97	.44	.26	.35	365	5.90
1993	188	5.24	.56	.22	.15	108	4.68
1994	169	5.13	.54	.23	.18	121	4.80
1995	102	4.63	.57	1.13	3.92		
1996	174	5.16	.52	.13	.06		

Table 5.19A (Option 2)

NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds (standard tuning)
 1,14,2 (No. of surveys, No. of years, VPA Column No.)
 1982, 99, 4.9
 1983, 220, 40.8
 1984, 164, 22.0
 1985, 81, 22.5
 1986, 60, 28.4
 1987, 62, 31.9
 1988, 225, 104.0
 1989, 369, 273.6
 1990, 244, 227.7
 1991, 176, 87.8
 1992, 320, 165.2
 1993, 145, 118.9
 1994, 109, 36.7
 1995, -11, 96.5

Analysis by RCT3 ver3.1 of data from file :

a:\rct3opt2.in

NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds (standard tuning)

Data for 1 surveys over 14 years : 1982 - 1995

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

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

Forecast/Hindcast variance correction used.

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1982	No valid surveys						
1983	No valid surveys						
1984	No valid surveys						
1985	168	5.13	.18	.04	.06	81	4.41
1986	137	4.93	.43	.13	.09	60	4.11
1987	116	4.75	.52	.19	.13	62	4.14
1988	104	4.65	.52	.58	1.22	226	5.42
1989	137	4.92	.55	.79	2.04	370	5.91
1990	202	5.31	.58	.69	1.44	245	5.50
1991	171	5.14	.52	.23	.19	177	5.18
1992	206	5.33	.49	.42	.73	320	5.77
1993	202	5.31	.47	.25	.29	146	4.98
1994	130	4.87	.46	.22	.23	110	4.70
1995	180	5.19	.43	.14	.11		

Table 5.19B (Option 2)

NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds (common tuning)
 1,11,2 (No. of surveys, No. of years, VPA Column No.)
 1986, 79, 15.7
 1987, 89, 24.8
 1988, 288, 99.6
 1989, 457, 87.8
 1990, 313, 163.5
 1991, 219, 106.9
 1992, 393, 34.4
 1993, 177, 38.7
 1994, 134, 37.0
 1995, -11, 5.1
 1996, -11, 43.6

Analysis by RCT3 ver3.1 of data from file :

a:\rct2opt2.in

NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds (common tuning)

Data for 1 surveys over 11 years : 1986 - 1996

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

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

Forecast/Hindcast variance correction used.

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1986	No valid surveys						
1987	No valid surveys						
1988	No valid surveys						
1989	224	5.42	.32	.29	.80	458	6.13
1990	400	5.99	.53	.64	1.46	314	5.75
1991	281	5.64	.48	.27	.31	220	5.39
1992	146	4.98	.44	.26	.35	393	5.98
1993	193	5.26	.57	.22	.15	178	5.18
1994	187	5.23	.52	.22	.18	135	4.91
1995	118	4.78	.54	1.06	3.83		
1996	193	5.26	.49	.12	.06		

Table 5.20 (Option 1)

September 8, 1999
 North-East Arctic saithe (Sub-areas I and II)

The SAS System

15:38 Wednesday,

Yield per recruit: Summary table

		1 January		Spawning time					
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	13949.302	2.713	11977.579	2.713	11977.579
0.0500	0.0199	0.099	358.474	5.023	10956.268	2.233	9003.507	2.233	9003.507
0.1000	0.0398	0.169	553.213	4.673	8974.488	1.897	7040.100	1.897	7040.100
0.1500	0.0597	0.222	660.639	4.410	7586.871	1.648	5670.294	1.648	5670.294
0.2000	0.0796	0.264	719.003	4.204	6573.946	1.454	4674.641	1.454	4674.641
0.2500	0.0995	0.298	748.889	4.037	5809.978	1.300	3927.429	1.300	3927.429
0.3000	0.1194	0.326	761.947	3.898	5218.238	1.174	3351.951	1.174	3351.951
0.3500	0.1393	0.350	765.006	3.780	4749.558	1.068	2899.060	1.068	2899.060
0.4000	0.1592	0.370	762.173	3.679	4371.185	0.979	2536.021	0.979	2536.021
0.4500	0.1791	0.388	755.956	3.590	4060.590	0.902	2240.326	0.902	2240.326
0.5000	0.1990	0.404	747.902	3.511	3801.864	0.834	1996.081	0.834	1996.081
0.5500	0.2189	0.418	738.967	3.441	3583.513	0.775	1791.810	0.775	1791.810
0.6000	0.2388	0.431	729.738	3.378	3397.068	0.723	1619.060	0.723	1619.060
0.6500	0.2587	0.443	720.572	3.321	3236.182	0.677	1471.499	0.677	1471.499
0.7000	0.2786	0.454	711.676	3.268	3096.024	0.635	1344.311	0.635	1344.311
0.7500	0.2985	0.464	703.167	3.220	2972.868	0.597	1233.782	0.597	1233.782
0.8000	0.3184	0.473	695.100	3.176	2863.802	0.562	1137.015	0.562	1137.015
0.8500	0.3383	0.481	687.496	3.135	2766.523	0.531	1051.718	0.531	1051.718
0.9000	0.3582	0.489	680.351	3.097	2679.194	0.502	976.067	0.502	976.067
0.9500	0.3781	0.496	673.650	3.061	2600.333	0.476	908.591	0.476	908.591
1.0000	0.3980	0.503	667.369	3.027	2528.733	0.451	848.094	0.451	848.094
1.0500	0.4179	0.510	661.481	2.996	2463.404	0.429	793.596	0.429	793.596
1.1000	0.4378	0.516	655.959	2.966	2403.528	0.408	744.288	0.408	744.288
1.1500	0.4577	0.522	650.774	2.938	2348.420	0.389	699.496	0.389	699.496
1.2000	0.4776	0.527	645.901	2.912	2297.508	0.371	658.656	0.371	658.656
1.2500	0.4975	0.532	641.313	2.887	2250.308	0.354	621.292	0.354	621.292
1.3000	0.5174	0.537	636.987	2.863	2206.407	0.338	587.000	0.338	587.000
1.3500	0.5373	0.542	632.903	2.840	2165.453	0.323	555.436	0.323	555.436
1.4000	0.5572	0.546	629.040	2.818	2127.142	0.309	526.304	0.309	526.304
1.4500	0.5771	0.551	625.381	2.797	2091.212	0.296	499.348	0.296	499.348
1.5000	0.5970	0.555	621.910	2.778	2057.435	0.284	474.348	0.284	474.348
1.5500	0.6169	0.559	618.612	2.759	2025.612	0.272	451.110	0.272	451.110
1.6000	0.6368	0.563	615.474	2.740	1995.569	0.261	429.467	0.261	429.467
1.6500	0.6567	0.566	612.485	2.723	1967.150	0.251	409.270	0.251	409.270
1.7000	0.6766	0.570	609.632	2.706	1940.221	0.241	390.389	0.241	390.389
1.7500	0.6965	0.573	606.907	2.690	1914.659	0.232	372.708	0.232	372.708
1.8000	0.7164	0.576	604.300	2.674	1890.357	0.223	356.126	0.223	356.126
1.8500	0.7363	0.580	601.804	2.659	1867.219	0.214	340.549	0.214	340.549
1.9000	0.7562	0.583	599.411	2.645	1845.158	0.206	325.898	0.206	325.898
1.9500	0.7761	0.586	597.114	2.631	1824.096	0.199	312.098	0.199	312.098
2.0000	0.7960	0.588	594.907	2.617	1803.962	0.192	299.084	0.192	299.084

Notes: Run name : YLDSME03
 Date and time : 31AUG99:09:07
 Computation of ref. F: Simple mean, age 3 - 6
 F-0.1 factor : 0.1885
 F-max factor : 0.3465
 F-0.1 reference F : 0.0750
 F-max reference F : 0.1379
 Recruitment : Single recruit

Table 5.21 (Option 2)

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	13949.302	2.713	11977.579	2.713	11977.579
0.0500	0.0141	0.073	263.697	5.154	11740.590	2.360	9781.930	2.360	9781.930
0.1000	0.0281	0.130	437.957	4.870	10086.512	2.085	8140.635	2.085	8140.635
0.1500	0.0422	0.176	554.255	4.642	8815.016	1.866	6881.652	1.866	6881.652
0.2000	0.0563	0.214	631.999	4.453	7816.525	1.687	5895.409	1.687	5895.409
0.2500	0.0704	0.246	683.601	4.295	7018.238	1.538	5109.115	1.538	5109.115
0.3000	0.0844	0.273	717.229	4.160	6370.114	1.413	4472.737	1.413	4472.737
0.3500	0.0985	0.296	738.380	4.044	5836.777	1.305	3950.904	1.305	3950.904
0.4000	0.1126	0.317	750.820	3.942	5392.620	1.212	3518.018	1.212	3518.018
0.4500	0.1267	0.335	757.165	3.852	5018.735	1.130	3155.178	1.130	3155.178
0.5000	0.1407	0.351	759.251	3.772	4700.917	1.058	2848.184	1.058	2848.184
0.5500	0.1548	0.366	758.382	3.700	4428.334	0.995	2586.211	0.995	2586.211
0.6000	0.1689	0.379	755.484	3.634	4192.612	0.937	2360.892	0.937	2360.892
0.6500	0.1829	0.391	751.221	3.575	3987.207	0.886	2165.686	0.886	2165.686
0.7000	0.1970	0.402	746.070	3.520	3806.944	0.839	1995.427	0.839	1995.427
0.7500	0.2111	0.413	740.370	3.470	3647.695	0.797	1845.991	0.797	1845.991
0.8000	0.2252	0.422	734.366	3.424	3506.138	0.758	1714.061	0.758	1714.061
0.8500	0.2392	0.431	728.232	3.380	3379.578	0.722	1596.947	0.722	1596.947
0.9000	0.2533	0.439	722.088	3.340	3265.810	0.689	1492.449	0.689	1492.449
0.9500	0.2674	0.447	716.021	3.303	3163.021	0.659	1398.760	0.659	1398.760
1.0000	0.2815	0.454	710.087	3.267	3069.709	0.631	1314.381	0.631	1314.381
1.0500	0.2955	0.461	704.323	3.234	2984.621	0.604	1238.064	0.604	1238.064
1.1000	0.3096	0.467	698.754	3.202	2906.707	0.580	1168.764	0.580	1168.764
1.1500	0.3237	0.473	693.392	3.173	2835.082	0.557	1105.599	0.557	1105.599
1.2000	0.3377	0.479	688.243	3.144	2768.997	0.535	1047.824	0.535	1047.824
1.2500	0.3518	0.485	683.307	3.117	2707.812	0.515	994.804	0.515	994.804
1.3000	0.3659	0.490	678.580	3.092	2650.982	0.496	945.997	0.496	945.997
1.3500	0.3800	0.495	674.057	3.068	2598.037	0.478	900.936	0.478	900.936
1.4000	0.3940	0.500	669.731	3.044	2548.572	0.461	859.221	0.461	859.221
1.4500	0.4081	0.504	665.592	3.022	2502.236	0.445	820.503	0.445	820.503
1.5000	0.4222	0.509	661.633	3.000	2458.723	0.430	784.480	0.430	784.480
1.5500	0.4362	0.513	657.844	2.980	2417.765	0.416	750.887	0.416	750.887
1.6000	0.4503	0.517	654.215	2.960	2379.128	0.402	719.494	0.402	719.494
1.6500	0.4644	0.521	650.739	2.941	2342.606	0.389	690.097	0.389	690.097
1.7000	0.4785	0.525	647.407	2.923	2308.018	0.377	662.517	0.377	662.517
1.7500	0.4925	0.528	644.209	2.905	2275.200	0.365	636.595	0.365	636.595
1.8000	0.5066	0.532	641.140	2.888	2244.010	0.353	612.190	0.353	612.190
1.8500	0.5207	0.535	638.190	2.872	2214.320	0.343	589.177	0.343	589.177
1.9000	0.5348	0.539	635.354	2.856	2186.015	0.332	567.444	0.332	567.444
1.9500	0.5488	0.542	632.625	2.841	2158.991	0.322	546.890	0.322	546.890
2.0000	0.5629	0.545	629.996	2.826	2133.157	0.313	527.425	0.313	527.425

Notes: Run name : YLDSME04
Date and time : 31AUG99:09:16
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.2786
F-max factor : 0.5075
F-0.1 reference F : 0.0784
F-max reference F : 0.1428
Recruitment : Single recruit

Table 5.22. Results of precautionary reference points analysis for Northeast Arctic saithe using the PASoft package.

Reference point	Deterministic	Median	80th percentile	95th percentile	Hist SSB < ref pt %
MedianRecruits	211802	211802	240782	278361	
MBAL	170000				50.00
Bloss	89100				
SSB90%R90%Surv	168813	167542	194915	254982	41.67
SPR%ofVirgin	7.51	7.33	9.49	12.25	
VirginSPR	11.95	11.66	14.35	17.94	
SPRloss	0.77	0.78	0.97	1.09	
	Deterministic	Median	20th percentile	5th percentile	Hist F > ref pt %
FBar	0.38	0.38	0.31	0.24	63.89
Fmax	0.14	0.14	0.11	0.09	100.00
F0.1	0.08	0.08	0.06	0.05	100.00
Flow	0.17	0.16	0.13	0.09	97.22
Fmed	0.32	0.31	0.25	0.21	72.22
Fhigh	0.59	0.56	0.46	0.38	11.11
F35%SPR	0.10	0.09	0.08	0.06	100.00
Floss	0.42	0.41	0.32	0.26	50.00

For estimation of Gloss and Floss:

A LOWESS smoother with a span of 0.5 was used.

Stock recruit data were log-transformed

A point representing the origin was included in the stock recruit data.

For estimation of the stock recruitment relationship used in equilibrium calculations:

A LOWESS smoother with a span of 1 was used.

Stock recruit data were un-transformed

A point representing the origin was included in the stock recruit data.

Steady state selection provided as input

FBar averaged from age 3 to 6

Number of iterations = 1000

Random number seed = -257

Stock recruitment data Monte Carloed using stock recruit pairs

Data source:

PASAITHE.XLS

FishLab DLL used

FLVB32.DLL built on May 6 1999 at 12:54:28

PASoft 10 June 1999

Table 5.23 (Option 1)

September 8, 1999

The SAS System

15:38 Wednesday,

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

Prediction with management option table: Input data

Year: 1998									
Age	Stock size	Natural mortality	Maturity ogive	Prop. of F ³ bef.spaw.	Prop. of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
2	174000.00	0.2000	0.0000	0.0000	0.0000	0.370	0.0003	0.370	
3	165000.00	0.2000	0.0000	0.0000	0.0000	0.700	0.0246	0.700	
4	66644.000	0.2000	0.0100	0.0000	0.0000	0.990	0.3777	0.990	
5	39017.000	0.2000	0.5500	0.0000	0.0000	1.440	0.4767	1.440	
6	71370.000	0.2000	0.8500	0.0000	0.0000	1.840	0.7128	1.840	
7	17626.000	0.2000	0.9800	0.0000	0.0000	2.500	0.7378	2.500	
8	10879.000	0.2000	1.0000	0.0000	0.0000	2.980	0.7582	2.980	
9	5551.000	0.2000	1.0000	0.0000	0.0000	4.070	0.7364	4.070	
10	1084.000	0.2000	1.0000	0.0000	0.0000	5.480	0.8068	5.480	
11+	667.000	0.2000	1.0000	0.0000	0.0000	7.860	0.8068	7.860	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Year: 1999									
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop. of F ³ bef.spaw.	Prop. of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.380	0.0040	0.380	
3	.	0.2000	0.0000	0.0000	0.0000	0.640	0.1274	0.640	
4	.	0.2000	0.0100	0.0000	0.0000	0.910	0.3574	0.910	
5	.	0.2000	0.5500	0.0000	0.0000	1.320	0.4778	1.320	
6	.	0.2000	0.8500	0.0000	0.0000	1.780	0.6293	1.780	
7	.	0.2000	0.9800	0.0000	0.0000	2.430	0.8070	2.430	
8	.	0.2000	1.0000	0.0000	0.0000	3.270	0.8075	3.270	
9	.	0.2000	1.0000	0.0000	0.0000	4.300	0.9346	4.300	
10	.	0.2000	1.0000	0.0000	0.0000	5.610	0.8790	5.610	
11+	.	0.2000	1.0000	0.0000	0.0000	7.500	0.8790	7.500	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Year: 2000									
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop. of F ³ bef.spaw.	Prop. of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch	
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.380	0.0040	0.380	
3	.	0.2000	0.0000	0.0000	0.0000	0.640	0.1274	0.640	
4	.	0.2000	0.0100	0.0000	0.0000	0.910	0.3574	0.910	
5	.	0.2000	0.5500	0.0000	0.0000	1.320	0.4778	1.320	
6	.	0.2000	0.8500	0.0000	0.0000	1.780	0.6293	1.780	
7	.	0.2000	0.9800	0.0000	0.0000	2.430	0.8070	2.430	
8	.	0.2000	1.0000	0.0000	0.0000	3.270	0.8075	3.270	
9	.	0.2000	1.0000	0.0000	0.0000	4.300	0.9346	4.300	
10	.	0.2000	1.0000	0.0000	0.0000	5.610	0.8790	5.610	
11+	.	0.2000	1.0000	0.0000	0.0000	7.500	0.8790	7.500	
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms	

Notes: Run name : MANSME03
Date and time: 27AUG99:14:07

Table 5.24 (Option 1)

September 8, 1999
 North-East Arctic saithe (Sub-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	Catch in weight	Stock biomass	Sp.stock biomass
0.9830	0.3912	543623	252563	153811	0.0000	0.0000	504926	186079	0	672241	304205			
.	0.0500	0.0199	.	186079	9301	660811	294819			
.	0.1000	0.0398	.	186079	18322	649732	285754			
.	0.1500	0.0597	.	186079	27073	638991	276998			
.	0.2000	0.0796	.	186079	35564	628576	268539			
.	0.2500	0.0995	.	186079	43804	618477	260368			
.	0.3000	0.1194	.	186079	51800	608681	252472			
.	0.3500	0.1393	.	186079	59562	599179	244843			
.	0.4000	0.1592	.	186079	67098	589961	237471			
.	0.4500	0.1791	.	186079	74415	581016	230346			
.	0.5000	0.1990	.	186079	81521	572335	223459			
.	0.5500	0.2189	.	186079	88423	563909	216802			
.	0.6000	0.2388	.	186079	95127	555729	210366			
.	0.6500	0.2587	.	186079	101642	547788	204144			
.	0.7000	0.2786	.	186079	107972	540076	198128			
.	0.7500	0.2985	.	186079	114124	532587	192309			
.	0.8000	0.3184	.	186079	120104	525312	186683			
.	0.8500	0.3383	.	186079	125918	518245	181240			
.	0.9000	0.3582	.	186079	131571	511378	175976			
.	0.9500	0.3781	.	186079	137069	504704	170883			
.	1.0000	0.3980	.	186079	142416	498218	165956			
.	1.0500	0.4179	.	186079	147619	491913	161188			
.	1.1000	0.4378	.	186079	152680	485783	156574			
.	1.1500	0.4577	.	186079	157606	479823	152109			
.	1.2000	0.4776	.	186079	162400	474026	147787			
.	1.2500	0.4975	.	186079	167067	468387	143603			
.	1.3000	0.5174	.	186079	171611	462901	139553			
.	1.3500	0.5373	.	186079	176035	457564	135631			
.	1.4000	0.5572	.	186079	180345	452369	131834			
.	1.4500	0.5771	.	186079	184542	447314	128157			
.	1.5000	0.5970	.	186079	188631	442393	124596			

Notes: Run name : MANSME03
 Date and time : 27AUG99:14:07
 Computation of ref. F: Simple mean, age 3 - 6
 Basis for 1998 : TAC constraints

Table 5.25 (Option 2)

September 8, 1999

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

Prediction with management option table: Input data

Year: 1998

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	193000.00	0.2000	0.0000	0.0000	0.0000	0.370	0.0003	0.370
3	180000.00	0.2000	0.0000	0.0000	0.0000	0.700	0.0225	0.700
4	75549.000	0.2000	0.0100	0.0000	0.0000	0.990	0.3250	0.990
5	77534.000	0.2000	0.5500	0.0000	0.0000	1.440	0.2117	1.440
6	84115.000	0.2000	0.8500	0.0000	0.0000	1.840	0.5665	1.840
7	19491.000	0.2000	0.9800	0.0000	0.0000	2.500	0.6385	2.500
8	13610.000	0.2000	1.0000	0.0000	0.0000	2.980	0.5531	2.980
9	6446.000	0.2000	1.0000	0.0000	0.0000	4.070	0.5958	4.070
10	1477.000	0.2000	1.0000	0.0000	0.0000	5.480	0.5216	5.480
11+	912.000	0.2000	1.0000	0.0000	0.0000	7.860	0.5216	7.860

Unit Thousands - - - - Kilograms - Kilograms

Year: 1999

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.380	0.0032	0.380
3	.	0.2000	0.0000	0.0000	0.0000	0.640	0.0866	0.640
4	.	0.2000	0.0100	0.0000	0.0000	0.910	0.2481	0.910
5	.	0.2000	0.5500	0.0000	0.0000	1.320	0.3112	1.320
6	.	0.2000	0.8500	0.0000	0.0000	1.780	0.4799	1.780
7	.	0.2000	0.9800	0.0000	0.0000	2.430	0.6322	2.430
8	.	0.2000	1.0000	0.0000	0.0000	3.270	0.5893	3.270
9	.	0.2000	1.0000	0.0000	0.0000	4.300	0.7139	4.300
10	.	0.2000	1.0000	0.0000	0.0000	5.610	0.5531	5.610
11+	.	0.2000	1.0000	0.0000	0.0000	7.500	0.5531	7.500

Unit Thousands - - - - Kilograms - Kilograms

Year: 2000

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F ³ bef.spaw.	Prop.of M ³ bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.380	0.0032	0.380
3	.	0.2000	0.0000	0.0000	0.0000	0.640	0.0866	0.640
4	.	0.2000	0.0100	0.0000	0.0000	0.910	0.2481	0.910
5	.	0.2000	0.5500	0.0000	0.0000	1.320	0.3112	1.320
6	.	0.2000	0.8500	0.0000	0.0000	1.780	0.4799	1.780
7	.	0.2000	0.9800	0.0000	0.0000	2.430	0.6322	2.430
8	.	0.2000	1.0000	0.0000	0.0000	3.270	0.5893	3.270
9	.	0.2000	1.0000	0.0000	0.0000	4.300	0.7139	4.300
10	.	0.2000	1.0000	0.0000	0.0000	5.610	0.5531	5.610
11+	.	0.2000	1.0000	0.0000	0.0000	7.500	0.5531	7.500

Unit Thousands - - - - Kilograms - Kilograms

Notes: Run name : MANSME05
Date and time: 27AUG99:14:06

Table 5.26 (Option 2)

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	Catch in weight	Stock biomass	Sp.stock biomass
0.9873	0.2779	669407	323519	153811	0.0000	0.0000	639373	286302	0	821285	432975			
.	0.0500	0.0141	.	286302	9610	809525	422801			
.	0.1000	0.0281	.	286302	18995	798047	412892			
.	0.1500	0.0422	.	286302	28161	786843	403241			
.	0.2000	0.0563	.	286302	37115	775905	393840			
.	0.2500	0.0704	.	286302	45861	765227	384683			
.	0.3000	0.0844	.	286302	54406	754801	375763			
.	0.3500	0.0985	.	286302	62754	744621	367073			
.	0.4000	0.1126	.	286302	70911	734680	358607			
.	0.4500	0.1267	.	286302	78881	724971	350358			
.	0.5000	0.1407	.	286302	86671	715489	342321			
.	0.5500	0.1548	.	286302	94284	706227	334490			
.	0.6000	0.1689	.	286302	101725	697180	326860			
.	0.6500	0.1829	.	286302	108998	688341	319424			
.	0.7000	0.1970	.	286302	116109	679706	312177			
.	0.7500	0.2111	.	286302	123061	671269	305114			
.	0.8000	0.2252	.	286302	129859	663025	298230			
.	0.8500	0.2392	.	286302	136505	654968	291521			
.	0.9000	0.2533	.	286302	143006	647094	284980			
.	0.9500	0.2674	.	286302	149363	639398	278605			
.	1.0000	0.2815	.	286302	155581	631876	272390			
.	1.0500	0.2955	.	286302	161663	624522	266330			
.	1.1000	0.3096	.	286302	167613	617332	260423			
.	1.1500	0.3237	.	286302	173435	610303	254662			
.	1.2000	0.3377	.	286302	179131	603429	249046			
.	1.2500	0.3518	.	286302	184705	596708	243569			
.	1.3000	0.3659	.	286302	190159	590135	238228			
.	1.3500	0.3800	.	286302	195498	583705	233019			
.	1.4000	0.3940	.	286302	200723	577417	227939			
.	1.4500	0.4081	.	286302	205838	571265	222984			
.	1.5000	0.4222	.	286302	210845	565246	218151			

Notes: Run name : MANSME05
 Date and time : 27AUG99:14:06
 Computation of ref. F: Simple mean, age 3 - 6
 Basis for 1998 : TAC constraints

Table 5.27. Short term predictions for 1999 for different levels of F

Option1. Tuning based on survey and commercial CPUE data (= standard ICES)

1998	1998	1998	1999	1999	1999	2000
SSB	F	Catch	SSB	F	Catch	SSB
253	0,39	154	186	Fpa=0,26	102	204
253	0,39	154	186	Fmed=0,32	120	186
253	0,39	154	186	F1998=0,39	142	166

Option 2. Tuning based on survey data only

1998	1998	1998	1999	1999	1999	2000
SSB	F	Catch	SSB	F	Catch	SSB
324	0.28	154	286	Fpa=0,26	146	282
324	0.28	154	286	F1998=0,28	155	272
324	0.28	154	286	Fmed=0,32	173	255

Figure 5.1A – D North – East Arctic saithe (Sub - areas I and II) (Option 1)

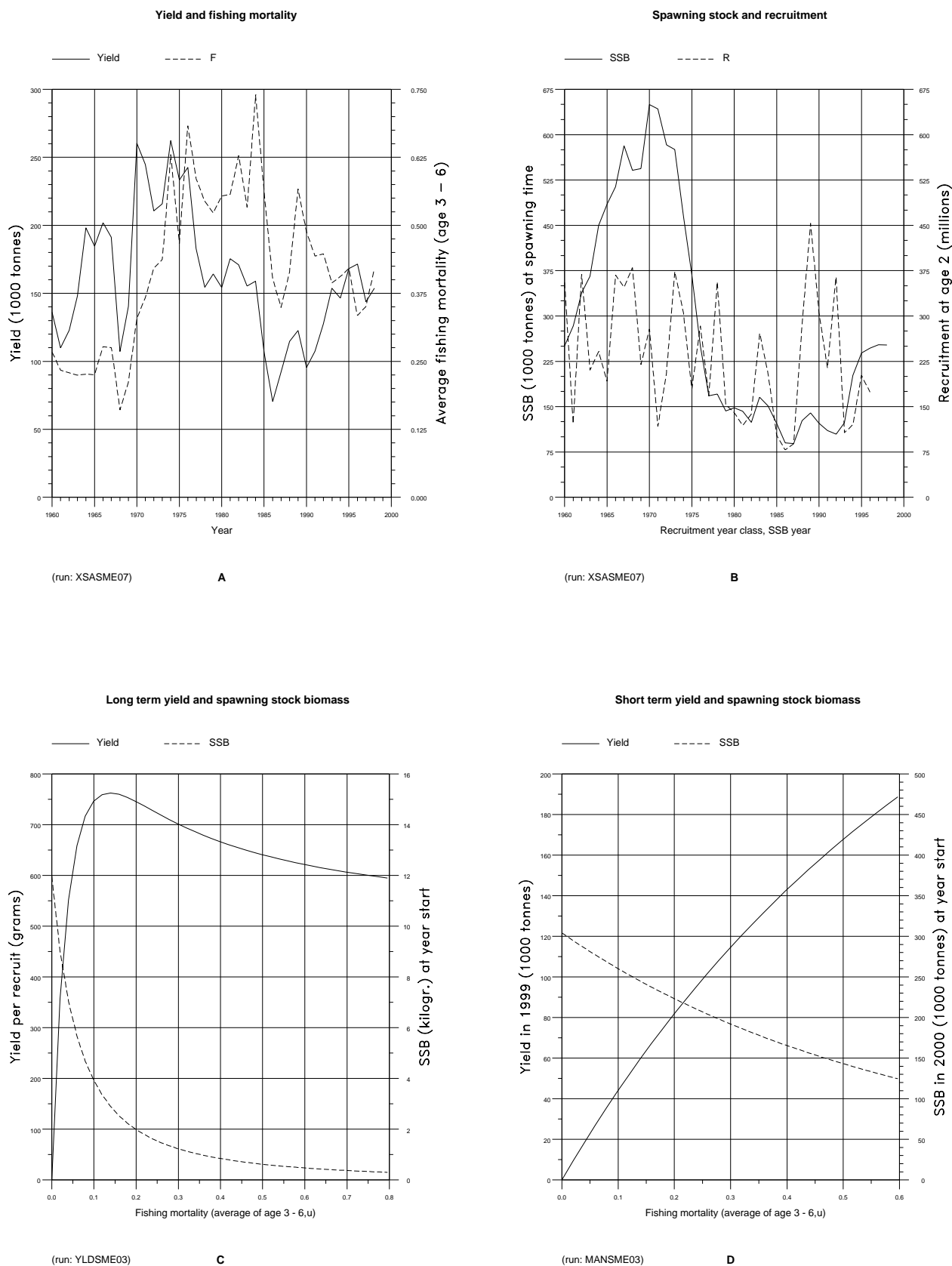
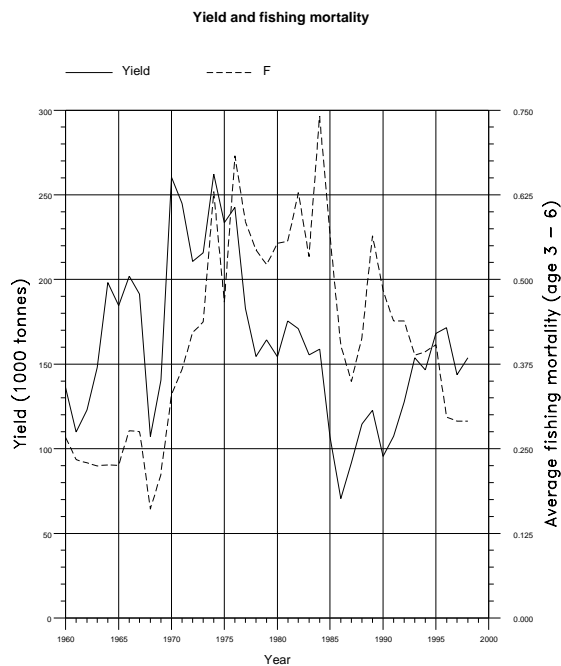
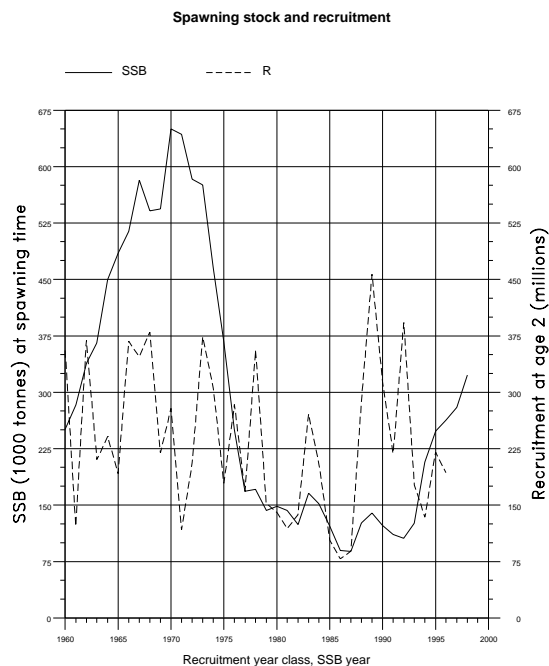


Figure 5.2 A – D North – East Arctic saithe (Sub - areas I and II) (Option 2)



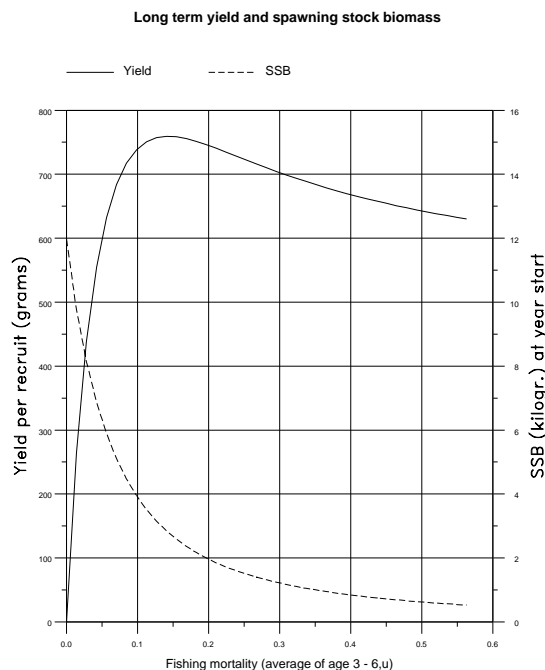
(run: XSASME08)

A



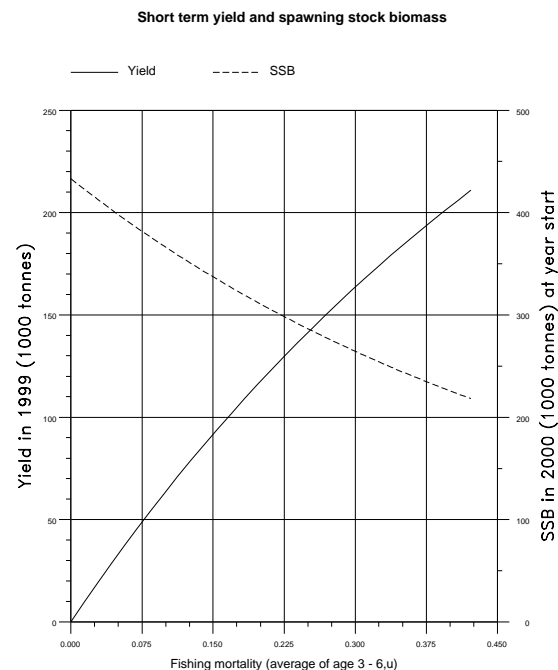
(run: XSASME08)

B



(run: YLDSME04)

C



(run: MANSME05)

D

Figure 5.3A. North-East Arctic Saithe - Acoustic survey vs VPA (Option 1)

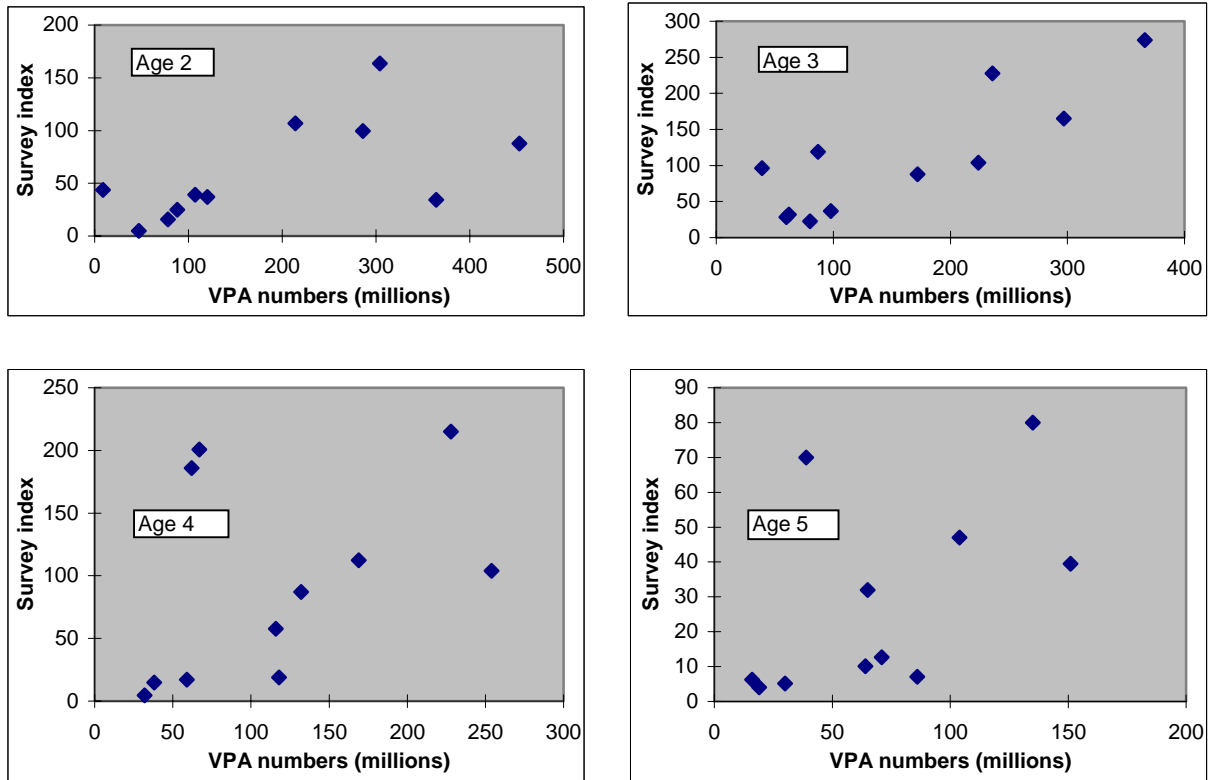


Figure 5.3B. North-East Arctic Saithe - Norwegian purse seine vs VPA (Option 1)

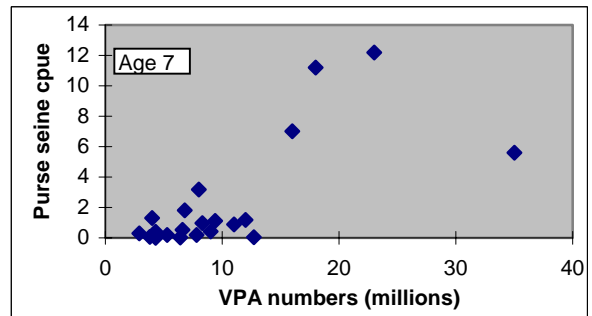
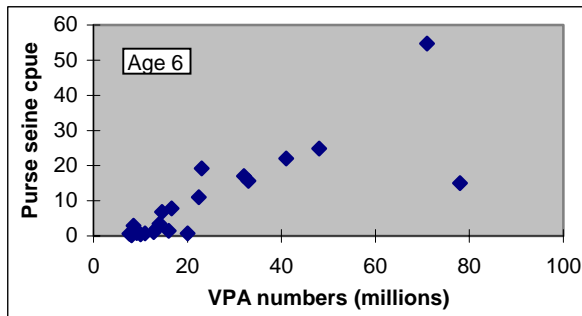
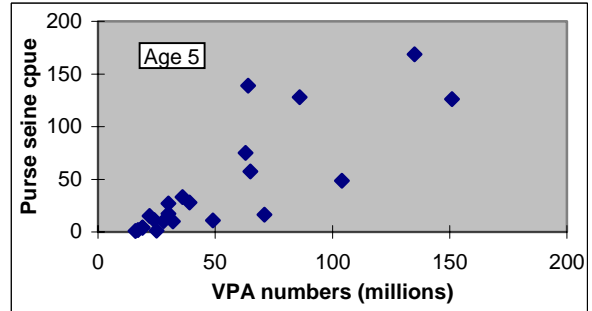
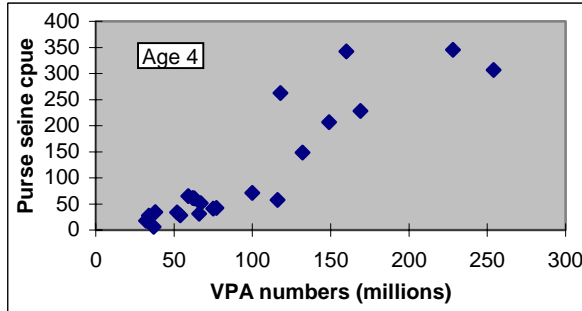
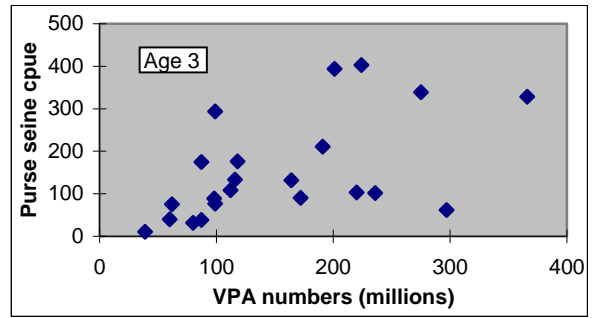
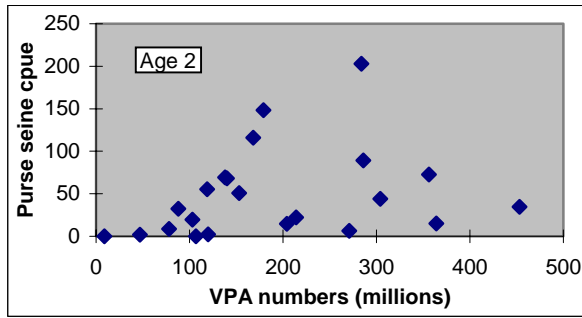


Figure 5.3C. North-East Arctic Saithe - Norwegian trawl vs VPA (Option 1)

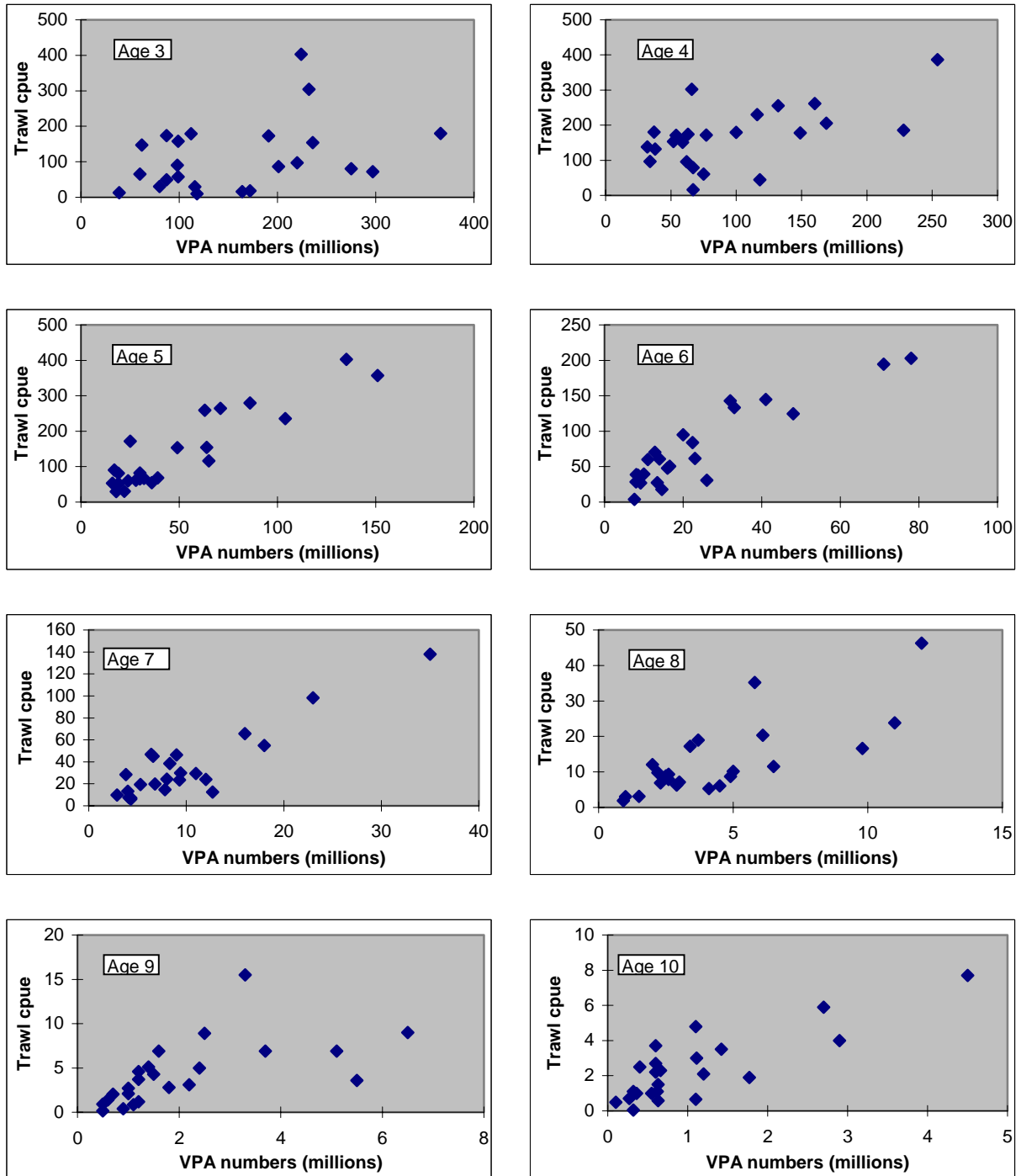


Figure 5.4. North-East Arctic Saithe - Acoustic survey vs VPA (Option 2)

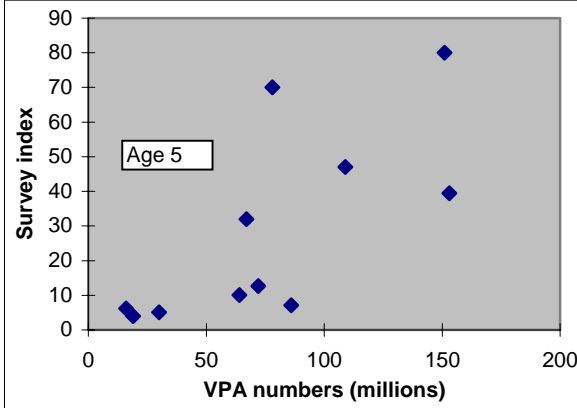
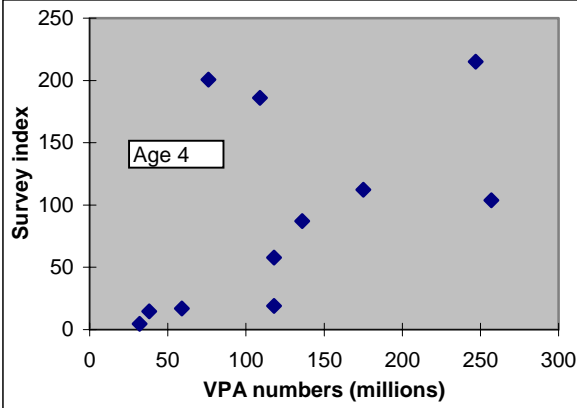
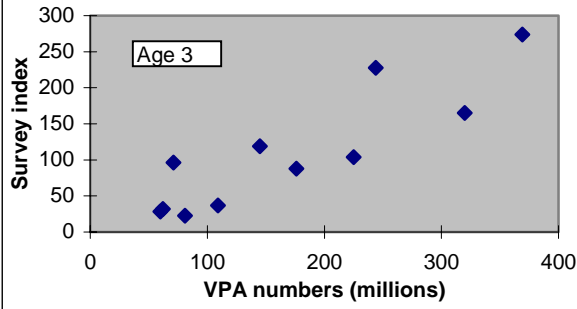
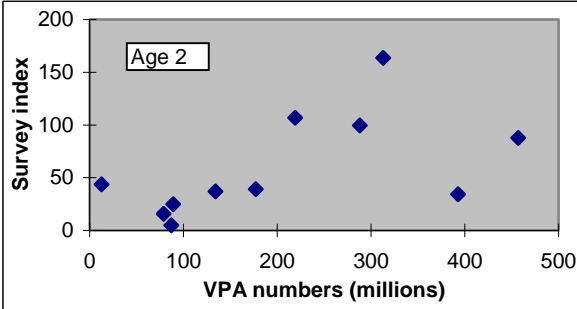


Figure 5.5A. North-East Arctic Saithe - Retrospective analysis (Option 1)

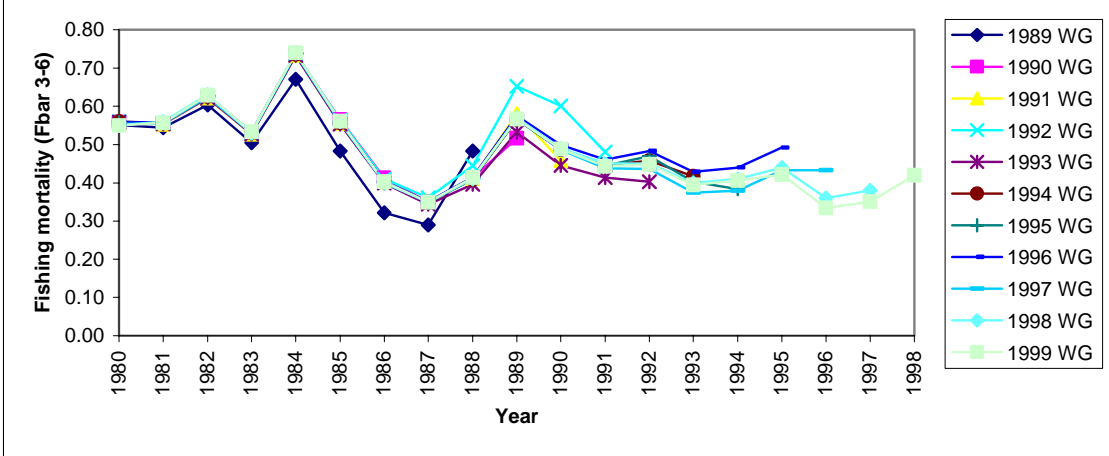


Figure 5.5B. North-East Arctic Saithe - Retrospective analysis (Option 1)

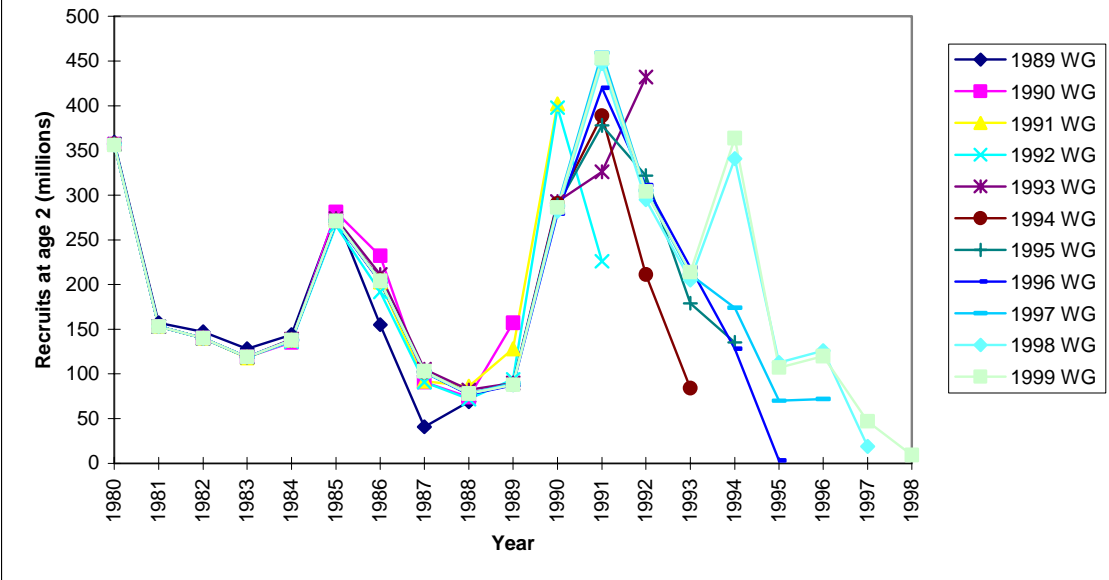


Figure 5.5C. North-East Arctic Saithe - Retrospective analysis (Option 1)

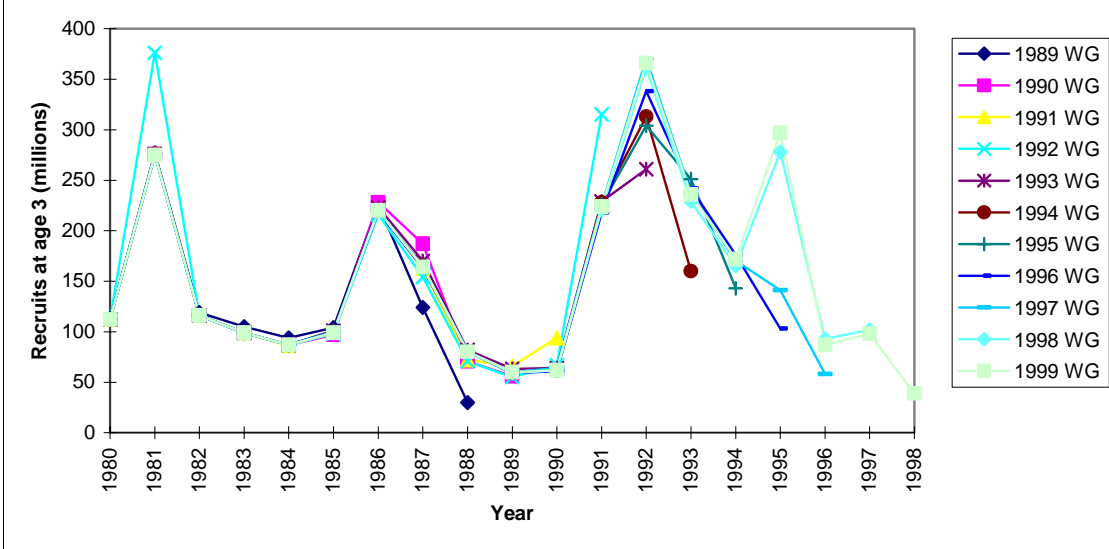
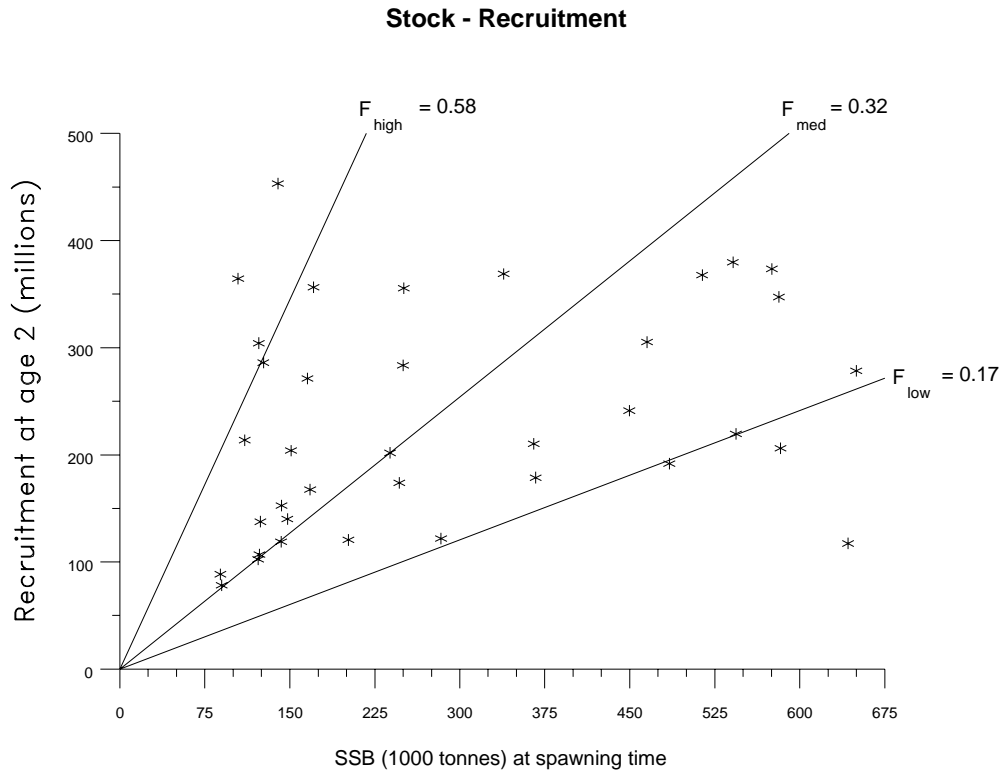


Figure 5.6 (Option 1)

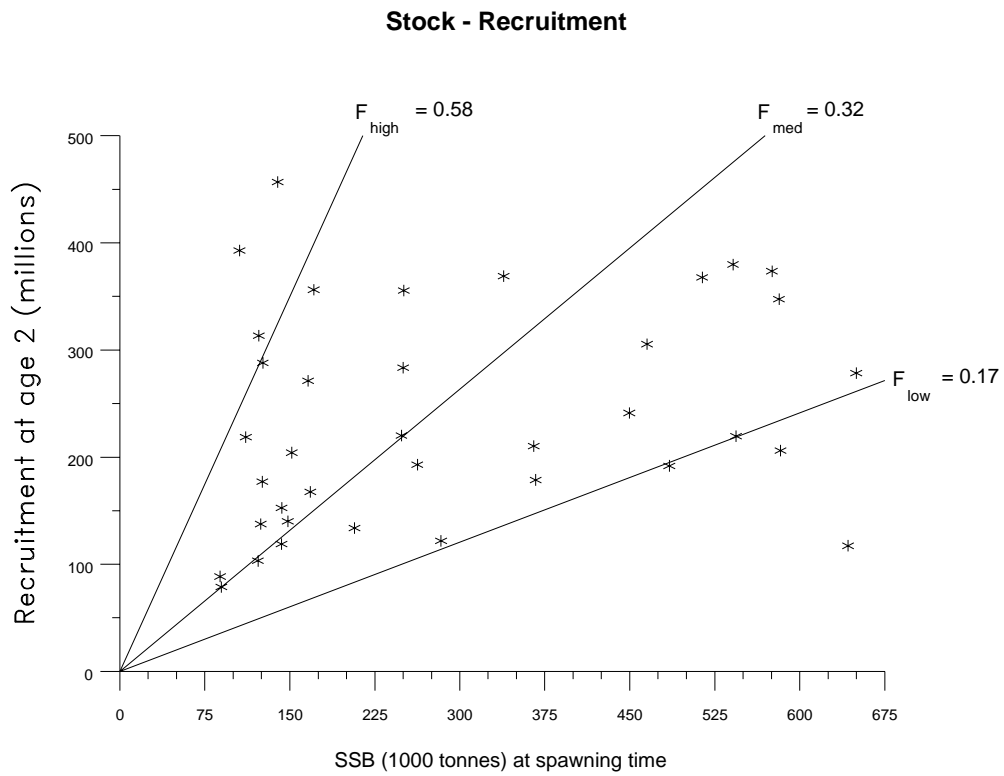
North – East Arctic saithe (Sub – areas I and II)



(run: XSASME07)

Figure 5.7 (Option 2)

North – East Arctic saithe (Sub – areas I and II)



(run: XSASME08)

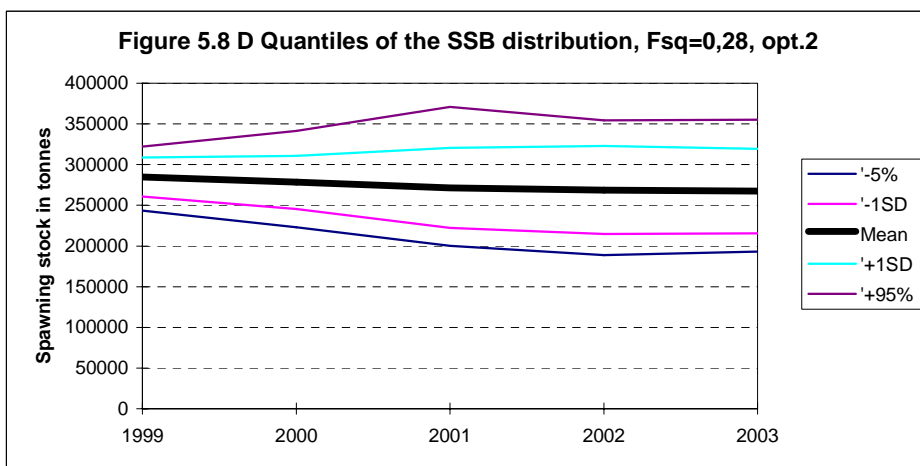
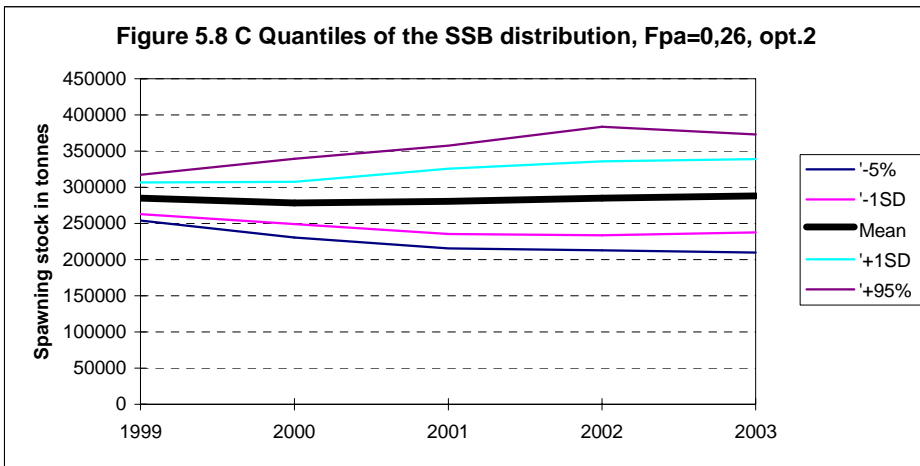
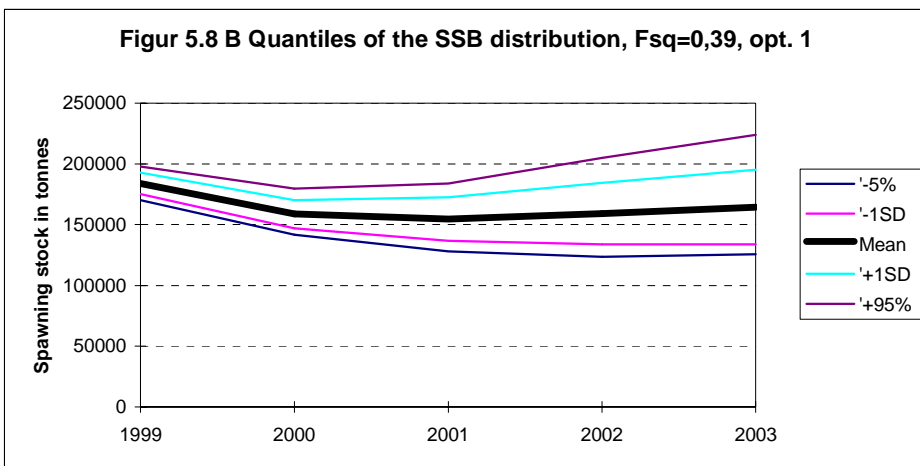
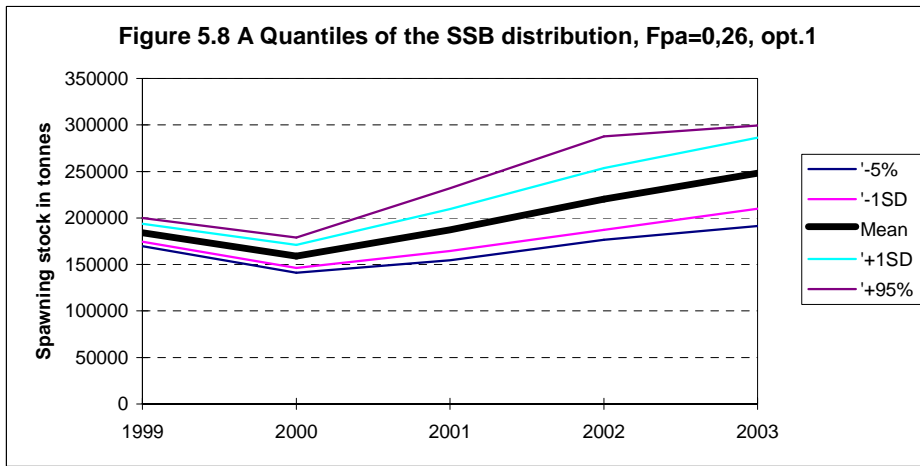


Figure 5.9 A Quantiles of the catch distribution Fpa=0,26 opt.1

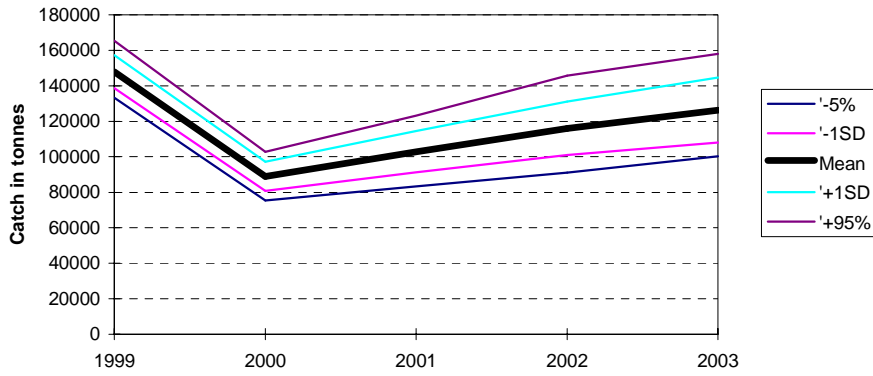


Figure 5.9 B Quantiles of the catch distribution Fsq=0,39 opt.1

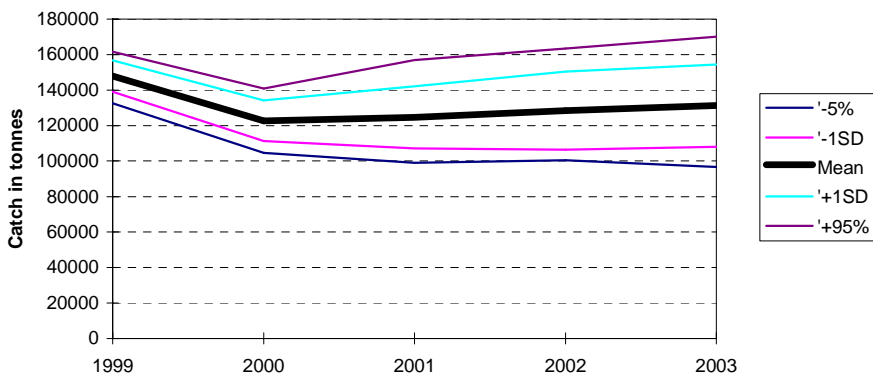


Figure 5.9 C Quantiles of the catch distribution Fpa=0,26 opt.2

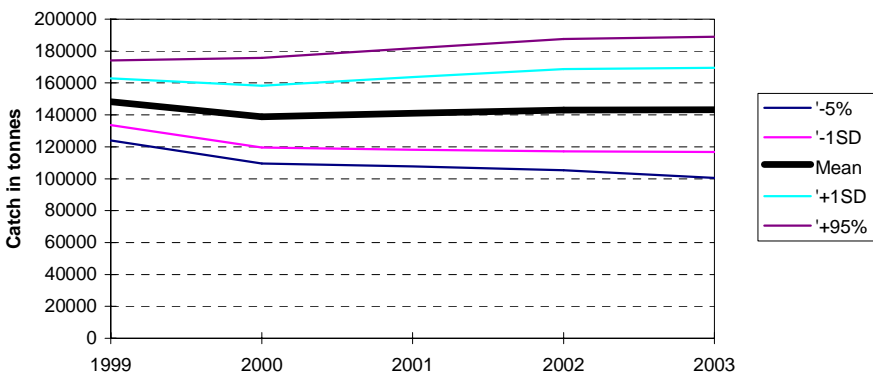


Figure 5.9 D Quantiles of the catch distribution Fsq=0,28 opt.2

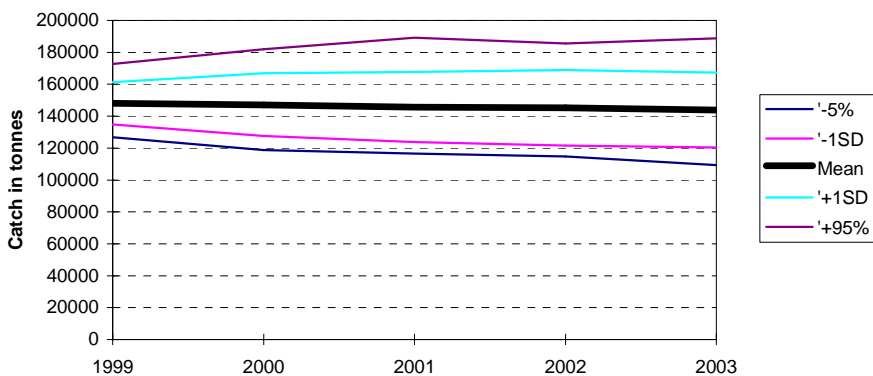


Table C.1 Northeast Arctic saithe. Norwegian purse seiners taking part in the saithe fishery. Data given are: number of vessels, catch in tonnes, catch per vessel.

Year	Vessel length (m)								
	-19.9			20.0-24.9			25.0-		
	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	87	10,153	117	48	20,135	419	32	14,012	637
1998 ¹	125	10,274	82	82	19,216	234	102	14,871	146

¹ Preliminary

Table C.2 Northeast 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	21,839	18,312	1193
1998 ²	18,590	24,796	750

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

² Preliminary.

Table C.3 Northeast 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	41.4	222
1998	189	65.3	369

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 trawl effort.

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 were raised to represent total Norwegian landings for the gear.

Table C.4 Northeast Arctic saithe. Acoustic abundance indices from Norwegian surveys in October-November. In 1985 - 1987 the area was incomplete. Numbers in millions.

Year	Age					Total
	2	3	4	5	6+	
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
1998	43.6	96.5	200.6	70.0	96.7	507.4

Table C.5 Northeast 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.

Year	agegroup											Total
	1	2	3	4	5	6	7	8	9	10	6+	
1995	680	13686	33703	9365	5695	2404	1342	708	110	171	4735	67865
1996	453	8332	21694	39385	7477	9440	3868	1249	0	0	14556	91897
1997	713	3410	7249	25713	7163	3741	2001	727	66	114	6648	50896
1998	1561	4451	3277	4260	1562	1257	1027	1854	378	332	4848	19958

Only inner parts of areas A,C and D (which are not covered by IMR) are included.

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. However, such criteria have been agreed upon by Norway and Russia and are expected to be put into force at the end of 1999. Traditionally, the fishery for *S. mentella* was conducted by Russia and other East European countries on grounds located 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 inhabited primarily 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. Since 1997 ACFM has advised that there should be no directed fishery and that the by-catch should be reduced.

6.1.2 Landings prior to 1999 (Tables 6.1–6.5, 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 has been made directly to Norwegian authorities during the fishery. In such cases the reportings to Norwegian authorities have been treated as preliminary figures. For Norway some area adjustments of the official statistics were made prior to the Working Group. Reliable estimates of species breakdown by area were available to the Working Group back to 1989. The national landings of redfish for 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.

After a continuous decrease in the total landings from 48,727 t in 1991 to a historical low at about 8,000 t in 1996 and 1997 the landings have increased to 13,616 t (provisional) in 1998. Landings from Division IIa in 1998 represent 90% of the total. The landings in 1998 are about 2,616 t more than the 11,000 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 effective in 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 1,500–3,000 t per year (Table D2). 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. Approximately 80% of the Norwegian catches are considered to be *S. mentella*.

6.1.3 Expected landings in 1999

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 1999. In addition to this, and based on reports from the eight first months in 1999, a by-catch of approx. 1,500 t in other fisheries and areas should give an expected total Russian catch in 1999 of about 3,500 t, i.e., the same level as in 1998.

Based on the landings of *S. mentella* halfway through the year the Norwegian landings in 1999 are expected to be around 10,000 t. On this basis, and assuming unchanged catch level for other countries, the total landings of *S. mentella* for 1999 is expected to be 14,000 t.

Strong regulations were enforced in the fishery in 1997. It is now forbidden to fish redfish (both *S. marinus* and *S. mentella*) in the Norwegian EEZ north and west of straight lines through the positions:

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

and in the Svalbard area (Division IIb). When fishing for other species in these areas, a maximum 25% by-catch (in weight) of redfish in each trawl haul is allowed. It is further expected that a maximum legal level of 10 redfish specimen (both *S. marinus* and *S. mentella*) per 10 kg shrimp in the shrimp fishery will be enforced during 1999.

6.2 Data used in the Assessment

All input data sets were updated up to and including 1998. Maturity ogives and some of the XSA tuning series were updated to 1999.

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

Catch-per-hour-trawling data for the *S. mentella* fishery were available from the Russian PST and BMRT vessels fishing in ICES Division IIa in 1998, representative for 11% and 56% of the Russian catch, respectively (Table D3). The CPUE has been fluctuating about the 1998-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 was carried out on a localised spawning concentration. This may also explain the different trend in the two fleets from 1997 to 1998. 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 1993–1997 was revised according to new catch data. Data on age for 1998 for *S. mentella* were only available from Russia in Division IIa and Norway. For Division IIb, a German length distribution was available, and were converted to age using the Norwegian age-length key from the same Division. 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 1998 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 year running average). The 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 and 1998 data were taken as representative for 1997 and 1998, respectively

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 1978–98 in fishing depths of 100–900 m (Table D4, Figure 6.2).
- 3) Norwegian Svalbard (Division IIb) bottom trawl survey (August-September) from 1986–98 in fishing depths of < 100–500 m. Data disaggregated on age only for the years 1992–98 (Table D5a,b and Figure 6.3a,b).

- 4) Norwegian Barents Sea bottom trawl survey (February) from 1986–99 in fishing depths of < 100–500 m. Data disaggregated on age only for the years 1992–99 (Tables D6a,b and Figures 6.4a,b).
- 5) Russian acoustic survey in April-May from 1992–99 (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 but it is believed to be mostly *S. mentella* (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 1996-1998 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 1986–1999 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 which seemed to be at an intermediate level as 1-3 year olds have decreased since then and must now be considered poor.

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 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 trawlh hour 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 has been observed since then. This could be explained by the strong 1982-year class migrating west-southwest and out of the surveyed area. The next year classes expected to contribute significantly to the spawning stock (i.e., the 1987–1990 year classes) are about to mature (males before females) but so far they have not contributed to any increase in the spawning biomass measured by this survey. 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 available information since last year's assessment confirm the bad situation for this stock. The surveys have not detected any improved recruitment, rather the contrary.

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 fishable stock due to the 1987–1989 year classes.

According to the last (1997) 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 the 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 the 1997-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 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 nor in the spawning stock biomass, which remains low. Therefore the same advice should be maintained for 2000. 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	-	5,182	-	963	6,260	57	293	-	12,866
1994	-	28	4	74	18	1	3	6,511	-	895	5,021	30	124	12	12,721
1995	-	-	3	16	176	2	4	2,646	-	927	6,346	67	93	4	10,284
1996	-	-	4	75	119	3	2	5,727	-	467	925	328	76	23	7,749
1997	-	-	17	37	80	16	6	4,570	1	474	2,972	210	71	7	8,462
1998 ¹	-	-	20	73	101	14	10	9,364	12	125	3,646	118		134 ⁵	13,616

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.

⁵ Total for England, Wales and Scotland.

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	-	-	16	588	-	606
1994	2 ²	2	-	36	308	-	348
1995	2 ²	-	-	20	203	-	225
1996	-	-	-	5	101	-	106
1997	-	-	3 ²	13	174	1 ²	191
1998 ¹	-	-	-	27	378	-	405

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	-	5,029	648 ²	5,328	-	2 ²	-	11,069
1994	2 ²	33 ²	16 ²	1 ²	2 ²	6,119	687 ²	4,692	8 ²	4 ²	-	11,564
1995	1 ²	16 ²	176 ²	2 ²	2 ²	2,251	715 ²	5,916	65 ²	41 ²	2 ²	9,187
1996	- ²	75 ²	119 ²	3 ²	-	5,541	429 ²	677	5 ²	42 ²	19 ²	6,910
1997	13 ²	37 ²	77	12 ²	2 ²	4,366	410 ²	2,341	4 ²	48 ²	7 ²	7,317
1998 ¹	20 ²	73 ²	59 ²	14 ²	6 ²	9,197	118 ²	2,626	37 ²	105 ^{2,6}		12,254

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.

⁶ Total for England, Wales and Scotland.

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	-	-	-	137	-	315 ²	344	57 ³	291 ²	-	1,191
1994	-	28 ²	-	41 ²	-	-	1 ²	356	-	208 ²	21	22 ³	120 ²	12 ²	809
1995	-	-	-	-	-	-	2 ²	375	-	212 ²	227	2 ³	52 ²	2 ²	872
1996	-	-	4 ²	-	-	-	2 ²	181	-	38 ²	147	323 ²	34 ²	4 ²	733
1997	-	-	4 ²	-	3	1 ²	4 ²	191	1 ²	64 ²	457	206 ²	22 ²	- ²	953
1998 ¹	-	-	-	-	42 ²	-	4 ²	140	12 ²	7 ²	642	81 ²		29 ^{2,7}	957

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 1991.⁷ Total for England, Wales and Scotland.

Table 6.5.

Run title : Arctic S. mentella (run: XSAKHN01/X01)

At 30/08/1999 14:28

Table 1		Catch numbers at age				Numbers*10**-3
YEAR,	1965,	1966,	1967,	1968,		
AGE						
1,	0,	0,	0,	0,		
2,	0,	0,	0,	0,		
3,	0,	0,	0,	0,		
4,	0,	0,	0,	0,		
5,	0,	0,	0,	0,		
6,	48,	0,	0,	7,		
7,	285,	0,	0,	0,		
8,	1592,	27,	7,	15,		
9,	2163,	279,	15,	89,		
10,	1141,	532,	182,	192,		
11,	1545,	465,	285,	355,		
12,	1972,	731,	343,	436,		
13,	2471,	1223,	394,	554,		
14,	2804,	1927,	489,	864,		
15,	1996,	2007,	496,	768,		
16,	2067,	1741,	628,	931,		
17,	1592,	1422,	613,	694,		
18,	1473,	944,	540,	665,		
+gp,	2589,	1980,	3254,	1802,		
0 TOTALNUM,	23738,	13278,	7246,	7372,		
TONSLAND,	15662,	10143,	6239,	5413,		
SOPCOF %,	104,	102,	100,	94,		

Table 1 Catch numbers at age

Numbers*10**-3

YEAR, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978,

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,	31,	0,	0,	466,	172,	606,	5834,	18891,	0,	2905,
7,	94,	0,	0,	792,	1660,	4847,	19417,	29815,	2418,	30158,
8,	409,	33,	114,	5728,	4865,	15451,	42425,	59395,	17175,	65162,
9,	524,	131,	284,	3586,	9729,	28781,	82480,	78241,	33454,	53391,
10,	838,	620,	681,	2049,	4636,	30144,	108462,	110712,	52102,	33569,
11,	933,	2122,	1590,	1770,	2633,	19843,	119075,	112524,	49617,	19909,
12,	954,	3428,	4429,	3865,	3148,	10603,	57231,	93144,	53938,	17242,
13,	849,	3983,	4884,	4564,	5208,	8634,	29651,	49550,	33287,	9270,
14,	618,	3526,	5451,	4704,	5666,	8634,	20894,	26134,	19095,	7410,
15,	482,	2808,	4940,	4098,	4578,	6514,	16499,	13881,	12605,	5456,
16,	807,	3983,	7496,	4704,	5380,	5908,	13465,	9839,	5796,	4134,
17,	451,	2743,	4486,	3632,	3777,	3332,	13668,	6300,	4874,	2134,
18,	849,	3559,	7382,	3167,	2747,	2878,	12207,	7233,	5499,	1545,
+gp,	2536,	5714,	14934,	3447,	3053,	5300,	22366,	11439,	13906,	2917,
0 TOTALNUM,	10375,	32650,	56671,	46572,	57252,	151475,	563674,	627098,	303766,	255202,
TONSLAND,	6836,	22916,	45063,	28862,	38380,	69372,	239070,	269022,	146365,	92611,
SOPCOF %,	95,	94,	98,	101,	118,	99,	91,	98,	95,	101,

Table 1 Catch numbers at age

Numbers*10**-3

YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
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,	3633,	1065,	932,	5,	20,	0,	98,	29,	0,	0,
7,	20497,	7412,	3000,	854,	86,	34,	571,	117,	0,	0,
8,	43553,	26296,	8620,	4775,	1987,	525,	2009,	215,	109,	0,
9,	46996,	44131,	26716,	12554,	4576,	2106,	4949,	1049,	1055,	379,
10,	37469,	40441,	48290,	47348,	16695,	7969,	17096,	3079,	3145,	1838,
11,	26298,	27089,	39206,	57134,	31310,	22092,	31564,	5921,	2679,	3512,
12,	20717,	19950,	33394,	46529,	51099,	36763,	41511,	10701,	3580,	4084,
13,	16341,	11172,	21178,	37731,	48307,	47096,	33190,	15930,	6213,	6958,
14,	6059,	6400,	11853,	15506,	29973,	25468,	10519,	7051,	3702,	7313,
15,	3589,	5607,	6038,	9492,	17132,	12002,	4243,	2495,	1459,	4022,
16,	3465,	6801,	2697,	5780,	8347,	4336,	1971,	704,	656,	1960,
17,	2465,	3441,	2172,	3368,	5238,	1499,	658,	390,	210,	983,
18,	1964,	3001,	1344,	2160,	2055,	517,	343,	81,	66,	328,
+gp,	6579,	2546,	1910,	4184,	673,	472,	52,	67,	0,	106,
0 TOTALNUM,	239625,	205352,	207350,	247420,	217498,	160879,	148774,	47829,	22874,	31483,
TONSLAND,	87145,	79354,	81546,	115383,	105273,	72934,	63068,	23112,	10518,	15586,
SOPCOF %,	100,	97,	95,	100,	99,	104,	101,	100,	100,	100,

Table 6.5 continued.

Table 1	Catch numbers at age				Numbers*10**-3					
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	5,	0,	0,	0,	0,
3,	0,	0,	0,	0,	0,	62,	0,	0,	0,	0,
4,	0,	0,	0,	1108,	569,	63,	0,	0,	0,	0,
5,	0,	0,	2044,	957,	298,	88,	119,	128,	70,	0,
6,	48,	1,	1653,	1873,	159,	738,	662,	212,	117,	34,
7,	475,	748,	5453,	2498,	159,	730,	941,	550,	505,	786,
8,	1933,	4036,	7994,	1898,	174,	722,	1279,	1474,	1264,	2711,
9,	3972,	6797,	6781,	1622,	512,	992,	719,	1361,	1221,	4108,
10,	4432,	7297,	8226,	1780,	2094,	2561,	740,	1119,	1285,	4136,
11,	4303,	6038,	5344,	1531,	3139,	2734,	1230,	978,	1217,	2829,
12,	4667,	8568,	6227,	2108,	2631,	3060,	2013,	1096,	867,	1910,
13,	7062,	11600,	9880,	2288,	2308,	1535,	4297,	1331,	1397,	1380,
14,	6068,	7499,	10824,	2258,	2987,	2253,	3300,	1761,	1780,	1256,
15,	4412,	3174,	4049,	2506,	1875,	2182,	2162,	859,	1208,	1519,
16,	3282,	1698,	2105,	2137,	1514,	3336,	1454,	591,	531,	1091,
17,	2399,	1419,	9603,	1512,	1053,	1284,	757,	437,	1165,	745,
18,	1733,	1093,	6522,	677,	527,	734,	794,	674,	336,	775,
+gp,	2220,	15595,	19299,	9258,	6022,	3257,	2404,	2124,	3487,	5799,
0 TOTALNUM,	47006,	75563,	106004,	36011,	26021,	26336,	22871,	14695,	16450,	29079,
TONSLAND,	23494,	35070,	48727,	15590,	12866,	12721,	10284,	7749,	8462,	13616,
SOPCOF %,	99,	97,	100,	103,	100,	104,	100,	97,	101,	100,

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Table 6.6.

Run title : Arctic S. mentella (run: XSAKHN01/X01)

At 30/08/1999 14:28

Table 2	Catch weights at age (kg)			
YEAR,	1965,	1966,	1967,	1968,
AGE				
1,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,
6,	.1680,	.1680,	.1680,	.1680,
7,	.1830,	.1830,	.1830,	.1830,
8,	.2250,	.2250,	.2250,	.2250,
9,	.3110,	.3110,	.3110,	.3110,
10,	.3670,	.3670,	.3670,	.3670,
11,	.4320,	.4320,	.4320,	.4320,
12,	.5080,	.5080,	.5080,	.5080,
13,	.6110,	.6110,	.6110,	.6110,
14,	.6790,	.6790,	.6790,	.6790,
15,	.7530,	.7530,	.7530,	.7530,
16,	.8210,	.8210,	.8210,	.8210,
17,	.8720,	.8720,	.8720,	.8720,
18,	.9100,	.9100,	.9100,	.9100,
+gp,	.9990,	.9930,	1.0320,	1.0100,
0 SOPCOFAC,	1.0367,	1.0223,	1.0037,	.9372,

Table 2		Catch weights at age (kg)								
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
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,	1.0260,	1.0000,	1.0220,	.9770,	.9800,	1.0000,	1.0070,	1.0210,	1.0320,	1.0300,
0 SOPCOFAC,	.9489,	.9357,	.9849,	1.0143,	1.1784,	.9888,	.9146,	.9847,	.9515,	1.0130,

Table 6.6 continued.

Run title : Arctic S. mentella (run: XSAKHN01/X01)

At 30/08/1999 14:28

Table 2		Catch weights at age (kg)								
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
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,	.1070,	.1070,	.1020,	.1020,	.1020,	.1020,	.1020,	.1020,	.1440,	.1440,
7,	.1550,	.1550,	.1380,	.1380,	.1380,	.1050,	.1350,	.1200,	.1800,	.1800,
8,	.2000,	.2000,	.1880,	.1880,	.1880,	.1650,	.1670,	.1370,	.1950,	.1950,
9,	.2520,	.2520,	.2520,	.2520,	.2520,	.2120,	.2150,	.2180,	.2190,	.2090,
10,	.3100,	.3100,	.3100,	.3100,	.3100,	.2830,	.3030,	.3010,	.2880,	.2800,
11,	.3740,	.3740,	.3640,	.3640,	.3200,	.3380,	.3520,	.3530,	.3300,	.3330,
12,	.4720,	.4720,	.4400,	.4400,	.4000,	.3830,	.4200,	.4480,	.4390,	.3970,
13,	.5680,	.5680,	.5600,	.5600,	.4660,	.4380,	.4810,	.5100,	.5110,	.4680,
14,	.7150,	.7150,	.6800,	.6800,	.5630,	.5020,	.5640,	.5810,	.5640,	.5370,
15,	.8980,	.8980,	.8280,	.8280,	.7300,	.5660,	.6730,	.6480,	.6360,	.5850,
16,	.9340,	.9340,	.9060,	.9060,	.9920,	.7110,	.8090,	.8450,	.7720,	.7470,
17,	1.0240,	1.0240,	.9700,	.9700,	1.1260,	.8610,	1.0140,	.9480,	.8090,	.8080,
18,	1.0500,	1.0500,	1.0500,	1.0500,	1.1490,	.9660,	1.0690,	1.0560,	.9540,	.9010,
+gp,	1.1300,	1.1050,	1.1180,	1.1220,	1.2280,	1.2910,	1.1600,	1.2610,	1.1800,	1.0470,
0 SOPCOFAC,	.9966,	.9734,	.9503,	1.0022,	.9891,	1.0415,	1.0066,	1.0023,	.9976,	1.0000,

Table 2		Catch weights at age (kg)								
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0200,	.0200,	.0200,	.0200,	.0200,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0600,	.0600,	.0600,	.0600,	.0600,
4,	.0000,	.0000,	.0000,	.0000,	.0000,	.0500,	.0500,	.0500,	.0500,	.0500,
5,	.0000,	.0000,	.0000,	.0000,	.1300,	.0900,	.1000,	.1900,	.1400,	.1400,
6,	.1980,	.1400,	.1300,	.1900,	.1700,	.1600,	.1400,	.2000,	.1800,	.1400,
7,	.2020,	.1460,	.1800,	.2200,	.2300,	.2200,	.1600,	.2000,	.2100,	.1900,
8,	.2420,	.1580,	.2100,	.2600,	.2500,	.2400,	.1900,	.2500,	.2500,	.2300,
9,	.2820,	.2060,	.2700,	.2800,	.2800,	.3000,	.2100,	.3100,	.2900,	.2800,
10,	.3310,	.2800,	.3400,	.3100,	.3300,	.3400,	.2800,	.4200,	.3300,	.3300,
11,	.3780,	.3550,	.3500,	.3300,	.3800,	.3700,	.3200,	.4400,	.3800,	.3900,
12,	.4560,	.4710,	.4200,	.3800,	.4400,	.4000,	.3700,	.4700,	.4600,	.4300,
13,	.5140,	.5430,	.4600,	.4600,	.4700,	.4400,	.4100,	.5900,	.4800,	.4800,
14,	.5680,	.6110,	.5100,	.4300,	.5000,	.4500,	.4700,	.6700,	.5100,	.5400,
15,	.5890,	.6250,	.5800,	.4300,	.5700,	.4900,	.5300,	.6900,	.5500,	.6600,
16,	.6720,	.7220,	.5900,	.4500,	.5800,	.5500,	.5800,	.7100,	.6000,	.6100,
17,	.7080,	.5760,	.5800,	.5200,	.6200,	.5800,	.6600,	.7400,	.6600,	.6500,
18,	.7740,	.6590,	.5900,	.5700,	.6500,	.6700,	.7100,	.7400,	.6500,	.6600,
+gp,	.8380,	.6590,	.7000,	.6700,	.6620,	.7900,	.8060,	.8480,	.7870,	.7530,
0 SOPCOFAC,	.9915,	.9668,	1.0032,	1.0291,	1.0022,	1.0365,	.9987,	.9706,	1.0092,	1.0020,

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Table 6.7.

Run title : Arctic S. mentella (run: XSAKHN01/X01)

At 30/08/1999 14:49

Table 5	Proportion mature at age			
YEAR,	1965,	1966,	1967,	1968,
AGE				
1,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0000,	.0000,
5,	.0000,	.0000,	.0000,	.0000,
6,	.0000,	.0000,	.0000,	.0000,
7,	.0000,	.0000,	.0000,	.0000,
8,	.0300,	.0300,	.0300,	.0300,
9,	.0600,	.0600,	.0600,	.0600,
10,	.0800,	.0800,	.0800,	.0800,
11,	.2200,	.2200,	.2200,	.2200,
12,	.3600,	.3600,	.3600,	.3600,
13,	.5500,	.5500,	.5500,	.5500,
14,	.7200,	.7200,	.7200,	.7200,
15,	.8500,	.8500,	.8500,	.8500,
16,	.8800,	.8800,	.8800,	.8800,
17,	.9500,	.9500,	.9500,	.9500,
18,	.9700,	.9700,	.9700,	.9700,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5	Proportion mature at age									
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
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,	.0090,	.0090,	.0090,
8,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0160,	.0160,	.0160,
9,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.0600,	.1010,	.1010,	.1010,
10,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.0800,	.1950,	.1950,	.1950,
11,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.2200,	.3000,	.3000,	.3000,
12,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.5400,	.5400,	.5400,
13,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.5500,	.7020,	.7020,	.7020,
14,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.8620,	.8620,	.8620,
15,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.9660,	.9660,	.9660,
16,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.8800,	.9940,	.9940,	.9940,
17,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	1.0000,	1.0000,	1.0000,
18,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	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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Run title : Arctic S. mentella (run: XSAKHN01/X01)

At 30/08/1999 14:49

Table 5	Proportion mature at age									
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
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,	.0050,	.0000,	.0000,	.0000,	.0000,
8,	.0160,	.0160,	.0160,	.0160,	.0160,	.0080,	.0000,	.0000,	.0000,	.0000,
9,	.1010,	.1010,	.1010,	.1010,	.1010,	.0570,	.0100,	.0340,	.0450,	.0830,
10,	.1950,	.1950,	.1950,	.1950,	.1950,	.1680,	.0790,	.1130,	.0760,	.0950,
11,	.3000,	.3000,	.3000,	.3000,	.3000,	.3020,	.2180,	.2380,	.1780,	.1940,
12,	.5400,	.5400,	.5400,	.5400,	.5400,	.5340,	.4530,	.5070,	.4300,	.4620,
13,	.7020,	.7020,	.7020,	.7020,	.7020,	.7210,	.7810,	.7940,	.7350,	.6890,
14,	.8620,	.8620,	.8620,	.8620,	.8620,	.8790,	.8460,	.8720,	.8270,	.8010,
15,	.9660,	.9660,	.9660,	.9660,	.9660,	.9520,	.9000,	.9120,	.8850,	.8620,
16,	.9940,	.9940,	.9940,	.9940,	.9940,	.9850,	.9250,	.9500,	.9580,	1.0000,
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 continued.

Table 5 YEAR,	Proportion mature at age									
	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
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,	.0180,	.0210,
8,	.0000,	.0150,	.0150,	.0150,	.0000,	.0000,	.0000,	.0000,	.0000,	.0140,
9,	.0040,	.0500,	.0550,	.0620,	.0230,	.0230,	.0000,	.0140,	.0270,	.0000,
10,	.0780,	.1260,	.1320,	.1330,	.1130,	.1130,	.0550,	.0930,	.1300,	.0740,
11,	.2010,	.2050,	.2020,	.2240,	.2670,	.2670,	.1110,	.2120,	.3120,	.1710,
12,	.4860,	.5060,	.4810,	.4110,	.4380,	.4380,	.3680,	.3250,	.2810,	.2760,
13,	.6530,	.6230,	.5450,	.5390,	.5740,	.5740,	.5870,	.5770,	.5660,	.6220,
14,	.7670,	.7260,	.7410,	.7740,	.8430,	.8430,	.6960,	.7160,	.7360,	.7140,
15,	.8320,	.8010,	.8500,	.8880,	.9510,	.9510,	.7290,	.7800,	.8310,	.8710,
16,	1.0000,	1.0000,	.9620,	.9460,	.9200,	.9200,	.7890,	.8740,	.9580,	.9190,
17,	1.0000,	1.0000,	1.0000,	.9920,	.9890,	.9890,	1.0000,	.9750,	.9500,	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,

1

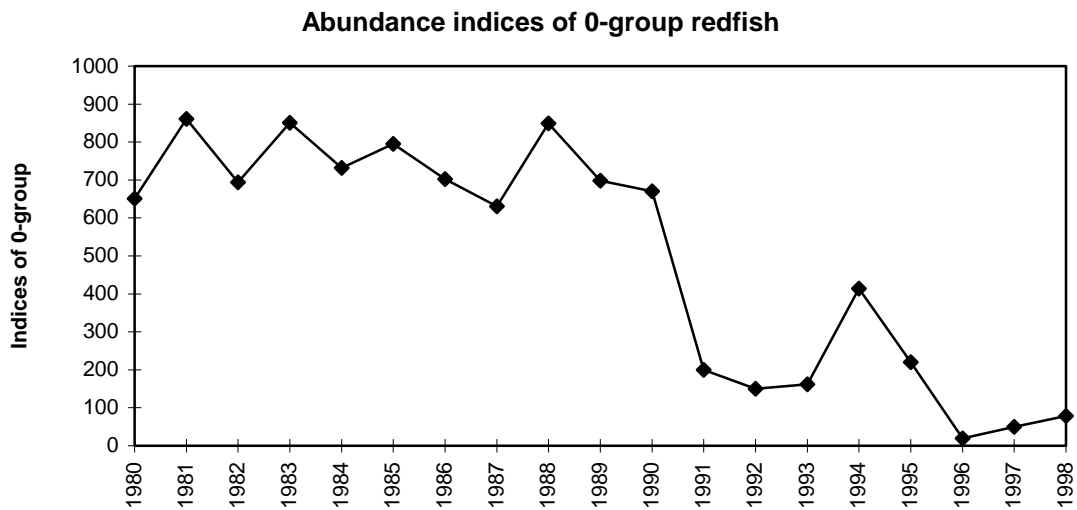


Figure 6.1. Abundance indices of 0-group redfish (believed to be mostly *S.mentella*) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-1998.

Mean catch per 1-trawling of young *Sebastes mentella*

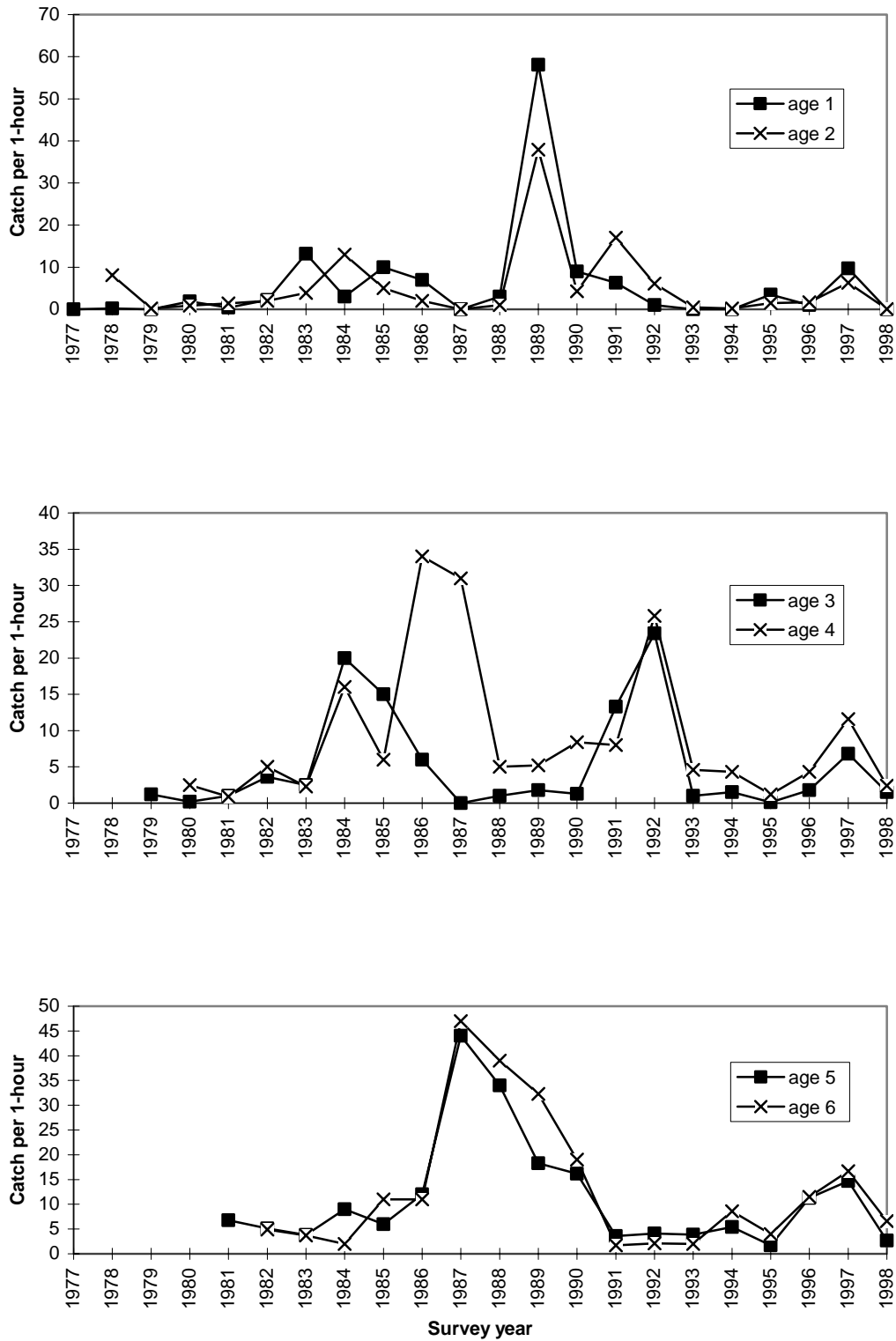


Figure 6.2. Catch (numbers of specimens) per hour trawling of different ages of *Sebastes mentella* in the Russian groundfish survey in the Barents Sea and Svalbard areas (ref. Table D4).

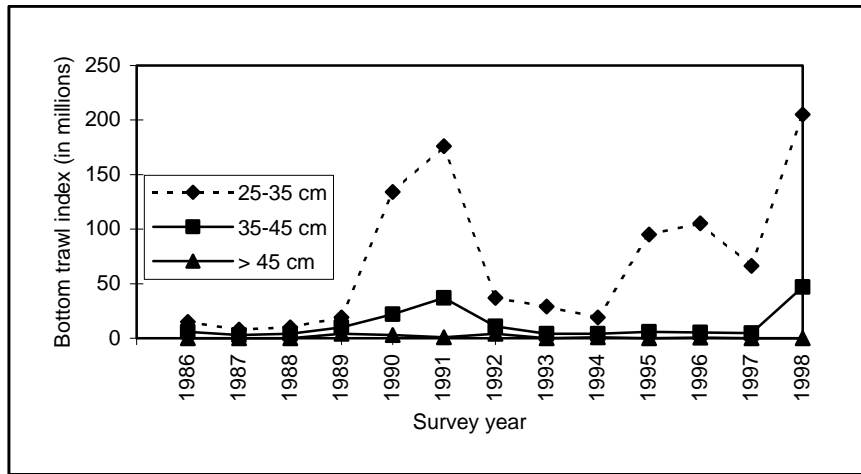
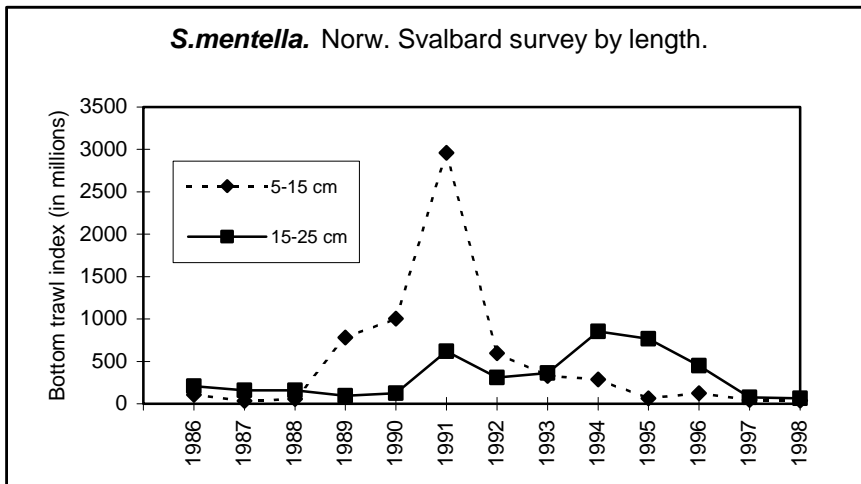
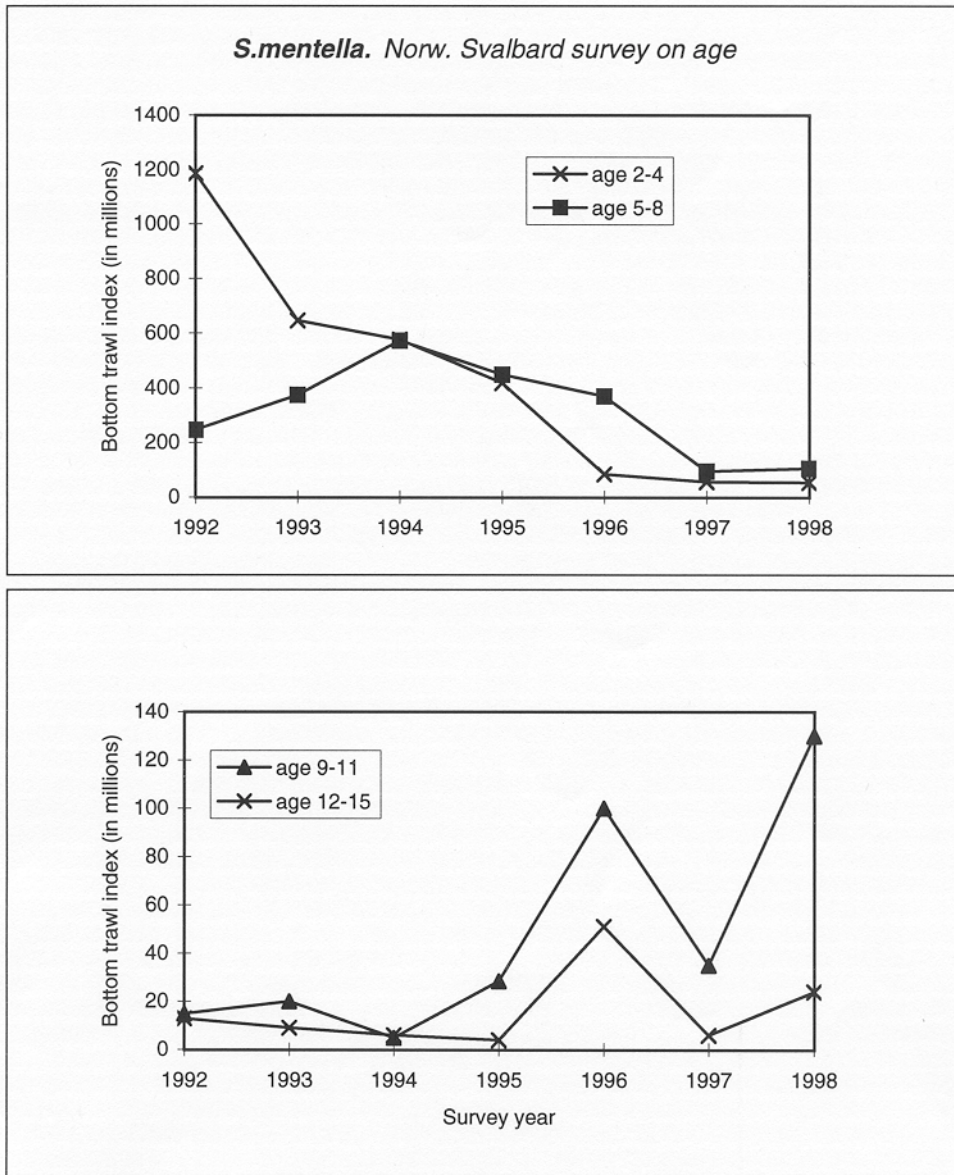


Figure 6.3a. *Sebastes mentella*. Abundance indices (on length) from the Norwegian bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1986-1998 (ref. Table D5a).

Figure 6.3b



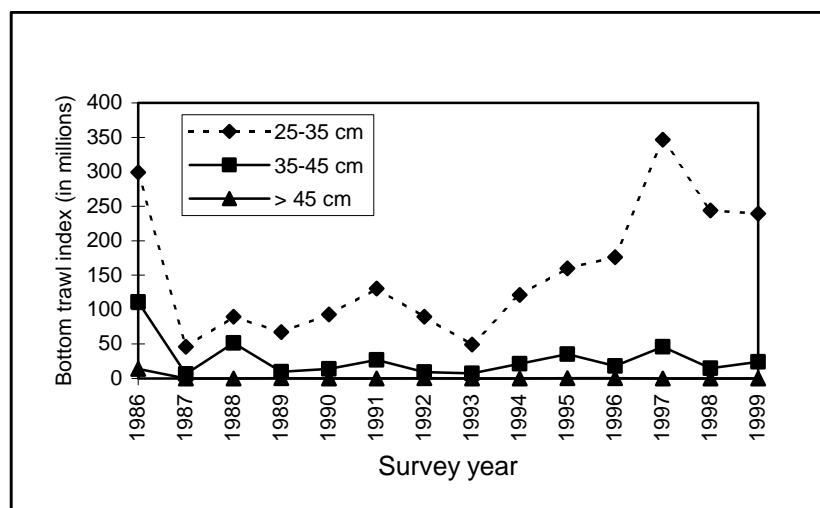
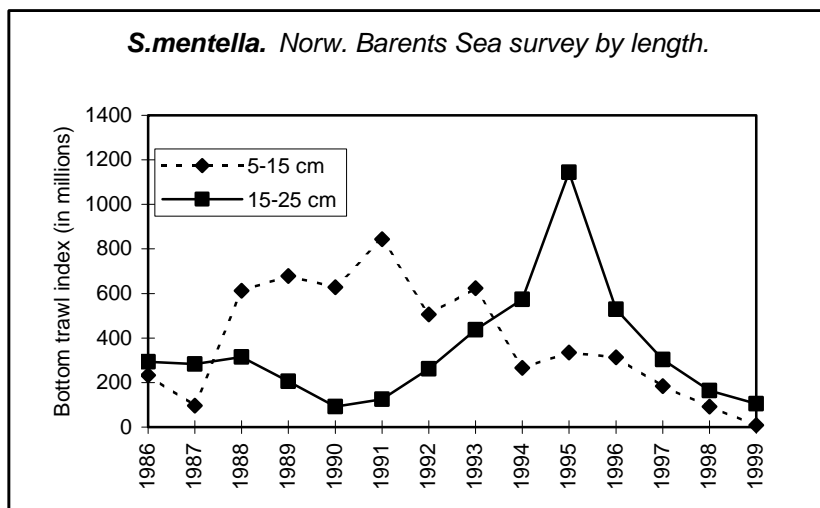


Figure 6.4a. *Sebastes mentella*. Abundance indices (on length) from the Norwegian bottom trawl survey in the Barents Sea in winter 1986-1999 (ref. Table D6a).

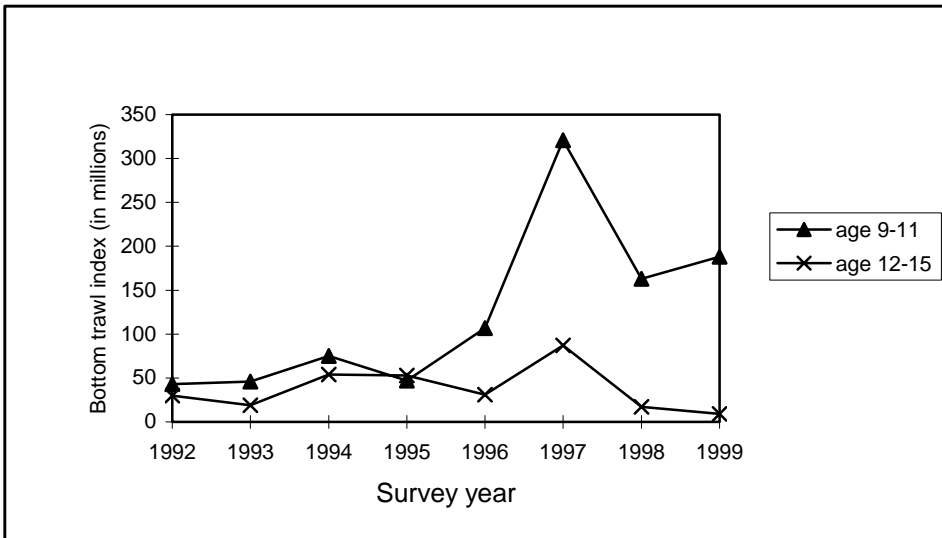
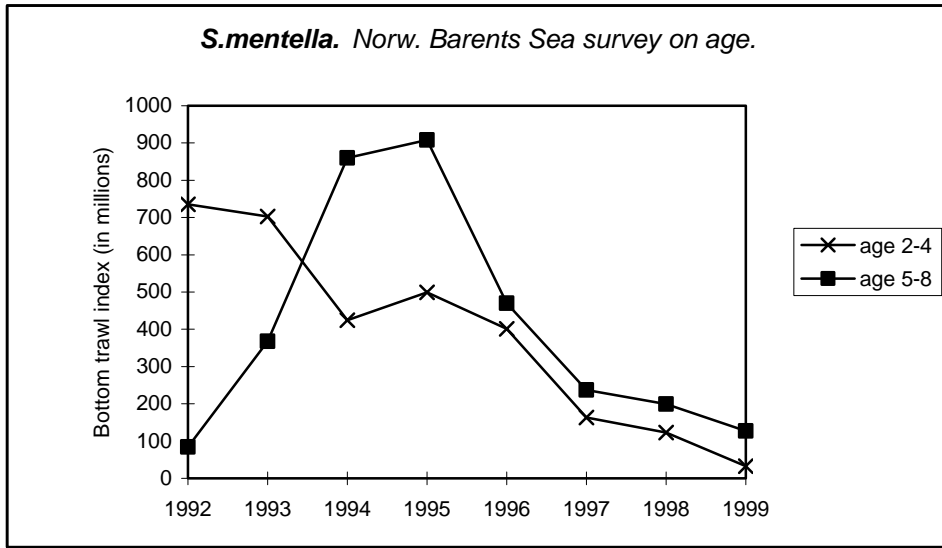


Figure 6.4b. *Sebastes mentella*. Abundance indices (on age) from the Norwegian bottom trawl survey in the Barents Sea in winter 1992-1999 (ref. Table D6b).

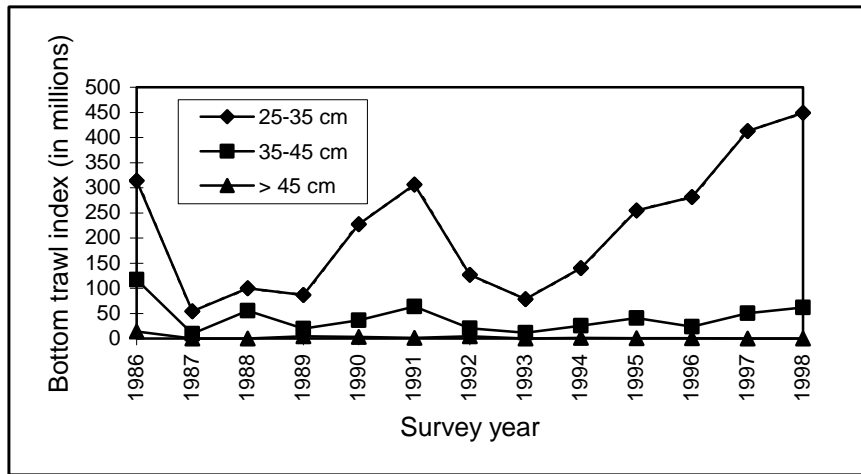
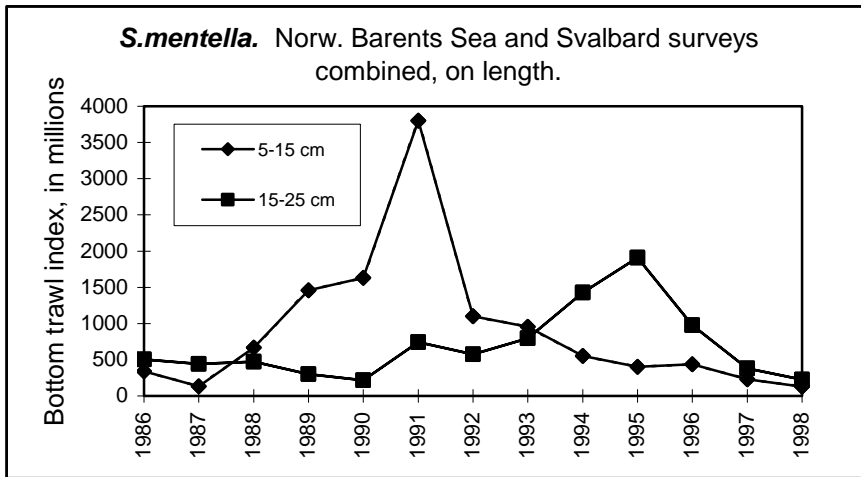


Figure 6.5a. *Sebastes mentella*. Abundance indices (on length) when combining the Norwegian bottom trawl surveys 1986-1998 at Svalbard (summer/fall) and in the Barents Sea (winter).

Figure 6.5b

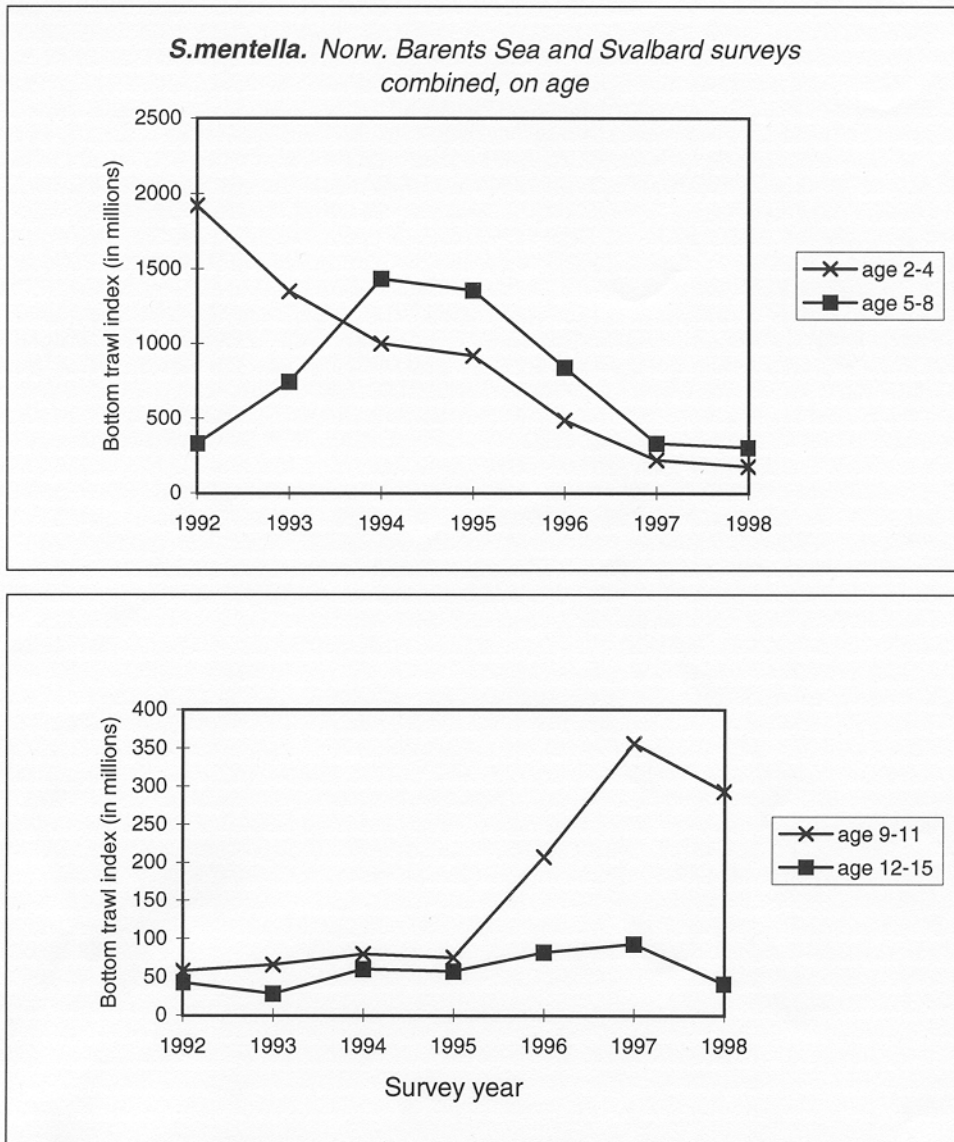


Table D1. REDFISH in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I, Divisions IIa and IIb combined as officially reported to ICES.

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	530	614	-	-	-	23,451	-	977	4,335	16	479	3	31,773
1993	8 ³	4	152	92	685	15	-	-	-	18,319	-	1,040	7,573	65	734	1	29,517
1994	-	28	26	77	1026	6	4	3	-	21,466	-	985	6,220	34	259	13	30,841
1995	-	-	30	748	692	7	1	5	1	16,162	-	936	6,985	67	252	13	25,899
1996	-	-	42 ³	746	618	37	-	2	-	20,533 ²	-	523	1,641	408	305	121	24,976
1997	-	-	28 ³	1,011	538	39 ²	-	11	-	18,808 ²	1	535	4,556	228 ²	235	29	26,019
1998 ¹	-	-	98 ³	567	233 ²	47 ³	-	28 ³	-	26,225 ²	12	131	5,278	152		304 ⁶	33,075

¹Provisional figures.

²Working Group figure.

³As reported to Norwegian authorities.

⁴Includes former GDR prior to 1991.

⁵USSR prior to 1991.

⁶Total for England, Wales and Scotland.

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	Netherlands	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	111	-	500 ²	134	6	1,342
1990	+	41	25	554	47	-	483 ²	369	6	1,525
1991	5	29	144	914	213	2	415 ²	43	38	1,803
1992	4	22	23	1,960	170	1	416	65	122	2,783
1993	28	14	4	1,211	33	1	373	138	71	1,873
1994	4	13	1	863	324	8	371	38	66	1,688
1995	16	12	65	1,120	80	16	297	46	241	1,893
1996	20	20	1	932	74	41	390 ¹	37	146	1,660
1997	16	23	-	1,049	45	53	612 ¹	21	528	2,347
1998 ¹	2	27	n.a.	570	370	21	1,113		748 ³	2,851

¹ Provisional figures.

² Working Group figure.

³ Total for England, Scotland and Wales.

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		German Dem.Rep.		Total effort	
	catch/hour trawling (t/hr)		catch/day (t/day)		(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	-	-	-	12,866
1994	-	0.74	-	-	-	17,191
1995	-	0.80	-	-	-	12,855
1996 ³	BMRT ²	0.80	-	-	-	9,686
1997	1.3	0.80	-	-	-	10,578
1998	0.8	1.00	-	-	-	13,616

¹Side trawlers, 800-1000 HP.

²Stern trawlers. Data from spring fishery only.

³Provisional 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	1.1
1988	4.0	58.1	4.3	13.3	25.8	3.9	8.6	11.2	2.8	4.1	3.1	-
1989	8.7	9.0	17.0	23.4	4.6	5.4	4.0	6.6	6.8	3.9	-	-
1990	2.5	6.3	6.1	1.0	4.3	1.7	11.5	12.8	5.8	-	-	-
1991	0.3	1.0	0.5	1.5	1.2	11.3	16.7	9.1	-	-	-	-
1992	0.6	+	0.2	0.1	4.3	14.7	6.6	-	-	-	-	-
1993 ¹	-	+	1.5	1.8	11.6	2.7	-	-	-	-	-	-
1994	0.3	3.5	1.7	6.8	2.4	-	-	-	-	-	-	-
1995	2.8	1.0	6.3	1.5	-	-	-	-	-	-	-	-
1996 ²	+	9.7	0.1	-	-	-	-	-	-	-	-	-
1997 ³	1.0	+	-	-	-	-	-	-	-	-	-	-
1998	+	-	-	-	-	-	-	-	-	-	-	-

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 1986-1998 (numbers in millions).

Year	Length group (cm)									Total
	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	
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	4	284	613	242	10	9	2	2	1	1,165
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
1998	+	37	35	28	132	73	45	2	+	353

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. Norwegian bottom trawl survey indices (**on age**) in the Svalbard area (Division IIb) in summer/fall 1992-1998 (numbers in millions).

Year	Age														Total
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
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
1998	+	26	28	14	10	13	69	66	49	15	1	6	15	5	317

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 1986-1999 (numbers in millions). The area coverage was extended from 1993.

Year	Length group (cm)									Total
	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	
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
1999	2.2	6.8	67.6	36.8	167.4	71.9	21.0	3.1	0.1	376.8

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.

Year	Age														Total
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
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
1999	1	+	32	43	30	24	30	81	79	28	2	1	6	+	357

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 1992-1999. Abundance indices in millions.

Year	Period of survey	Age																		Total				Area of survey in n.m. ²
		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	
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
1999	Apr-May	11	1	9	14	57	75	63	73	31	25	17	15	11	8	3	1	1	1	415	134	120	55	19333

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	1999
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.021	0.000
8	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000	0.014	0.016
9	0.006	0.083	0.000	0.000	0.012	0.139	0.013	0.033	0.000	0.027	0.000	0.059
10	0.017	0.182	0.028	0.074	0.131	0.174	0.092	0.133	0.055	0.130	0.074	0.110
11	0.132	0.278	0.125	0.178	0.300	0.138	0.169	0.364	0.111	0.312	0.171	0.333
12	0.377	0.616	0.297	0.473	0.688	0.358	0.396	0.480	0.368	0.281	0.276	0.579
13	0.822	0.821	0.562	0.684	0.714	0.470	0.452	0.696	0.587	0.566	0.622	0.689
14	0.795	0.926	0.760	0.716	0.824	0.637	0.761	0.925	0.696	0.736	0.714	0.788
15	0.862	0.938	0.855	0.794	0.848	0.762	0.939	0.962	0.729	0.831	0.871	0.813
16	0.875	1.000	1.000	1.000	1.000	1.000	0.886	0.953	0.789	0.958	0.919	0.903
17	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.977	1.000	0.950	1.000	0.923
18	1.000	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	18	1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
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 = 623

Dependent Variable: CPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	32	42.03596900	1.31362403	3.22	0.0001
Error	590	240.56687113	0.40774046		
Corrected Total	622	282.60284013			
	R-Square	C.V.	Root MSE	CPUE Mean	
	0.148746	88.38934	0.63854558	0.72242376	

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	17	12.86072458	0.75651321	1.86	0.0193
AREA	4	19.39238154	4.84809538	11.89	0.0001
MONTH	11	9.78286288	0.88935117	2.18	0.0141

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	17	11.63484042	0.68440238	1.68	0.0425
AREA	4	21.24018480	5.31004620	13.02	0.0001
MONTH	11	9.78286288	0.88935117	2.18	0.0141

Parameter	Estimate	T for H0: Parameter=0	Pr > T	Std Error of Estimate
INTERCEPT	0.4799938648 B	3.00	0.0028	0.15998490
YEAR	1981	-0.0782939274 B	-0.49	0.16053300
	1982	0.0582314944 B	0.32	0.18303276
	1983	-0.0328955296 B	-0.20	0.16747817
	1984	0.0615355080 B	0.42	0.14645137
	1985	-0.1527085624 B	-1.10	0.13916856
	1986	0.0671856790 B	0.48	0.14003805
	1987	-0.0176887764 B	-0.12	0.14286001
	1988	0.1459532360 B	0.48	0.30696051
	1989	-0.0944499770 B	-0.62	0.15204891
	1990	0.3768922531 B	2.57	0.14657835
	1991	0.2810619762 B	1.92	0.14612320
	1992	-0.0212227585 B	-0.14	0.15173601
	1993	0.0856310847 B	0.54	0.15733224
	1994	0.2111341218 B	1.35	0.15614076
	1995	0.0040144309 B	0.02	0.16374482
	1996	0.1231861714 B	0.80	0.15462527
	1997	0.0370353304 B	0.25	0.14815039
	1998	0.0000000000 B	.	.
AREA	3	0.5278747323 B	5.86	0.09000619
	4	0.2285879495 B	2.64	0.08647653
	5	0.1094476746 B	1.33	0.08206642
	6	-0.0329973339 B	-0.37	0.08853981
	7	0.0000000000 B	.	.
MONTH	1	0.1490428288 B	1.00	0.14834343
	2	0.2428485209 B	1.71	0.14233541

Table D9 Continued

3	0.2127312534 B	1.54	0.1231	0.13777045
4	0.1207083403 B	0.91	0.3654	0.13326490
5	0.1254201089 B	0.94	0.3484	0.13363320
6	-.0210893028 B	-0.15	0.8785	0.13795056
7	-.1364592982 B	-0.95	0.3447	0.14430537
8	-.0256709111 B	-0.18	0.8586	0.14406277
9	-.1116287285 B	-0.84	0.4011	0.13286117
10	-.0758583790 B	-0.57	0.5705	0.13365183
11	-.1137053795 B	-0.82	0.4100	0.13792596
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.

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General Linear Models Procedure

Level of YEAR	N	-----CPUE-----	
		Mean	SD
1981	29	0.57551724	0.46942660
1982	19	0.72631579	0.61012030
1983	25	0.63800000	0.39518983
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	33	0.79242424	0.48058578
1997	39	0.66358974	0.45331230
1998	36	0.61750000	0.47564317

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	1.17	17688
1982	2,014	12.3	1.31	12615
1983	1,588	8.3	1.22	12873
1984	3,960	14.0	1.31	21574
1985	3,086	10.5	1.10	27142
1986	4,502	14.9	1.32	22918
1987	2,168	9.0	1.23	19527
1988	4,349	16.8	1.40	18550
1989	3,044	13.1	1.16	20084
1990	3,589	12.8	1.63	17251
1991	4,943	26.0	1.53	12431
1992	2,265	14.0	1.23	13164
1993	1,426	8.6	1.34	12460
1994	1,241	6.8	1.46	12395
1995	928	5.9	1.25	12446
1996	1,831	9.0	1.37	12539
1997	1,313	7.5	1.29	13635
1998 ²	1,779	9.1	1.25	15558

¹ Only including days with more than 50% *S. marinus* in the catches, and analysed by a GLM-analysis.

²Provisional figures.

Table D11a. *Sebastes marinus*. Abundance indices (**on length**) from the bottom trawl surveys in the Barents Sea in the winter 1986-1999 (numbers in millions). The area coverage was extended from 1993.

Year	Length group (cm)									Total
	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	
1986	3.0	11.7	26.4	34.3	17.7	21.0	12.8	4.4	2.6	133.9
1987	7.7	12.7	32.8	7.7	6.4	3.4	3.8	3.8	4.2	82.5
1988	1.0	5.6	5.5	14.2	12.6	7.3	5.2	4.1	3.7	59.2
1989	48.7	4.9	4.3	11.8	15.9	12.2	6.6	4.8	3.0	112.2
1990	9.2	5.3	6.5	9.4	15.5	14.0	8.0	4.0	3.4	75.3
1991	4.2	13.6	8.4	19.4	18.0	16.1	14.8	6.0	4.0	104.5
1992	1.8	3.9	7.7	20.6	19.7	13.7	10.5	6.6	5.8	90.3
1993	0.1	1.2	3.5	6.9	10.3	14.5	12.5	8.6	6.3	63.9
1994	0.7	6.5	9.3	11.7	11.5	19.4	9.1	4.4	2.8	75.4
1995	0.6	5.0	13.1	11.5	9.1	15.9	17.2	10.9	4.7	88.0
1996	+	0.7	3.5	6.4	9.4	11.7	16.6	7.9	3.9	60.1
1997 ¹	-	0.5	1.3	2.7	6.9	21.4	28.2	8.5	3.3	72.7
1998 ¹	0.1	3.9	2.0	7.4	45.9	25.3	13.2	7.0	2.3	107.1
1999	0.2	0.9	2.1	4.0	4.6	6.4	6.0	5.3	3.5	33.0

¹ - Adjusted indices to account for not covering the Russian EEZ in Subarea I.

Table D11b. *Sebastes marinus* in Sub-areas I and II. Norwegian bottom trawl indices (**on age**) from the annual Barents Sea survey in February (numbers in thousands). The area coverage was extended from 1993 onwards.

Year	Age												Total	
	3	4	5	6	7	8	9	10	11	12	13	14		15
1992	2,295	4,261	10,760	2,043	1,474	13,178	4,230	6,302	8,251	3,751	3,865	3,064	3,568	67,042
1993	468	1,218	1,424	2,020	979	5,048	2,968	4,230	2,142	4,634	3,338	2,951	9,148	40,568
1994	2,951	4,485	2,573	3,801	8,338	3,254	1,297	7,231	6,443	248	10,192	6,341	2,612	59,766
1995	2,540	7,450	6,090	7,150	5,820	6,590	5,670	2,000	4,440	6,500	4,320	5,330	6,030	69,930
1996	310	1,300	2,340	3,520	3,660	8,720	5,650	3,960	6,590	5,730	6,230	4,070	2,950	55,030
1997 ¹	190	80	360	1,320	2,530	5,370	10,570	6,840	5,810	7,390	8,790	9,740	1,980	60,980
1998 ¹	2,380	1,930	850	660	1,140	7,090	32,750	16,580	14,280	5,190	8,790	2,730	2,560	96,920
1999	737	916	1,246	3,469	1,650	1,826	1,679	3,084	2,371	2,953	3,837	2,132	1,979	27,879

Table D12a. *Sebastes marinus* in Division IIb. Abundance indices (**on length**) from the bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1985-1998 (numbers in thousands).

Year	Length group (cm)									Total
	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	
1985 ¹	158	1,307	795	1,728	2,273	1,417	311	142	194	8,325
1986 ¹	200	2,961	1,768	547	643	1,520	639	467	196	8,941
1987 ¹	124	1,343	1,964	1,185	1,367	652	352	29	44	7,060
1988 ¹	520	1,001	1,953	1,609	684	358	158	68	95	6,450
1989	197	1,629	2,963	2,374	1,320	846	337	323	104	10,100
1990	1,673	3,886	4,478	4,047	2,972	1,509	365	140	122	19,185
1991	127	5,371	5,821	9,171	8,523	4,499	1,531	982	395	36,420
1992	1,689	10,228	8,858	5,330	13,960	12,720	4,547	494	346	58,172
1993	205	10,160	9,078	5,855	7,071	4,327	2,088	1,552	948	41,284
1994	51	3,340	5,883	4,185	3,922	3,315	1,021	845	423	22,985
1995	470	2,000	9,100	5,070	3,060	2,400	1,040	920	780	24,840
1996	80	130	1,260	2,480	1,030	480	550	990	400	7,400
1997	40	810	1,980	5,470	5,560	2,340	590	190	450	17,430
1998	210	2,698	1,741	4,620	4,053	1,761	535	545	241	16,403

¹ - Old trawl equipment (bobbins gear and 80 meter sweep length)

Table D12b. *Sebastes marinus* in Sub-areas I and II. Norwegian bottom trawl survey indices (**on age**) in the Svalbard area (Division IIb) in summer/fall 1992-1998 (numbers in thousands).

Year	Age														Total
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1992	284	12,378	5,576	2,279	371	2,064	3,687	5,704	9,215	6,413	1,454	1,387	696	22	51,530
1993	32	10,704	5,710	5,142	1,855	1,052	1,314	3,520	2,847	2,757	2,074	1,245	844	119	39,215
1994	429	1,150	3,418	2,393	1,723	1,106	1,714	1,256	1,938	1,596	2,039	484	550	319	20,115
1995	600	1,600	6,400	5,100	1,800	2,200	1,800	700	700	400	700	500	400	500	23,400
1996	40	110	+	560	1,050	940	930	400	1,050	280	320	590	160	70	6,500
1997	320	490	+	480	1,500	6,950	2,720	1,680	800	1,310	550	30	+	120	16,950
1998	210	1,817	881	202	1,555	2,187	4,551	1,913	1,010	797	49	264	73	187	15,696

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 1999 (Tables 7.1–7.5, 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 17,000 t in the years 1992–1997. The provisional total landings figure for *S. marinus* in 1998 is 19,458 t. This is 2,458 t more than expected by last year's Working Group.

Information describing the splitting of the redfish landings by species and area is given in Section 6.1.2. The time series of *S. marinus* landings are given in Table 7.5 and shows a longterm mean of 17,600 t.

7.1.3 Expected landings in 1999

On the basis of reports from the first half of 1999, the Norwegian landings in 1999 are expected to be around 15,000 t. The Russian catches are expected to be 1,500 t. On this basis landings of 17,500 t are expected in 1999, which is close to the longterm mean.

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 Working Group Table D9). The CPUEs have been standardised and scaled to a certain area (Norwegian statistical area 03, i.e. Finnmark) and month (February, 02). 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 was observed in 1991-1997 compared to the years before. The year, area and month effects are all significant, but the differences in the standardized CPUEs from year to year were not significant 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 1998 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 7.7).

Catch at age data for 1993-1997 were revised. Age composition data for 1998 were only provided by Norway, accounting for 87% of the total landings. Russian catch-at-length from each Sub-area were converted to catch-at-age by using the Norwegian age-length key for trawlers in each Sub-area. In Division IIa, also German catch-at-length was converted to age by using the Norwegian age-length key for trawl in Div. IIa. 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 7.8).

Weight-at-age data for ages 7–24+ were available from the Norwegian landings in 1998. 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 7.6a,b, 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 1986–99 in fishing depths of < 100–500 m. Data on length for the years 1986–1999 are shown in Table D11a and Fig 7.2a. Data disaggregated on age for the years 1992–99 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 1985–98 in fishing depths of < 100–500 m. Data disaggregated on age only for the years 1992–98 (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.

- 3) Catch rates (numbers/nautical mile) and acoustic indices of *Sebastes marinus* from the Norwegian Coastal and Fjord survey in 1995–98 from Finnmark to Møre (Table 7.6a,b).

Both the Barents Sea and the Svalbard bottom trawl surveys show the abundance indices over the commercial size range (> 30 cm) to be relatively stable at least during the 1990's. Lack of pre-recruit sizegroups may be a sign of poor recruitment although the Svalbard survey shows an increase in numbers of the smaller fish in 1998. This should be carefully monitored in the future since the more abundant *S. mentella* (~10 times) may obscure significant changes in *S. marinus* indices, especially for smaller fish less than 12–15 cm where the species identification is sometimes difficult.

Results from the Norwegian Coastal and Fjord survey confirm poor recruitment and also show an overall reduction in the abundance of this species irrespective of fish size.

7.3 Results of the Assessment

All newly available information confirm last year evaluation of the stock situation.

Available data from both the open sea 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 (slightly increasing) and an annual catch of about 17,000 t during the last six years. The survey covering the near-coast and fjord resources shows an overall reduction in abundance from 1995 to 1998, irrespective of size. 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 expected in the near future.

Possible alternative methods to conventional catch-at-age analyses, such as the use of stock-production models, were discussed. Since no significant year effect was observed in the commercial CPUEs, a surplus production analysis was considered to be of little value at this stage.

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 assessment indicates that the commercial stock has been relatively stable since about 1981. However, the stock is expected to decline over the next several years as a series of poor year-classes recruit to the fishery. In this regard, it is recommended that a management plan consistent with the precautionary approach be developed and implemented as a prerequisite to continued fishing.

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. **Error! Bookmark not defined.**

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	-	-	-	13,137	77	1,313	8	441	1	16,651
1994	22	697 ¹	1,008	5	4	-	-	14,955	90	1,199	4	135	1	18,120
1995	27	732 ¹	517	5	1	1	1	13,516	9	639	-	159	9	15,616
1996	38	671 ¹	499	34	-	-	-	14,806	55	716	81	229	98	17,227
1997	11	974	457	23	-	5	-	14,239	61	1,584	18	164	22	17,558
1998 ¹	78	494	127	33	-	18	-	16,861	6	1,632	34		170 ⁴	19,458

¹ Provisional figures.

² Includes former GDR prior to 1991.

³ USSR prior to 1991.

⁴ Total for England, Wales and Scotland.

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	-	-	-	1,178	330	-	-	1,532
1994	12 ²	72	-	4	1,607	109	-	-	1,804
1995	19 ²	1 ²	-	1 ²	1,947	201	1 ²	-	2,170
1996	7 ²	-	-	-	2,245	131	3 ²	-	2,386
1997	3	-	5 ²	-	2,643	160	2 ²	-	2,813
1998 ¹	-	5 ²	-	-	2,158	308	-	31 ^{2,6}	2,502

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.

⁶ Total for England, Wales and Scotland.

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	-	-	11,959	77 ²	940	-	431 ²	1 ²	14,881
1994	10 ²	697 ²	654 ²	5 ²	-	-	13,330	90 ²	1,030	-	129 ²	-	15,945
1995	8 ²	732 ²	328 ²	5 ²	1 ²	1	11,466	2 ²	405	-	158 ²	9 ²	13,115
1996	27 ²	671 ²	448 ²	34 ²	-	-	12,529	51 ²	449	5 ²	223 ²	98 ²	14,535
1997	8 ²	974 ²	438	18 ²	5 ²	-	11,558	61 ²	1,199	18 ²	162 ²	22 ²	14,463
1998 ¹	78 ²	494 ²	117 ²	33 ²	18 ²	-	14,675	6 ²	1,078	34 ²	136 ^{2,6}		16,669

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.

⁶ Total for England, Wales and Scotland.

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 E & W	UK Scotland	Total
1986	-									+
1987 ⁴	-	1,533	-	-	-	-	-	-	-	1533
1988				No species specific data presently available						
1989	-	-	-	66	-	242	-	-	-	308
1990	-	-	1 ²	210	-	1,157	-	-	-	1368
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	-	103	7	33	-	-	-	330
1996	4	51 ²	-	32	5	136	76 ²	3 ²	-	307
1997	-	20	-	37	-	225	-	-	-	282
1998 ¹	-	10 ²	-	28	-	246	-		3 ^{2,7}	287

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.

⁷ Total for England, Wales and Scotland.

Table 7.5 *Sebastes marinus* in Sub-areas I and II.
Total international landings 1908-1998 (thousand tons)

Year	Landings '000 t	Year	Landings '000 t
1908	0.65	1957	51.61
1909	1.00	1958	33.12
1910	1.03	1959	28.07
1911	1.01	1960	31.77
1912	1.01	1961	26.73
1913	0.81	1962	22.82
1914	1.14	1963	28.10
1915	1.31	1964	26.55
1916	1.46	1965	24.31
1917	1.16	1966	25.63
1918	1.11	1967	17.73
1919	1.51	1968	13.35
1920	1.17	1969	24.07
1921	1.83	1970	12.82
1922	1.47	1971	13.82
1923	1.94	1972	17.73
1924	2.21	1973	21.44
1925	2.72	1974	27.27
1926	3.19	1975	39.13
1927	4.47	1976	48.58
1928	1.95	1977	39.51
1929	5.28	1978	31.74
1930	5.29	1979	26.48
1931	5.88	1980	23.41
1932	6.10	1981	20.83
1933	9.59	1982	16.37
1934	15.86	1983	19.26
1935	17.69	1984	28.38
1936	21.03	1985	29.48
1937	34.59	1986	30.20
1938	39.17	1987	24.08
1939	21.87	1988	25.91
1940	2.29	1989	23.22
1941	1.68	1990	28.08
1942	1.43	1991	19.04
1943	1.02	1992	16.19
1944	0.92	1993	16.65
1945	0.56	1994	18.12
1946	3.57	1995	15.62
1947	14.88	1996	17.23
1948	20.00	1997	17.56
1949	22.36	1998	19.46
1950	25.56		
1951	45.30		
1952	56.17		
1953	34.83		
1954	35.78	average	17.62
1955	35.47		
1956	43.38		

Table 7.6. a) Catch rate (numbers/nautical mile) and **b)** acoustic index of *Sebastes marinus* from the Norwegian Coastal Surveys in 1995-98, within 5-cm length-groups and six sub-areas. TT: Total number of trawls; TS: Number of trawl hauls catching *Sebastes marinus*; N: Number *Sebastes marinus* measured.

a. Areas 00 and 03-07				
Length (cm)	1995	1996	1997	1998
5-9	71	59	7	0
10-14	109	123	21	0
15-19	40	150	33	6
20-24	45	228	103	11
25-29	54	185	214	19
30-34	93	225	109	20
35-39	201	353	125	78
40-44	138	172	136	67
45-49	18	54	33	13
50-54	2	1	2	2
55-59	1	0	1	0
60-64	0	0	1	0
TT	106	97	109	102
TS	66	67	64	43
N	1078	1480	682	303

b. Areas 00 and 03-07				
Length (cm)	1995	1996	1997	1998
5-9	40519	1908	232	0
10-14	13627	7656	706	24
15-19	8161	11057	1207	96
20-24	9396	7983	6171	1500
25-29	4229	10275	12113	81
30-34	3914	10504	7382	2090
35-39	15711	34437	22440	9914
40-44	13960	19171	28846	5477
45-49	3431	4539	5653	499
50-54	657	8	230	0
55-59	519	0	147	0
60-64	0	0	20	0

Table 7.7.

Run title : Arctic S. marinus (run: XSAKHN06/X06)

At 29/08/1999 18:00

Table 1		Catch numbers at age				Numbers*10**-3				
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
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,	1,	0,	0,	0,
6,	0,	0,	0,	2,	0,	0,	4,	0,	0,	0,
7,	0,	0,	0,	5,	0,	46,	60,	9,	9,	18,
8,	232,	0,	142,	22,	24,	7,	85,	119,	98,	48,
9,	445,	0,	88,	78,	193,	292,	230,	313,	157,	216,
10,	739,	0,	520,	114,	359,	640,	672,	361,	322,	482,
11,	1339,	266,	321,	394,	406,	816,	908,	879,	689,	723,
12,	1948,	1488,	350,	549,	1036,	1930,	1610,	1234,	1069,	974,
13,	1591,	1708,	1387,	783,	1022,	2096,	2038,	1638,	1788,	1515,
14,	1527,	1854,	2062,	1718,	1523,	2030,	2295,	2134,	2284,	1737,
15,	2013,	1722,	1258,	3102,	2353,	1601,	1783,	1675,	2180,	1570,
16,	1331,	1571,	2497,	2495,	1410,	2725,	1406,	1614,	1855,	1032,
17,	1619,	1894,	1695,	2104,	1655,	2668,	785,	1390,	1426,	1277,
18,	1575,	1895,	2472,	1837,	1678,	1409,	563,	952,	854,	967,
19,	1413,	1921,	1150,	998,	745,	617,	670,	679,	807,	1028,
20,	1457,	1808,	1026,	858,	716,	733,	593,	439,	610,	847,
21,	976,	1935,	617,	688,	534,	514,	419,	560,	513,	449,
22,	932,	1304,	425,	547,	528,	256,	368,	334,	206,	771,
23,	1053,	908,	659,	268,	576,	177,	250,	490,	335,	498,
+gp,	5625,	6346,	3991,	3110,	3482,	1508,	3232,	3135,	2139,	3415,
0 TOTALNUM,	25815,	26620,	20660,	19672,	18240,	20065,	17972,	17955,	17341,	17567,
TONSLAND,	23222,	28077,	19041,	16185,	16651,	18120,	15616,	17227,	17558,	19458,
SOPCOF %,	84,	102,	101,	97,	104,	100,	100,	100,	100,	100,

Table 7.8.

Table 2 Catch weights at age (kg)

YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0200,	.0200,	.0200,	.0200,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0300,	.0300,	.0300,	.0300,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
5,	.0530,	.0530,	.0530,	.0530,	.0000,	.0000,	.1600,	.0000,	.0000,	.0000,
6,	.0780,	.0780,	.0780,	.0800,	.0000,	.0000,	.2400,	.0000,	.0000,	.0000,
7,	.1330,	.1330,	.1330,	.1800,	.0000,	.2500,	.3300,	.2200,	.2300,	.1900,
8,	.3900,	.3900,	.3700,	.2900,	.3300,	.3700,	.4300,	.4900,	.5100,	.3300,
9,	.4100,	.4100,	.5100,	.4800,	.3600,	.3800,	.6400,	.5600,	.5300,	.4700,
10,	.5100,	.5100,	.4600,	.4200,	.4300,	.4900,	.6100,	.6500,	.7400,	.6200,
11,	.6200,	.5500,	.5300,	.5000,	.5100,	.5100,	.5900,	.7100,	.7200,	.6800,
12,	.6600,	.7100,	.6100,	.5900,	.5100,	.6400,	.6500,	.8100,	.7800,	.7700,
13,	.7200,	.7200,	.6400,	.5800,	.6400,	.7400,	.7400,	.8400,	.8000,	.7700,
14,	.8100,	.7800,	.7100,	.6500,	.6400,	.7600,	.7900,	.8800,	.8600,	.8500,
15,	.8600,	.8500,	.7600,	.6500,	.7600,	.8600,	.8400,	.9600,	.9100,	1.0500,
16,	.8900,	.8300,	.8300,	.7100,	.8600,	.9500,	.9200,	1.0000,	.9900,	.9600,
17,	.9400,	.9100,	.8400,	.8200,	.8900,	1.0300,	1.1200,	1.0200,	1.1600,	1.2600,
18,	1.0400,	.9000,	1.0000,	.8400,	.9800,	1.0700,	1.0100,	1.0100,	1.1800,	1.2900,
19,	1.1000,	.9300,	.9600,	.9400,	1.0000,	1.1100,	1.0100,	1.0000,	1.2100,	1.3000,
20,	1.1300,	1.0400,	1.0400,	1.0200,	1.0300,	1.1600,	1.2100,	1.0300,	1.3400,	1.2300,
21,	1.2700,	1.1300,	1.0300,	1.0300,	1.2100,	1.1500,	1.1400,	1.0400,	1.2800,	1.8800,
22,	1.2800,	1.0600,	1.0800,	1.1500,	1.0300,	1.1300,	1.0900,	1.1400,	1.5400,	1.4700,
23,	1.2500,	1.2300,	1.0200,	1.2700,	1.2000,	1.0200,	1.3000,	1.0900,	1.1900,	1.7400,
+gp,	1.6840,	1.4450,	1.2160,	1.2700,	1.1400,	1.3600,	1.0100,	1.1600,	1.2900,	1.2900,
0 SOPCOFAC,	.8400,	1.0174,	1.0135,	.9702,	1.0376,	1.0038,	.9998,	1.0008,	1.0030,	1.0016,
1										

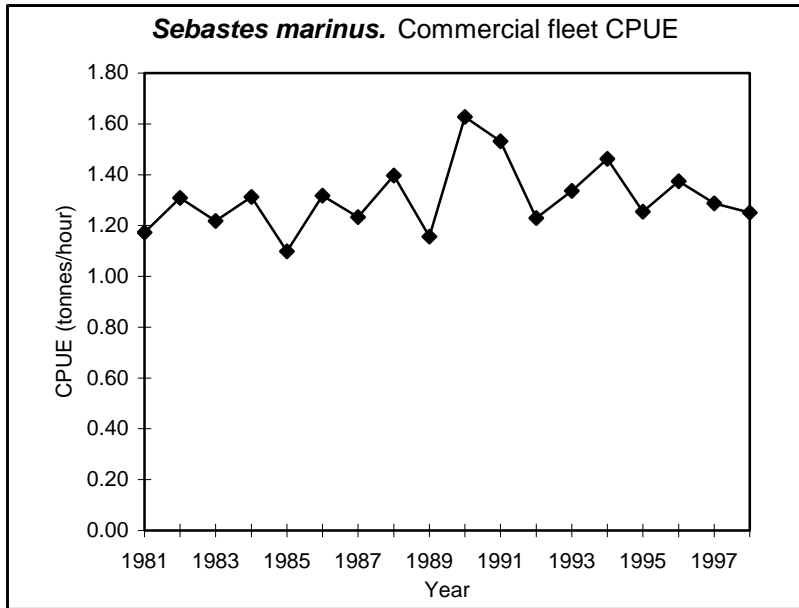


Figure 7.1. Plot of CPUE based on logbook information from freezer trawlers. Only days where *S. marinus* composed more than 50% of total catch were included in a GLM-analysis. The CPUEs have been standardized and scaled to a certain area (03) and month (2).

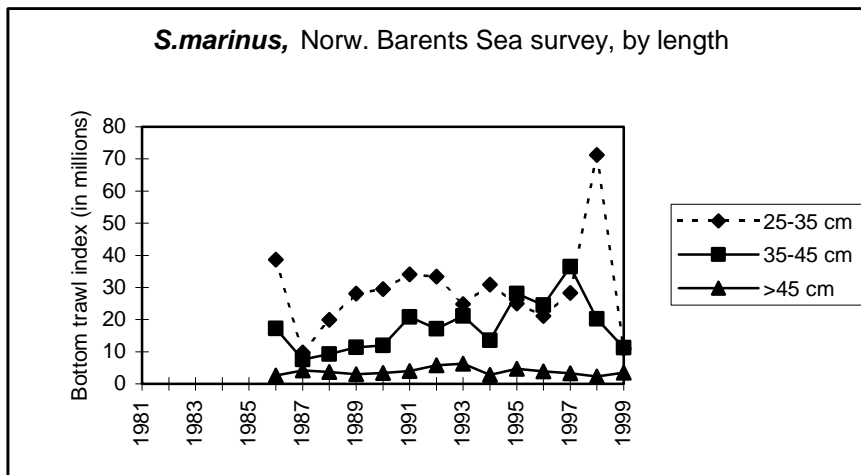
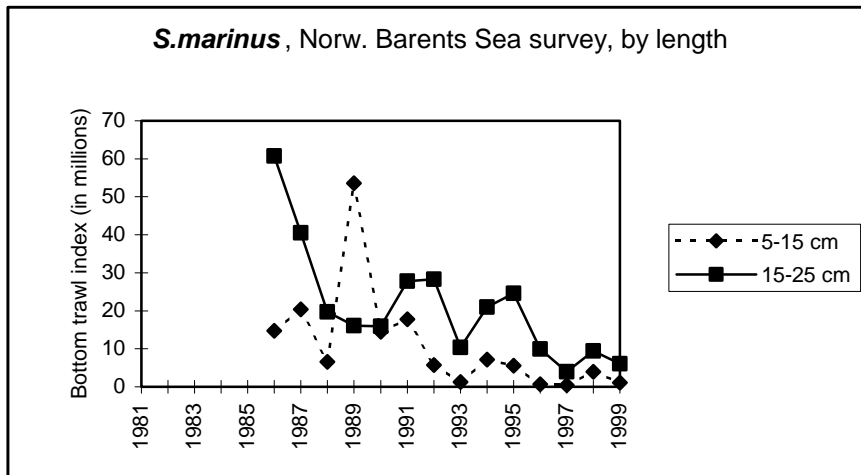


Figure 7.2a. *Sebastes marinus*. Abundance indices (by length) from the Norwegian bottom trawl survey in the Barents Sea in winter 1992-1999 (ref. Table D11a).

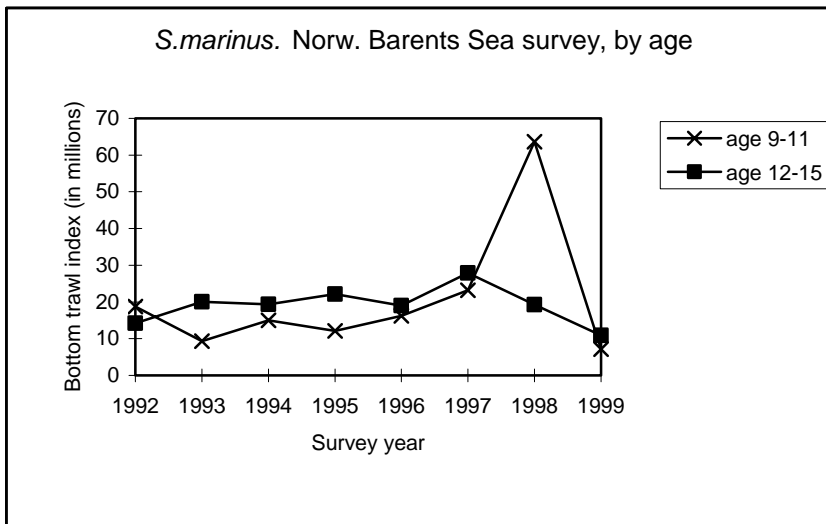
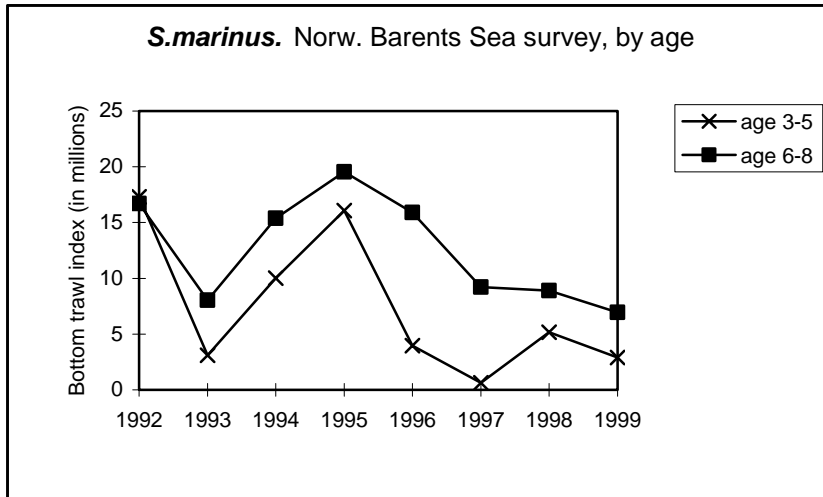


Figure 7.2b. *Sebastes marinus*. Abundance indices (by age) from the Norwegian bottom trawl surveys 1992-1999 in the Barents Sea (ref. Table D11b).

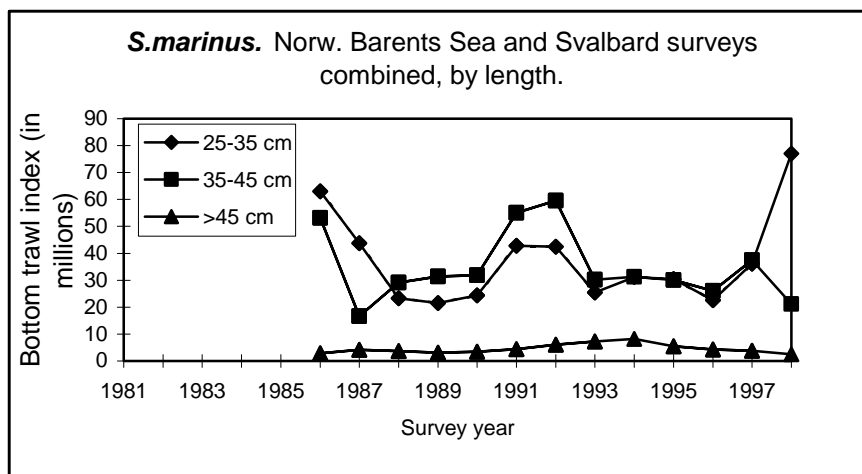
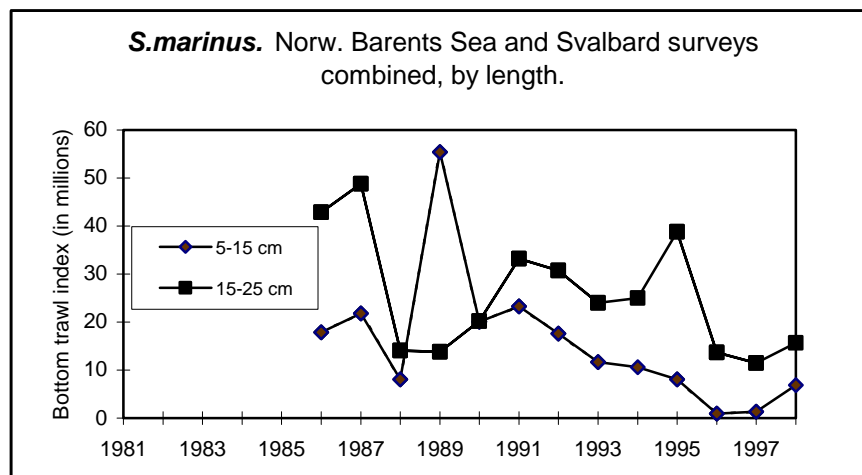


Figure 7.3a. *Sebastes marinus*. Abundance indices (by length) when combining the Norwegian bottom trawl surveys 1986-1998 in the Barents Sea (winter) and at Svalbard (summer/fall).

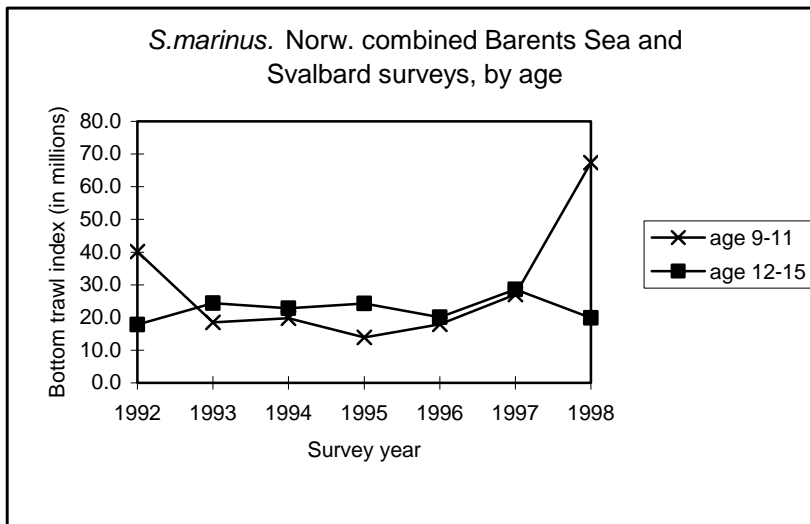
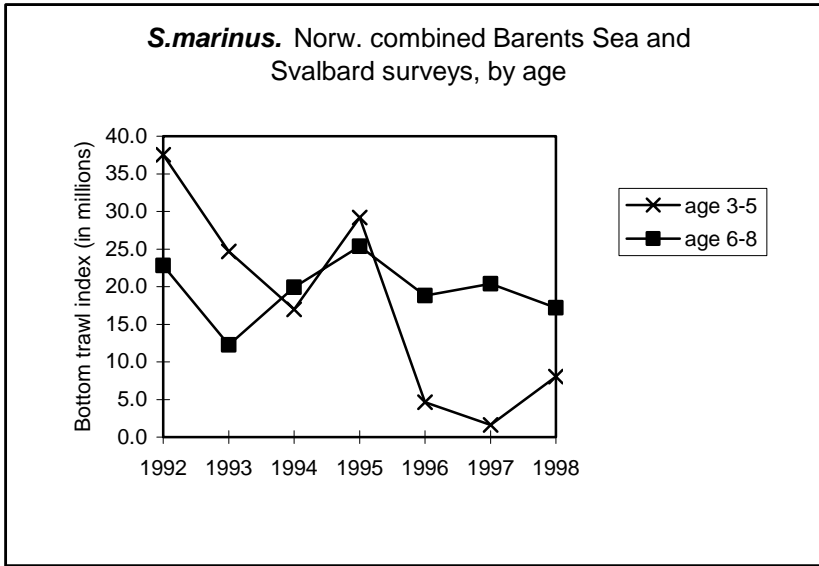


Figure 7.3b. *Sebastes marinus*. Abundance indices (by age) when combining the Norwegian bottom trawl surveys 1992-1998 in the Barents Sea (winter) and at Svalbard (summer/fall).

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 to 5% bycatch in each haul, and from January 1999 this percentage was increased to 10%. In August 1999 it was adjusted to 10% in each haul but only 5% of the landed catch.

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 in recent years. This is attributed to the increased difficulties of regulating a fishery which only lasts for a few weeks.

8.1.2 Landings prior to 1998 (Tables 8.1 - 8.5, E8)

Nominal catches by country for Sub-areas I and II combined are presented in Table 8.1. 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. The tables also incorporate data presented to the working group on foreign catches in the Russian economic zone, and also some Spanish survey catches. Landings separated by gear type are presented in Table 8.5.

The revised total catch for 1997 is 9,575 t which is close to that used in the previous assessment. The preliminary estimate of total catch for 1998 is 12,088 t. This is almost equal to the projected catch of 11,700 t estimated by the Working Group during its 1998 meeting.

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 increased sharply from 558 t in 1991 to 2,529 t in 1996 (Table E8). In 1997 and 1998 landings were reduced to 1,510 and 1,356 t respectively. The increase from 1973 to 1991 was mainly due to a gillnet fishery. In recent years most of the catch 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.

Around Jan Mayen, small catches of Greenland halibut have been taken in some years. In the period 1992–98 reported annual catches were 56, 0, 140, 270, 59, 54 and 0 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 1999

The fishery for Greenland halibut is regulated by quotas that should be taken by gillnetters and longliners within a restricted time period, and by restricting allowed bycatch in the trawl fishery. By mid-August 1999 the total Norwegian catch was 11,371 t. This is nearly the double of the catches at the same time in the previous year and is due to increases in both gillnet/longline and trawl catches. It is expected that the total Norwegian catch in 1999 will be approximately 15,000 t. In addition 3,500 t is expected to be caught by Russian vessels and 500 t by other countries. These increases are mainly due to the relaxed regulations in 1999.

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 1984–1998 in fishing depths of < 100–500 m. (Table E1, Figure 8.1).
2. Norwegian Barents Sea bottom trawl survey (winter) from 1989–1999 in fishing depths of < 100–500 m. In order to utilise the 1999 values in the VPA calibration, this series was adjusted back by one year and one 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 1984–1998 in fishing depths of 100–900 m. This series has been revised substantially since the 1998 assessment in order to make the years more comparable with respect to area coverage and gear type (Table E3, Figure 8.3).
4. Norwegian Svalbard shrimp trawl surveys from 1992–1998 in fishing depths of 200–600 m. This series had also been revised since last working group meeting, by including areas to the east of Bear Island. The years 1988–1991 of the previous shrimp survey series have not been updated yet (Table E4).
5. Norwegian Greenland halibut surveys in August 1994–1999. 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 1996–1998 (Table E6).
7. Norwegian pelagic 0-group surveys from 1970–1998. (Table A14).

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 1983–1987 year classes, which were all relatively abundant, there were no trend in this variation (Figure 8.1 top). The 1988 and 1989 year classes were at some ages well below the previous year classes (Figure 8.1 upper middle), and from 1990 to 1994 all year classes were consistently extremely poor up to and including age five (Figure 8.1 lower middle). After that age, estimated abundance approached the previous year classes. However, age-group five and younger are not considered to be well represented in this survey due to the limited depth range covered. In the last three years there were again high abundances of young fish in this survey (Figure 8.1 bottom). Both the 1995, 1996 and 1997 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 were not particularly effective in catching fish older than 7 years. This is likely due to 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 was comparable with the survey above: no clear pattern for the 1983–1987 year classes, an increasing trend for the 1988–1989 year classes, and a very sharp increase for the 1990–1992 year classes (Figure 8.2). From age 3–4 to age 6–8 the 1990–1992 year classes increased from only a few percentage to approximately 100% of the mean for the 1983–1987 year classes. In this survey the 1995–1997 year classes were not as abundant as in the survey above.

The Russian Barents Sea bottom trawl survey series from 1984–1998 caught fish mainly in the range of 4–10 years old. The relative abundance of the year classes against age was similar to the surveys above: no clear pattern for the 1983–1987 year classes, an increasing trend for the 1988–1989 year classes, and a very sharp increase for the 1990–1992 year classes (Figure 8.3).

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. With the old area coverage the relative abundance of the year classes against age was similar to the two surveys discussed above (Table E2a and Figure 8.3 in last years report). The 1990 and 1991 year classes in particular increased from near zero values at ages 1–4 to 50% of the mean for the 1983–1987

year classes at age 6. The same pattern is also seen with the new area coverage, although the time series is shorter. The 1995-1997 year classes were relatively abundant in this survey also.

The Norwegian Greenland halibut surveys along the deep continental slope south and west of Spitsbergen begun 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 (Table E5 and Figure 8.4). 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 in Figure 8.4 (1985-1995). 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 1991-1992 year classes compared with the preceding ones increased gradually from age 4 to age 8.

Data from the new survey north and east of Svalbard were available for three years only. Very high abundances were found for ages below 5 (Table E6). The time series is too short to compare year class abundance, but it is noted that none of the year classes 1991-1997 were consistently different from the other.

The strengths of the Greenland halibut year class of 1970-1997 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 1988-1992 and the 1996 year classes have been well below the long term average. The 1993-1995 and 1997-1998 year classes are closer to the average.

All in all, the surveys seem to indicate that the catchability of the 1990-1994 year classes increases considerably as the fish becomes five years and older. This pattern was described in last years assessment and is further strengthened this year. 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 1990-1992 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 1993-1994 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 (Table E6 and 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 1994-1996. These displacements corresponded to changes in hydrography and may be explained by increased migration of the 1990-1994 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 1992-1996. In 1997 this trend stopped and the catches were reduced to approximately the same level as in 1995. The CPUE has remained at this new level since.

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 1998 data. This is mainly seen in the data originating from the western part of the assessment area, i.e. in catches from the continental slope (Table E5 and E7). The low catches of nine-year-olds in these data correspond to low catches of the length groups associated with that age. This may indicate that the problem is one of catchability and survey coverage, or of stock composition and distribution by sex.

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 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, and to some extent to the converged part and older ages of the VPA. 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 1997 were updated using revised catch figures and revised Norwegian age composition. Catch-at-age data for 1998 were available from both the Norwegian and Russian fisheries. 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 similar low numbers of age 9 as in the surveys.

This year the time series was extended backwards to 1964. For the years 1965–1969 data on catch at age was available from both the Norwegian and Russian catches. For 1964 Russian catches were available on age while only total catch was available for Norway. The Norwegian catches in 1994 were allocated to age according to the Norwegian age-distribution from 1965. Catches from other countries were allocated proportionately to the combined Russian and Norwegian catch at age matrix.

8.3.2 Weight at age (Table 8.8)

For the years 1964–1969 separate weight at age data were used for the Norwegian and the Russian catches. Both data sets were mean values for the period and were combined as a weighted average for each year. A constant set of weight-at-age data was used for the total catches in the years 1970–1978. For subsequent years annual estimates were used. The mean weight at age in the catch in 1998 (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)

Annual ogives based on Russian survey data were given for the years 1984–1990 and 1992–1998. An average ogive derived from 1984–1987 was used for 1964–1983. For 1984–1998 a three-year running average was used.

8.3.5 Tuning data

The following abundance indices were used for tuning the VPA:

- Fleet 1: Norwegian Svalbard bottom trawl surveys (autumn) from 1984–1998 for ages 5–8.
- Fleet 2: Norwegian bottom trawl surveys in the Barents Sea (conducted in winter and adjusted to the autumn the year before) from 1989–1999 for ages 5–12.
- Fleet 3: Norwegian Greenland halibut surveys using a commercial vessel along the continental slope from 1994–1998 for ages 5–14.
- Fleet 4: Experimental commercial fishery CPUE from 1992–1998 for ages 5–14.
- Fleet 5: Russian trawl survey from 1984–1998 for ages 5–14.
- Fleet 6: Norwegian Svalbard shrimp trawl surveys from 1988–1998 for ages 5–8.

8.3.6 Recruitment indices (Tables A14, E1-E6)

In addition to the indices mentioned in Section 8.3.5, 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 most recent year classes were abundant in several 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 to the default value 0.5. In previous assessments 2.0 SE was used for the shrinkage. This represents high weighting on the surveys, which no longer is justified due to the problems of catching young fish.

The catchability was assumed to be independent on stock size for all ages and independent on age for ages above age 10.

8.5 Results of the Assessment

8.5.1 Results of the illustrative VPA (Tables 8.10–8.13)

The fishing mortality (F) matrix indicates that historically Greenland halibut were fully recruited to the fishery at approximately age 6–7. In recent years the age of full recruitment appears closer to age 10 (Table 8.10). This is likely due to a substantial proportional reduction in trawler effort since 1991 combined with reduced catchability of some year classes in the fishing areas. Trawlers catch more young fish compared to gillnetters and longliners. Nevertheless, F on ages 6–10 still represents the average fishing mortality on the major age groups represented in the fishery.

Until 1976 the spawning stock was well above 100,000 t, then it was relatively stable at around 75,000 t for several years. In 1990–1992 it dropped from 50,000 to 30,000 t and has remained at that level since. Prior to the reduction the fishing mortality had increased continuously for more than a decade and peaked in 1991 at 0.67. After the reduction the fishing mortality has again increased and is now at the level just prior to 1991.

Recent evidence suggests that some year classes estimated at young ages to be extremely low in abundance may be considerably better than previously believed. The assumption in the 1997 assessment that the SSB was below the level required to ensure historic recruitment levels seems no longer valid. However, the current spawning stock (mean of the last five years) is only 20% of the level in 1970–1975 and 46% of the level in 1976–1986. For the older part (age 10+) of the spawning stock which constitutes the major part of the female spawners, these figures were 11 and 30% respectively (Table 8.13).

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

Recruitment at age 5 has been relatively low in recent years, and was lower in 1990–1997 than in any previous years. The reduction does not seem dramatic though, and the present level in 1991–1997 is about 70% of the level in the 1980's. In 1998 the recruitment estimate is lower, but this is totally dependent on the recent survey indices and consequently the WG has low confidence in the figures.

8.5.2 Biological reference points

No limit or precautionary reference points for the fishing mortality or the biomass are proposed.

8.5.3 Catch options for 2000

Based upon the evaluation of the stock, the spawning stock biomass remains relatively stable near historically low levels. The anticipated landings of 19,000 tons for 1999 will likely result in a substantial reduction in the already low spawning stock size. In order to expect any improvement in the spawning stock catches should be kept well below recent levels for at least the next several years.

8.6 Comments to the assessment

In order to reduce the influence of erroneously low survey indices of the younger ages, the lowest age used in the current assessment was 5 years. This means that the output of the VPA run is not directly comparable with the 1997 and earlier assessments. However, the results illustrate the problems encountered in the assessments in recent years, i.e., with increasing age year classes that were initially considered extremely weak gradually increase. Using the higher recruitment age these year classes were estimated to be much closer to the average. This is more consistent with the new survey results.

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	Den mark	Est onia	Faroe Isl.	France	Fed. Rep. Germ any	Gre enl.	Ice land	Ire land	Lithu ania	Norway	Pola nd	Portu gal	Rus sia ³	Spain	UK (Engl. & Wales)	UK (Scot land)	UK	Total
1984	0	0	0	138	2,165	0	0	0	0	4,376	0	0	15,181	0	23	0		21,883
1985	0	0	0	239	4,000	0	0	0	0	5,464	0	0	10,237	0	5	0		19,945
1986	0	0	42	13	2,718	0	0	0	0	7,890	0	0	12,200	0	10	2		22,875
1987	0	0	0	13	2,024	0	0	0	0	7,261	0	0	9,733	0	61	20		19,112
1988	0	0	186	67	744	0	0	0	0	9,076	0	0	9,430	0	82	2		19,587
1989	0	0	67	31	600	0	0	0	0	10,622	0	0	8,812	0	6	0		20,138
1990	0	0	163	49	954	0	0	0	0	17,243	0	0	4,764 ²	0	10	0		23,183
1991	11	2564	314	119	101	0	0	0	0	27,587	0	0	2,490 ²	132	0	2		33,320
1992	0	0	16	111	13	13	0	0	0	7,667	0	31	718	23	10	0		8,602
1993	2	0	582 ²	80	22	15 ²	56	0	30	10,381 ²	0	43	1,235	0	16	0		12,462
1994	4	0	86 ²	55	296	3 ²	15	5	4	8,451 ²	0	36	283	2	76	2		9,318
1995	0	0	254 ²	174	35	27 ²	25	2	0	9,391 ²	0	84	794	757	115	7		11,665
1996	0	0	2 ²	219	81	123 ²	70	0	0	11,609 ²	0	79	1,576	137	317	57		14,270
1997	0	0	76 ²	253	56	1 ²	62	2	0	7,879 ²	12	50	1,038	54 ²	67	25		9,575
1998 ¹	0	0	20 ²	67	34 ²	0 ²	21	0	0	8,693 ²	31	99	2,659	254 ²			210	12,088

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	Greenlan d	Iceland	Norway	Russia ³	Spain	UK (England & Wales)	UK (Scot land)	UK	Total
1984	-	-	-	-	-	593	81	-	17	-		691
1985	-	-	-	-	-	602	122	-	1	-		725
1986	-	-	1	-	-	557	615	-	5	1		1,179
1987	-	-	2	-	-	984	259	-	10	+		1,255
1988	-	9	4	-	-	978	420	-	7	-		1,418
1989	-	-	-	-	-	2039	482	-	+	-		2,521
1990	-	7	-	-	-	1304	321 ²	-	-	-		1,632
1991	164	-	-	-	-	2,029	522 ²	-	-	-		2,715
1992	-	-	+	-	-	2,349	467	-	-	-		2,816
1993	-	553 ²	-	7 ²	56	1,755 ²	867	-	-	-		3,238
1994	-	17 ²	217	- ²	15	1,188 ²	175	-	+	-		1,612
1995	-	254 ²	-	15 ²	25	1,375 ²	270	57	-	-		1,996
1996	-	2 ²	+	- ²	70	795 ²	198	-	+	-		1,065
1997	-	64 ²	-	1 ²	62	606 ²	170	-	+	-		903
1998 ¹	-	20 ²	+ ²	- ²	21	780 ²	491	-			2	1,314

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. Germ.	Greenland	Ireland	Norway	Portugal	Russia ⁵	Spain	UK (Engl. & Wales)	UK (Scotland)	UK	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	6,382	26	67	+	14	-	-	6,644
1995	-	-	174	30	12 ⁴	2	6,354	60	227	-	83	2	-	6,944
1996	-	-	219	34	123 ⁴	-	9,565 ²	55	466	3	278	57	-	10,800
1997	-	-	253	23	- ⁴	-	6,057 ²	41	334	-	21	25	-	6,754
1998 ¹	-	-	67	16 ²	- ⁴	-	7,052 ²	80	530	5	-	-	115	7,865

¹ Provisional figures.

² Working Group figure.

³ As reported to Norwegian authorities.

⁴ Includes Division IIb.

⁵ USSR prior to 1991.

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	Denmark	Estonia	Faroe Islands	France	Fed. rep. Germ.	Ireland	Lithuania	Norway	Poland	Portugal	Russia ⁴	Spain	UK (Engl. & Wales)	UK (Scotland)	UK	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	9	-	-	1,988
1993	2 ³	-	-	2 ³	8	-	30 ³	649	-	26	158	-	14	-	-	889
1994	4	-	1 ³	8 ³	46	1	4 ³	881	-	10	41	2 ²	62	2	-	1,062
1995	-	-	-	-	5	-	-	1,662	-	24	297	700	32	5	-	2,725
1996	+	-	-	-	47	-	-	1,249 ²	-	24	912	134	39	+	-	2,405
1997	-	-	12	-	33	2	-	1,216 ²	12	9	534	54 ²	46	+	-	1,918
1998 ¹	-	-	-	-	18 ²	-	-	861 ²	31	19	1638	249 ²	-	-	93	2,909

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). Approximate figures, the total may differ slightly from Table 8.1

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	998	3,378	5,198	9,574
1998	1,327	3,891	6,871	12,089

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	-	-	-	-	-
1999	-	-	0.82	1.77	-	-	-	-	-

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: XSAOLE07/X07)
 At 30/08/1999 14:07

Table 1		Catch numbers at age					Numbers*10** ⁻³				
YEAR,	1964,	1965,	1966,	1967,	1968,						
AGE											
5,	372,	253,	170,	156,	114,						
6,	1480,	853,	563,	332,	283,						
7,	2808,	1735,	1106,	623,	452,						
8,	5674,	3868,	2715,	2006,	1976,						
9,	4951,	4203,	4054,	3237,	3923,						
10,	3981,	3799,	2499,	2409,	2950,						
11,	1853,	1799,	1284,	1718,	2234,						
12,	1018,	1002,	783,	871,	792,						
13,	364,	372,	246,	315,	146,						
14,	251,	282,	261,	155,	43,						
+gp,	76,	50,	28,	19,	7,						
0 TOTALNUM,	22828,	18216,	13709,	11841,	12920,						
TONSLAND,	40391,	34751,	26321,	24267,	26168,						
SOPCOF %,	100,	100,	101,	100,	100,						

Table 1		Catch numbers at age					Numbers*10** ⁻³				
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
AGE											
5,	1064,	526,	80,	1109,	212,	917,	840,	830,	2037,	1897,	
6,	2420,	2792,	4486,	3521,	1117,	2519,	2337,	2982,	3255,	3589,	
7,	3208,	10464,	12712,	9605,	3923,	6204,	6520,	5824,	4200,	4118,	
8,	6288,	18562,	12283,	6438,	3515,	3838,	4118,	5002,	2524,	2365,	
9,	4921,	10034,	6130,	2775,	2551,	1834,	2265,	3000,	1610,	1509,	
10,	4431,	6671,	4339,	1734,	1919,	1942,	1654,	1350,	1104,	946,	
11,	2381,	2517,	2703,	1368,	1536,	1622,	1857,	915,	1062,	934,	
12,	812,	1250,	1660,	1234,	1127,	1338,	1536,	1212,	858,	438,	
13,	229,	616,	1044,	675,	716,	734,	1122,	698,	595,	349,	
14,	100,	1104,	300,	200,	251,	531,	600,	526,	384,	147,	
+gp,	30,	281,	143,	80,	126,	216,	368,	358,	180,	112,	
0 TOTALNUM,	25884,	54817,	45880,	28739,	16993,	21695,	23217,	22697,	17809,	16404,	
TONSLAND,	43789,	89484,	79034,	43055,	29938,	37763,	38172,	36074,	28827,	24617,	
SOPCOF %,	103,	94,	104,	98,	92,	98,	88,	93,	101,	105,	

Table 1		Catch numbers at age					Numbers*10** ⁻³				
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
5,	2218,	731,	1896,	1304,	1543,	915,	1219,	1672,	1212,	907,	
6,	3155,	1138,	1917,	1494,	1864,	3698,	2874,	3335,	2972,	2540,	
7,	2727,	1665,	1919,	1276,	1851,	3350,	2561,	2712,	3572,	3141,	
8,	1234,	1341,	933,	1208,	2287,	1938,	1548,	1531,	1746,	2096,	
9,	495,	944,	484,	1493,	1491,	1064,	972,	1128,	752,	1182,	
10,	319,	473,	448,	1258,	1228,	1191,	1037,	997,	828,	860,	
11,	296,	511,	482,	838,	713,	602,	614,	530,	362,	481,	
12,	243,	275,	380,	502,	488,	340,	363,	434,	202,	313,	
13,	103,	242,	384,	324,	247,	171,	161,	314,	186,	133,	
14,	45,	145,	150,	108,	201,	132,	120,	305,	63,	140,	
+gp,	51,	78,	62,	46,	64,	71,	63,	239,	7,	47,	
0 TOTALNUM,	10886,	7543,	9055,	9851,	11977,	13472,	11532,	13197,	11902,	11840,	
TONSLAND,	17312,	13284,	15018,	16789,	22147,	21883,	19945,	22875,	19112,	19587,	
SOPCOF %,	104,	109,	107,	100,	98,	100,	99,	98,	101,	100,	

Table 1		Catch numbers at age					Numbers*10** ⁻³				
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
5,	2080,	2139,	3312,	1098,	1140,	631,	846,	1034,	330,	343,	
6,	4453,	5163,	3889,	1195,	1088,	708,	992,	2083,	921,	1134,	
7,	3655,	4642,	4716,	1069,	1608,	1252,	1719,	3795,	1822,	2528,	
8,	1657,	1932,	2355,	778,	1118,	817,	990,	1426,	953,	1451,	
9,	801,	1221,	1031,	360,	140,	310,	405,	262,	342,	529,	
10,	318,	499,	1284,	600,	976,	642,	726,	655,	822,	932,	
11,	228,	264,	774,	188,	444,	416,	461,	270,	231,	243,	
12,	126,	314,	673,	150,	144,	330,	371,	132,	150,	132,	
13,	120,	42,	177,	79,	36,	88,	154,	29,	18,	14,	
14,	140,	96,	266,	89,	20,	39,	56,	22,	41,	31,	
+gp,	28,	44,	517,	56,	4,	3,	8,	1,	1,	15,	
0 TOTALNUM,	13606,	16356,	18994,	5662,	6718,	5236,	6728,	9709,	5631,	7352,	
TONSLAND,	20138,	23183,	33320,	8602,	12462,	9318,	11665,	14269,	9574,	12089,	
SOPCOF %,	103,	102,	105,	95,	106,	100,	100,	100,	100,	100,	

TABLE 8.8

Run title : Arctic Green.halibut (run: XSAOLE07/X07)
 At 30/08/1999 14:07

Table 2		Catch weights at age (kg)				
YEAR,	1964,	1965,	1966,	1967,	1968,	
AGE						
5,	.4200,	.4200,	.4200,	.4200,	.4200,	
6,	.6400,	.6400,	.6400,	.6500,	.6600,	
7,	.9000,	.9000,	.9100,	.9300,	.9600,	
8,	1.2000,	1.2200,	1.2400,	1.2700,	1.3100,	
9,	1.6300,	1.6600,	1.7000,	1.7100,	1.7400,	
10,	2.2600,	2.2300,	2.2200,	2.2000,	2.1900,	
11,	3.1100,	3.0000,	2.9400,	2.8400,	2.7900,	
12,	3.7400,	3.4900,	3.3900,	3.3000,	3.1900,	
13,	4.5700,	4.4000,	4.3800,	4.2700,	4.2700,	
14,	5.0100,	4.9100,	4.8400,	4.8800,	5.0000,	
+gp,	5.9400,	5.8900,	5.8800,	5.8000,	5.9900,	
0 SOPCOFAC,	.9986,	1.0046,	1.0054,	1.0024,	.9994,	

Table 2		Catch weights at age (kg)									
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
AGE											
5,	.4200,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	
6,	.6400,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	
7,	.9100,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	
8,	1.2500,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	
9,	1.6400,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	
10,	2.2500,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	
11,	2.9900,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	
12,	3.6300,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	
13,	4.6800,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	
14,	5.3800,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	
+gp,	5.9900,	5.7940,	5.8410,	6.0370,	6.0060,	5.9640,	5.9100,	5.9230,	6.0270,	5.9060,	
0 SOPCOFAC,	1.0262,	.9436,	1.0434,	.9752,	.9231,	.9825,	.8805,	.9255,	1.0095,	1.0485,	

Table 2		Catch weights at age (kg)									
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
5,	.9000,	.7020,	.6600,	.6900,	.7500,	.6300,	.6000,	.6200,	.7090,	.7400,	
6,	1.2000,	.8720,	.8400,	.8400,	1.0400,	.9600,	.8900,	.9200,	1.0030,	.9620,	
7,	1.5000,	1.1410,	1.1500,	1.0300,	1.3400,	1.1800,	1.2000,	1.2800,	1.2660,	1.2490,	
8,	1.8000,	1.4680,	1.5600,	1.3100,	1.5700,	1.5300,	1.8500,	1.9000,	1.6830,	1.6260,	
9,	2.2000,	1.7780,	2.0400,	1.7400,	1.9700,	2.3100,	2.5900,	2.4800,	2.4820,	2.1640,	
10,	2.6000,	2.3020,	2.5700,	2.2400,	2.7300,	2.8700,	3.1800,	3.1100,	2.9820,	2.8970,	
11,	3.0000,	2.6640,	2.9800,	2.7700,	3.2900,	3.4600,	3.6200,	3.3500,	3.5470,	3.4060,	
12,	3.5000,	3.0460,	3.4300,	3.3700,	4.2200,	3.7700,	3.9500,	3.7200,	3.8000,	3.6610,	
13,	4.1000,	3.3680,	4.1300,	4.3200,	4.7100,	3.9900,	4.4800,	4.0000,	4.5600,	4.2470,	
14,	4.8000,	4.2850,	4.6800,	5.3500,	6.0800,	4.3500,	4.2500,	4.1800,	5.0020,	4.1870,	
+gp,	6.1760,	5.3460,	5.9990,	5.8330,	6.1220,	4.5250,	4.8250,	4.5260,	5.9530,	4.4630,	
0 SOPCOFAC,	1.0364,	1.0894,	1.0680,	1.0038,	.9783,	1.0009,	.9858,	.9782,	1.0116,	.9973,	

Table 2		Catch weights at age (kg)									
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
5,	.7600,	.7100,	.7700,	.6800,	.7900,	.7200,	.7300,	.7700,	.7700,	.7300,	
6,	1.0300,	1.0600,	1.0500,	.9700,	1.0200,	.9400,	.9400,	.9700,	.9400,	.9300,	
7,	1.3200,	1.2900,	1.3800,	1.2700,	1.3500,	1.2700,	1.2500,	1.3100,	1.2800,	1.3000,	
8,	1.8000,	1.7000,	1.7500,	1.7600,	1.8800,	1.7200,	1.7400,	1.7400,	1.6400,	1.6100,	
9,	2.4200,	2.1000,	2.2000,	2.2100,	2.4600,	2.1900,	2.0900,	2.2400,	2.0700,	2.1200,	
10,	3.1300,	2.6100,	2.6000,	2.5600,	2.6700,	2.5200,	2.5100,	2.5900,	2.5900,	2.5700,	
11,	3.3700,	2.8700,	2.7900,	3.1100,	3.4300,	2.9700,	2.9500,	3.2900,	3.3000,	3.2500,	
12,	4.0500,	3.4500,	3.2800,	3.5900,	4.2900,	3.2900,	3.3400,	4.0200,	4.0100,	3.9100,	
13,	4.2900,	3.7200,	3.8900,	3.8300,	5.0800,	3.8400,	3.8300,	4.7500,	4.8300,	4.9000,	
14,	4.5000,	4.0900,	4.3800,	4.2500,	6.3300,	4.9500,	4.9800,	6.2400,	5.9500,	5.6600,	
+gp,	4.7200,	4.5200,	5.2900,	4.8000,	8.9100,	6.6800,	8.1500,	6.0900,	6.2600,	4.9100,	
0 SOPCOFAC,	1.0346,	1.0204,	1.0470,	.9519,	1.0634,	1.0037,	1.0036,	1.0011,	1.0022,	1.0018,	

TABLE 8.9

Run title : Arctic Green.halibut (run: XSAOLE07/X07)
 At 30/08/1999 14:07

Proportion mature at age					
YEAR,	1964,	1965,	1966,	1967,	1968,
AGE					
5,	.3600,	.3600,	.3600,	.3600,	.3600,
6,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8000,	.8000,	.8000,	.8000,	.8000,
8,	.8400,	.8400,	.8400,	.8400,	.8400,
9,	.9000,	.9000,	.9000,	.9000,	.9000,
10,	.9500,	.9500,	.9500,	.9500,	.9500,
11,	.9900,	.9900,	.9900,	.9900,	.9900,
12,	.9900,	.9900,	.9900,	.9900,	.9900,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age										
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
5,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,
8,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,
9,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,
10,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,
12,	.9900,	.9900,	.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,	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,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
5,	.3600,	.3600,	.3600,	.3600,	.3600,	.4500,	.4300,	.3500,	.2100,	.0500,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7700,	.7500,	.7200,	.6400,	.6600,
7,	.8000,	.8000,	.8000,	.8000,	.8000,	.7900,	.7900,	.8400,	.7900,	.7800,
8,	.8400,	.8400,	.8400,	.8400,	.8400,	.8300,	.8400,	.8500,	.8300,	.7900,
9,	.9000,	.9000,	.9000,	.9000,	.9000,	.8600,	.8900,	.9300,	.9200,	.9100,
10,	.9500,	.9500,	.9500,	.9500,	.9500,	.9200,	.9400,	.9800,	.9800,	.9700,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	1.0000,	.9900,	.9900,
12,	.9900,	.9900,	.9900,	.9900,	.9900,	.9800,	.9900,	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,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,
AGE										
5,	.0700,	.0700,	.1200,	.2800,	.3200,	.3800,	.3800,	.4800,	.5700,	.5600,
6,	.6200,	.6000,	.2800,	.4600,	.4900,	.5200,	.4900,	.6000,	.7600,	.7500,
7,	.7400,	.7000,	.3900,	.5200,	.5700,	.6200,	.5900,	.6300,	.7100,	.7300,
8,	.7900,	.6800,	.4900,	.6100,	.6700,	.6700,	.6500,	.7000,	.7300,	.7400,
9,	.9000,	.8500,	.7100,	.8900,	.8900,	.8600,	.7900,	.7900,	.7500,	.7500,
10,	.9600,	.9000,	.9200,	.9500,	.9000,	.9100,	.9000,	.9400,	.8900,	.9000,
11,	.9800,	1.0000,	1.0000,	.9800,	.9800,	.9800,	1.0000,	.9800,	.9500,	.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,

TABLE 8.10

Run title : Arctic Green.halibut (run: XSAOLE07/X07)
 At 30/08/1999 14:07

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age
 YEAR, 1964, 1965, 1966, 1967, 1968,

AGE	1964	1965	1966	1967	1968
5,	.0094,	.0053,	.0032,	.0024,	.0019,
6,	.0484,	.0255,	.0138,	.0072,	.0051,
7,	.1146,	.0699,	.0397,	.0180,	.0116,
8,	.2531,	.2160,	.1411,	.0892,	.0694,
9,	.4566,	.2848,	.3476,	.2356,	.2381,
10,	.7003,	.7255,	.2583,	.3382,	.3302,
11,	.6375,	.7606,	.5421,	.2684,	.5685,
12,	.5666,	.8215,	.8585,	.8373,	.1802,
13,	.4065,	.3910,	.4515,	1.0093,	.2946,
14,	.5568,	.6004,	.4944,	.5409,	.3237,
+gp,	.5568,	.6004,	.4944,	.5409,	.3237,
FBAR 6-10,	.3146,	.2643,	.1601,	.1376,	.1309,

YEAR, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978,

AGE	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
5,	.0207,	.0139,	.0027,	.0363,	.0074,	.0380,	.0413,	.0417,	.0991,	.1050,
6,	.0484,	.0660,	.1492,	.1512,	.0443,	.1081,	.1216,	.1908,	.2159,	.2398,
7,	.0691,	.2865,	.4474,	.5114,	.2374,	.3454,	.4205,	.4692,	.4217,	.4373,
8,	.2082,	.6558,	.6024,	.4035,	.3339,	.3633,	.3829,	.6271,	.3588,	.4203,
9,	.2333,	.5605,	.4394,	.2446,	.2598,	.2748,	.3572,	.5024,	.3948,	.3564,
10,	.4350,	.5341,	.4741,	.2001,	.2518,	.3044,	.4025,	.3528,	.3272,	.4012,
11,	.4572,	.4458,	.4039,	.2513,	.2588,	.3302,	.5031,	.3835,	.4889,	.4788,
12,	.3906,	.4363,	.5629,	.3065,	.3194,	.3551,	.5629,	.6847,	.7117,	.3597,
13,	.0686,	.5467,	.7566,	.4417,	.2768,	.3352,	.5367,	.5092,	.8227,	.6739,
14,	.3183,	.5075,	.5305,	.2900,	.2744,	.3213,	.4750,	.4892,	.5523,	.4564,
+gp,	.3183,	.5075,	.5305,	.2900,	.2744,	.3213,	.4750,	.4892,	.5523,	.4564,
FBAR 6-10,	.1988,	.4206,	.4225,	.3022,	.2254,	.2792,	.3370,	.4285,	.3437,	.3710,

YEAR, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988,

AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
5,	.1309,	.0450,	.1235,	.0778,	.0917,	.0570,	.0683,	.0953,	.0697,	.0435,
6,	.2408,	.0870,	.1512,	.1282,	.1443,	.3110,	.2408,	.2546,	.2312,	.1933,
7,	.2735,	.1826,	.1962,	.1349,	.2192,	.3918,	.3475,	.3546,	.4474,	.3848,
8,	.2119,	.1981,	.1398,	.1727,	.3579,	.3541,	.2978,	.3405,	.3832,	.4856,
9,	.1358,	.2355,	.0964,	.3269,	.3150,	.2648,	.2845,	.3476,	.2633,	.4578,
10,	.1111,	.1762,	.1583,	.3646,	.4613,	.4211,	.4204,	.4978,	.4378,	.5111,
11,	.1978,	.2468,	.2589,	.4665,	.3420,	.4062,	.3764,	.3715,	.3176,	.4632,
12,	.2054,	.2692,	.2769,	.4425,	.5144,	.2561,	.4325,	.4705,	.2222,	.4709,
13,	.1259,	.3062,	.6956,	.3799,	.3830,	.3200,	.1750,	.7848,	.3554,	.2111,
14,	.1556,	.2477,	.2984,	.3980,	.4051,	.3422,	.3674,	.5465,	.3255,	.4672,
+gp,	.1556,	.2477,	.2984,	.3980,	.4051,	.3422,	.3674,	.5465,	.3255,	.4672,
FBAR6-10	.1946,	.1759,	.1484,	.2255,	.2996,	.3486,	.3182,	.3590,	.3526,	.4065,

YEAR, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, FBAR 96-98

AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	FBAR 96-98
5,	.1149,	.1748,	.3329,	.1235,	.1075,	.0480,	.0642,	.0887,	.0349,	.0650,	.0629,
6,	.2928,	.4324,	.5168,	.1810,	.1642,	.0854,	.0940,	.2103,	.1010,	.1531,	.1548,
7,	.4408,	.5310,	.8536,	.2435,	.3714,	.2725,	.2898,	.5765,	.2717,	.4137,	.4206,
8,	.3392,	.4158,	.5326,	.2990,	.4079,	.3086,	.3393,	.3915,	.2582,	.3409,	.3302,
9,	.3252,	.4242,	.3851,	.1335,	.0756,	.1770,	.2335,	.1326,	.1433,	.2107,	.1622,
10,	.2002,	.3259,	1.0372,	.3822,	.5973,	.5424,	.7487,	.6815,	.7279,	.6692,	.6929,
11,	.2301,	.2406,	1.1853,	.3708,	.5112,	.5186,	.9181,	.6567,	.5113,	.4584,	.5421,
12,	.1976,	.5342,	1.6377,	.7165,	.5100,	.8587,	1.2184,	.6942,	.9145,	.5853,	.7313,
13,	.3118,	.0884,	.6208,	.8325,	.3453,	.6392,	1.3373,	.2437,	.1729,	.1769,	.1979,
14,	.3390,	.4157,	1.1400,	.6984,	.4814,	.7321,	1.0840,	.6277,	.6040,	.4743,	.5687,
+gp,	.3390,	.4157,	1.1400,	.6984,	.4814,	.7321,	1.0840,	.6277,	.6040,	.4743,	.5687,
FBAR6-10	.3196,	.4259,	.6651,	.2478,	.3233,	.2772,	.3411,	.3985,	.3004,	.3575,	

TABLE 8.11

Run title : Arctic Green.halibut (run: XSAOLE07/X07)
 At 30/08/1999 14:07

Terminal Fs derived using XSA (With F shrinkage)

Table 10	Stock number at age (start of year)					Numbers*10** ⁻³
YEAR,	1964,	1965,	1966,	1967,	1968,	
AGE						
5,	42837,	51676,	57817,	70426,	64263,	
6,	33791,	36525,	44244,	49606,	60472,	
7,	27960,	27711,	30646,	37559,	42388,	
8,	27351,	21460,	22241,	25351,	31749,	
9,	14559,	18277,	14882,	16624,	19959,	
10,	8521,	7937,	11832,	9048,	11306,	
11,	4237,	3641,	3307,	7866,	5553,	
12,	2537,	1928,	1465,	1655,	5176,	
13,	1175,	1239,	730,	534,	617,	
14,	634,	673,	721,	400,	168,	
+gp,	190,	118,	77,	49,	27,	
TOTAL,	163791,	171186,	187962,	219118,	241677,	

Table 10	Stock number at age (start of year)					Numbers*10** ⁻³				
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,
AGE										
5,	55918,	41094,	31502,	33502,	31020,	26541,	22402,	21885,	23272,	20511,
6,	55206,	47142,	34882,	27040,	27806,	26502,	21993,	18503,	18066,	18141,
7,	51786,	45271,	37985,	25862,	20007,	22897,	20474,	16762,	13159,	12530,
8,	36064,	41596,	29257,	20901,	13348,	13580,	13952,	11573,	9024,	7429,
9,	25493,	25207,	18582,	13786,	12016,	8228,	8128,	8188,	5320,	5425,
10,	13539,	17377,	12387,	10306,	9292,	7976,	5380,	4895,	4264,	3086,
11,	6994,	7542,	8767,	6636,	7262,	6217,	5063,	3096,	2960,	2646,
12,	2707,	3811,	4157,	5039,	4443,	4825,	3846,	2635,	1816,	1563,
13,	3720,	1577,	2120,	2038,	3192,	2778,	2912,	1885,	1144,	767,
14,	395,	2990,	785,	856,	1128,	2083,	1710,	1465,	975,	432,
+gp,	118,	755,	372,	341,	564,	843,	1042,	990,	454,	327,
TOTAL,	251941,	234363,	180797,	146306,	130077,	122471,	106903,	91877,	80454,	72857,

Table 10	Stock number at age (start of year)					Numbers*10** ⁻³				
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,
AGE										
5,	19486,	17895,	17595,	18775,	18989,	17803,	19898,	19832,	19406,	22949,
6,	15894,	14714,	14725,	13385,	14950,	14913,	14475,	15995,	15518,	15579,
7,	12284,	10753,	11609,	10895,	10135,	11139,	9405,	9792,	10673,	10600,
8,	6964,	8043,	7710,	8211,	8194,	7006,	6479,	5719,	5912,	5873,
9,	4200,	4849,	5679,	5771,	5947,	4931,	4232,	4141,	3502,	3469,
10,	3269,	3156,	3298,	4439,	3582,	3735,	3257,	2741,	2517,	2316,
11,	1778,	2518,	2278,	2423,	2653,	1944,	2110,	1841,	1434,	1398,
12,	1411,	1256,	1693,	1513,	1308,	1622,	1114,	1246,	1093,	898,
13,	939,	989,	826,	1105,	837,	673,	1081,	622,	670,	753,
14,	337,	712,	627,	355,	650,	491,	421,	781,	244,	404,
+gp,	380,	382,	258,	150,	206,	263,	220,	607,	27,	135,
TOTAL,	66943,	65268,	66296,	67022,	67451,	64519,	62690,	63317,	60998,	64374,

Table 10	Stock number at age (start of year)										Numbers*10** ⁻³	
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	GMST-64-96

AGE														
5,	20659,	14373,	12607,	10183,	12058,	14524,	14664,	13124,	10358,	5874,	0,	23716,	27257,	
6,	18911,	15852,	10387,	7779,	7746,	9321,	11916,	11836,	10337,	8609,	4737,	19743,	23146,	
7,	11052,	12146,	8854,	5332,	5586,	5658,	7366,	9336,	8255,	8043,	6358,	14974,	18352,	
8,	6209,	6122,	6147,	3245,	3598,	3316,	3708,	4745,	4515,	5415,	4577,	9928,	13093,	
9,	3110,	3807,	3477,	3106,	2071,	2059,	2097,	2273,	2761,	3002,	3314,	6420,	8588,	
10,	1889,	1934,	2144,	2036,	2339,	1653,	1485,	1429,	1714,	2059,	2093,	4310,	5587,	
11,	1196,	1331,	1202,	654,	1196,	1108,	827,	604,	622,	712,	908,	2564,	3342,	
12,	757,	818,	901,	316,	389,	617,	568,	284,	270,	321,	388,	1506,	1982,	
13,	483,	535,	413,	151,	133,	201,	225,	145,	122,	93,	154,	807,	1127,	
14,	525,	304,	422,	191,	56,	81,	91,	51,	97,	88,	67,	457,	672,	
+gp,	104,	139,	807,	119,	11,	6,	13,	2,	2,	43,	70,			
TOTAL	64896,	57360,	47359,	33112,	35184,	38545,	42959,	43830,	39053,	34259,	22666,			

TABLE 8.12

Run title : Arctic Green.halibut (run: XSAOLE07/X07)
 At 30/08/1999 14:07

Terminal Fs derived using XSA (With F shrinkage)

Table 13		Spawning stock biomass at age (spawning time)					Tonnes				
YEAR,	1964,	1965,	1966,	1967,	1968,						
AGE											
5,	6477,	7813,	8742,	10648,	9717,						
6,	15571,	16831,	20387,	23215,	28736,						
7,	20131,	19952,	22310,	27944,	32554,						
8,	27570,	21992,	23166,	27044,	34937,						
9,	21357,	27306,	22770,	25585,	31255,						
10,	18295,	16815,	24954,	18911,	23521,						
11,	13046,	10813,	9626,	22115,	15338,						
12,	9393,	6661,	4916,	5408,	16347,						
13,	5368,	5452,	3196,	2281,	2634,						
14,	3175,	3306,	3491,	1951,	838,						
+gp,	1131,	697,	452,	282,	163,						
TOTSPBIO,	141513,	137640,	144011,	165386,	196039,						

Table 13		Spawning stock biomass at age (spawning time)					Tonnes				
YEAR,	1969,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	
AGE											
5,	8455,	8388,	6430,	6838,	6332,	5418,	4573,	4467,	4750,	4187,	
6,	25439,	25015,	18510,	14348,	14755,	14063,	11670,	9818,	9587,	9626,	
7,	37700,	39078,	32789,	22324,	17270,	19765,	17673,	14469,	11359,	10816,	
8,	37868,	49651,	34923,	24948,	15933,	16210,	16653,	13814,	10771,	8868,	
9,	37628,	41925,	30905,	22930,	19986,	13685,	13519,	13618,	8849,	9023,	
10,	28940,	37655,	26842,	22333,	20134,	17284,	11659,	10606,	9240,	6686,	
11,	20703,	21557,	25059,	18967,	20756,	17769,	14472,	8850,	8461,	7563,	
12,	9728,	12250,	13362,	16197,	14281,	15512,	12364,	8471,	5838,	5024,	
13,	17411,	6784,	9124,	8768,	13735,	11955,	12530,	8113,	4921,	3302,	
14,	2127,	14742,	3873,	4223,	5560,	10271,	8433,	7226,	4809,	2132,	
+gp,	707,	4377,	2171,	2059,	3385,	5029,	6157,	5866,	2734,	1933,	
TOTSPBIO,	226706,	261423,	203986,	163934,	152126,	146959,	129704,	105319,	81320,	69159,	

Table 13		Spawning stock biomass at age (spawning time)					Tonnes				
YEAR,	1979,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	
AGE											
5,	6313,	4523,	4181,	4664,	5127,	5047,	5134,	4304,	2889,	849,	
6,	13732,	9238,	8905,	8095,	11195,	11023,	9662,	10595,	9962,	9891,	
7,	14741,	9815,	10680,	8978,	10864,	10383,	8916,	10528,	10675,	10326,	
8,	10530,	9918,	10104,	9036,	10806,	8896,	10069,	9236,	8258,	7544,	
9,	8317,	7760,	10426,	9037,	10544,	9795,	9755,	9550,	7996,	6831,	
10,	8076,	6902,	8052,	9445,	9290,	9863,	9735,	8353,	7356,	6509,	
11,	5281,	6641,	6719,	6645,	8642,	6658,	7562,	6167,	5035,	4716,	
12,	4889,	3787,	5750,	5048,	5465,	5993,	4358,	4637,	4153,	3289,	
13,	3849,	3331,	3411,	4773,	3941,	2686,	4842,	2490,	3056,	3199,	
14,	1616,	3053,	2933,	1897,	3954,	2136,	1788,	3264,	1223,	1693,	
+gp,	2349,	2041,	1547,	876,	1260,	1189,	1060,	2748,	161,	602,	
TOTSPBIO,	79692,	67008,	72707,	68493,	81087,	73670,	72879,	71872,	60764,	55448,	

Table 13		Spawning stock biomass at age (spawning time)					Tonnes				
YEAR,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	
AGE											
5,	1099,	714,	1165,	1939,	3048,	3974,	4068,	4851,	4546,	2401,	
6,	12076,	10082,	3054,	3471,	3872,	4556,	5488,	6889,	7385,	6005,	
7,	10796,	10967,	4765,	3521,	4299,	4455,	5432,	7705,	7502,	7632,	
8,	8829,	7077,	5271,	3484,	4532,	3822,	4194,	5779,	5405,	6451,	
9,	6774,	6795,	5431,	6109,	4535,	3879,	3462,	4023,	4286,	4773,	
10,	5676,	4543,	5128,	4951,	5622,	3791,	3354,	3478,	3950,	4763,	
11,	3949,	3819,	3352,	1993,	4019,	3225,	2440,	1949,	1950,	2199,	
12,	3068,	2821,	2954,	1135,	1667,	2031,	1896,	1143,	1082,	1256,	
13,	2071,	1990,	1605,	577,	675,	771,	862,	686,	590,	456,	
14,	2362,	1244,	1846,	811,	357,	401,	454,	317,	580,	501,	
+gp,	493,	626,	4270,	571,	100,	41,	105,	14,	15,	209,	
TOTSPBIO,	57194,	50680,	38841,	28563,	32725,	30945,	31756,	36834,	37291,	36645,	

TABLE 8.13

Run title : Arctic Green.halibut (run: XSAOLE07/X07)
 At 30/08/1999 14:07

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS	TOTALBIO	TOTSPBIO	SSB	LANDINGS	YIELD/SSB	FBAR(6-10)
	Age 5			>10 years			
1964	42837	172930	141513	50408	40391	0.2854	0.3146
1965	51676	171348	137640	43744	34751	0.2525	0.2643
1966	57817	181461	144011	46635	26321	0.1828	0.1601
1967	70426	209598	165386	50948	24267	0.1467	0.1376
1968	64263	244312	196039	58841	26168	0.1335	0.1309
1969	55918	274279	226706	79616	43789	0.1932	0.1988
1970	41094	312272	261423	97365	89484	0.3423	0.4206
1971	31502	242700	203986	80431	79034	0.3874	0.4225
1972	33502	196082	163934	72547	43055	0.2626	0.3022
1973	31020	180107	152126	77851	29938	0.1968	0.2254
1974	26541	172854	146959	77820	37763	0.2570	0.2792
1975	22402	152349	129704	65615	38172	0.2943	0.3370
1976	21885	125573	105319	49132	36074	0.3425	0.4285
1977	23272	99998	81320	36003	28827	0.3545	0.3437
1978	20511	86220	69159	26640	24617	0.3559	0.3710
1979	19486	103399	79692	26060	17312	0.2172	0.1946
1980	17895	84314	67008	25755	13284	0.1982	0.1759
1981	17595	89905	72707	28412	15018	0.2066	0.1484
1982	18775	85518	68493	28684	16789	0.2451	0.2255
1983	18989	101133	81087	32552	22147	0.2731	0.2996
1984	17803	90355	73670	28525	21883	0.2970	0.3486
1985	19898	89140	72879	29345	19945	0.2737	0.3182
1986	19832	88509	71872	27659	22875	0.3183	0.3590
1987	19406	82663	60764	20984	19112	0.3145	0.3526
1988	22949	82519	55448	20008	19587	0.3532	0.4065
1989	20659	86407	57194	17619	20138	0.3521	0.3196
1990	14373	76627	50680	15043	23183	0.4574	0.4259
1991	12607	70840	38841	19155	33320	0.8579	0.6651
1992	10183	44158	28563	10038	8602	0.3012	0.2478
1993	12058	49974	32725	12440	12462	0.3808	0.3233
1994	14524	47319	30945	10260	9318	0.3011	0.2772
1995	14664	51431	31756	9111	11665	0.3673	0.3411
1996	13124	55015	36834	7587	14269	0.3874	0.3985
1997	10358	50136	37291	8167	9574	0.2567	0.3004
1998	5874	47859	36645	9384	12089	0.3299	0.3575
Arith.							
Mean	26163	122837	97438	37154	27006	0.305	0.3092
Units	(Thous.)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)		

Figure 8.1. GREENLAND HALIBUT in Sub-area I and II:

Relative abundance at age for each yearclass from Norwegian bottom-trawl survey in the Svalbard area (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 year classes.

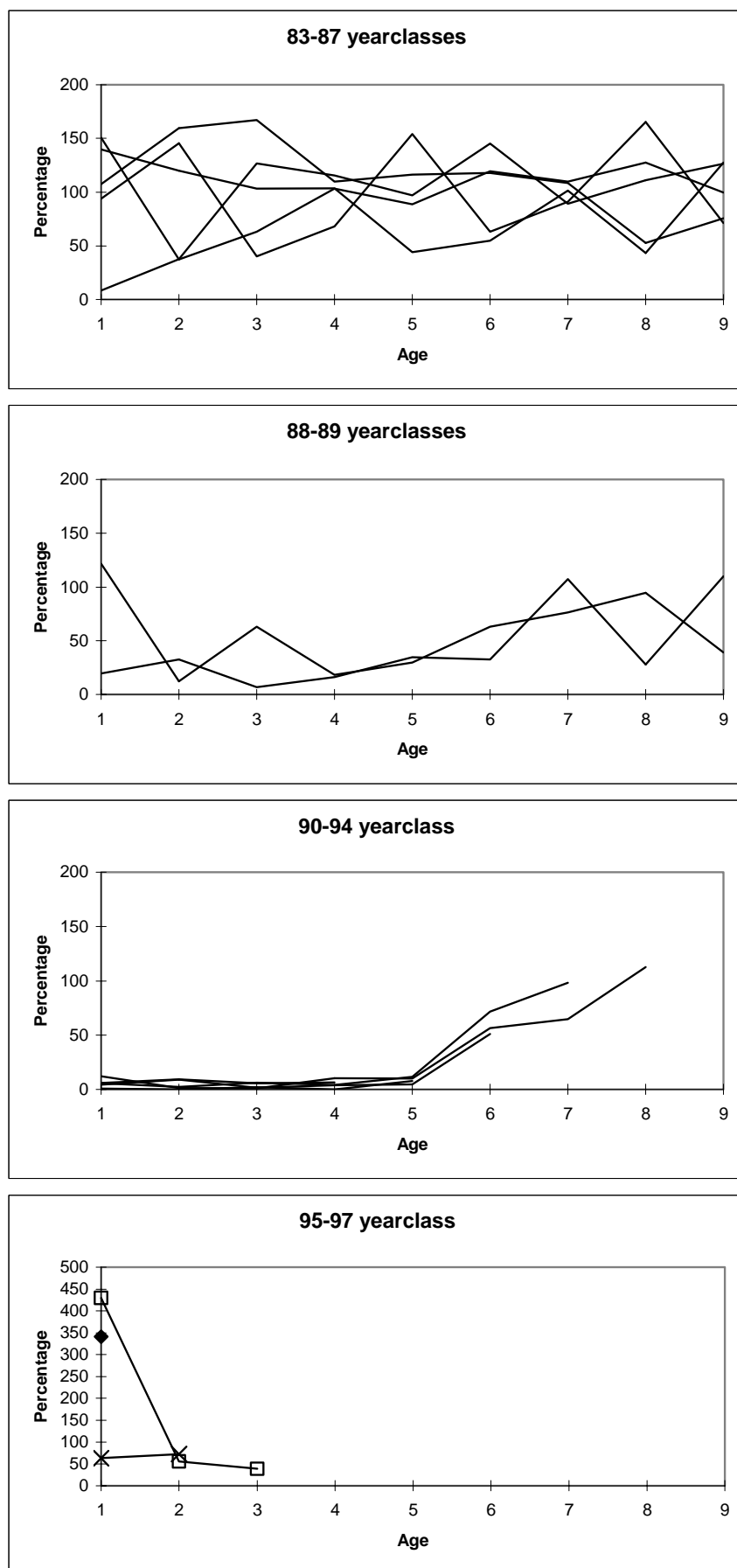


Figure 8.2. GREENLAND HALIBUT in Sub-area I and II:

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.

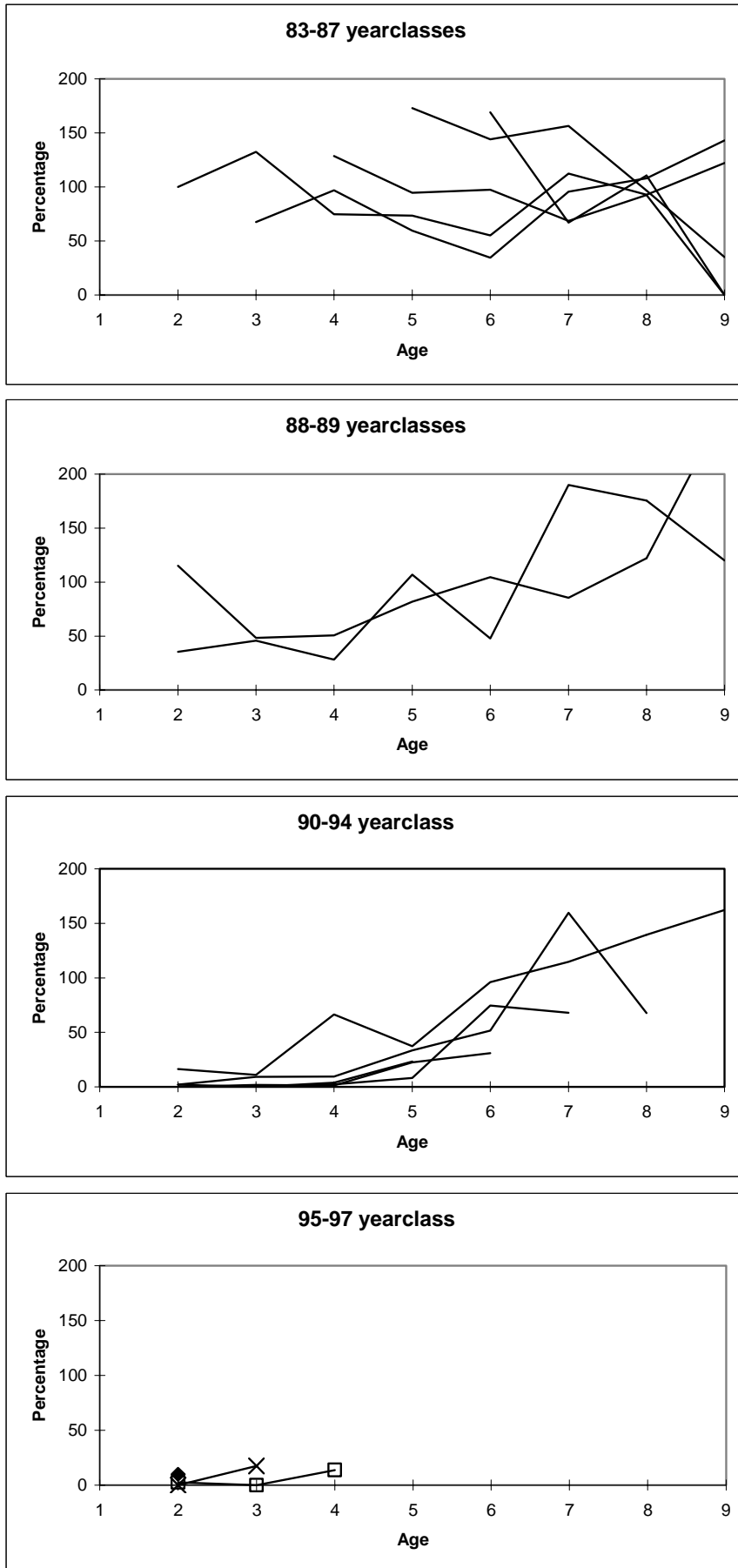


Figure 8.3. GREENLAND HALIBUT in Sub-area I and II:
 Relative abundance at age for each yearclass from Russian bottom-trawl survey in the Barents Sea
 (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 year classes.

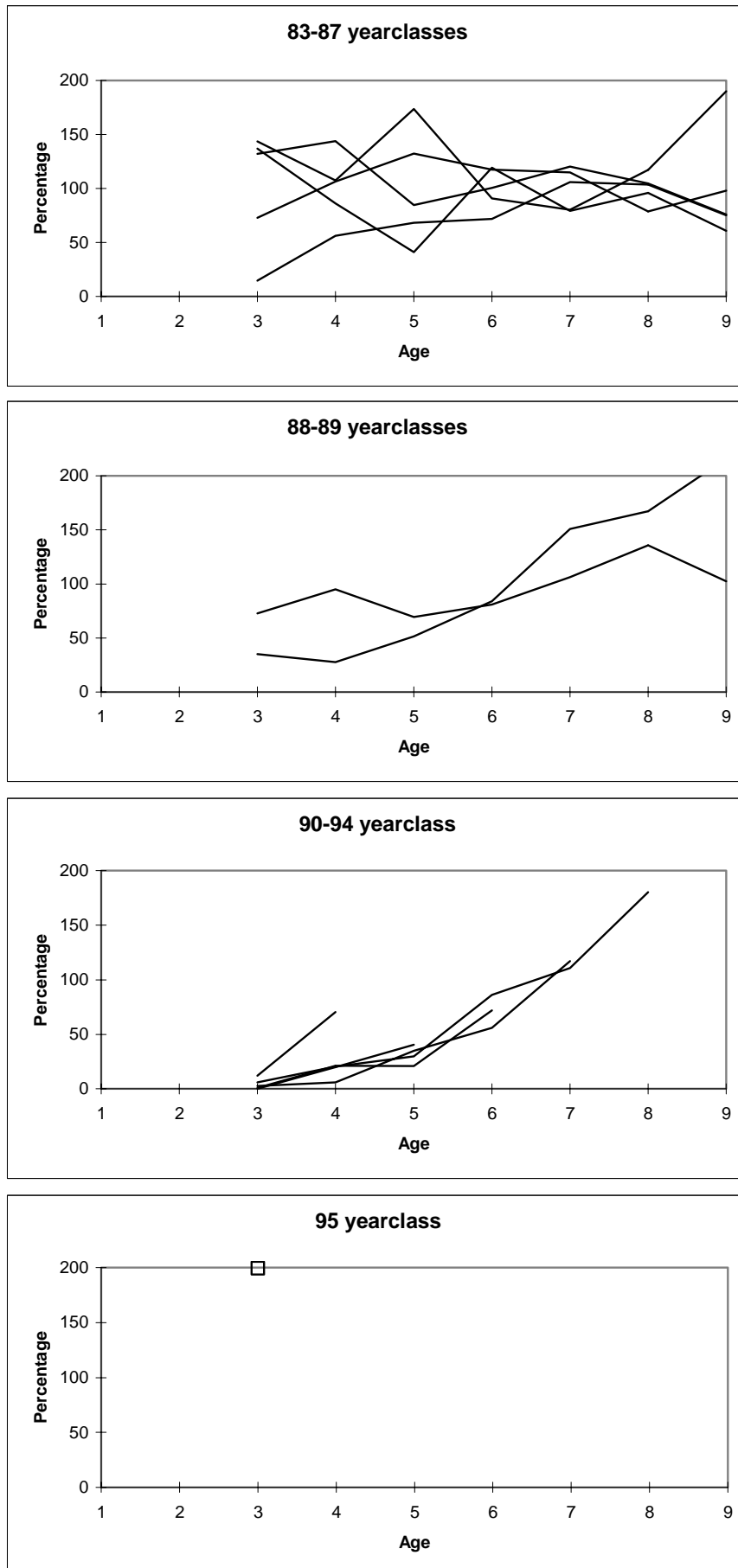


Figure 8.4. GREENLAND HALIBUT in Sub-area I and II:
 Abundance at age from the Norwegian stratified Greenland halibut survey. Data for consecutive yearclasses at selected ages. The last bar in each figure is based on preliminary data from 1999.

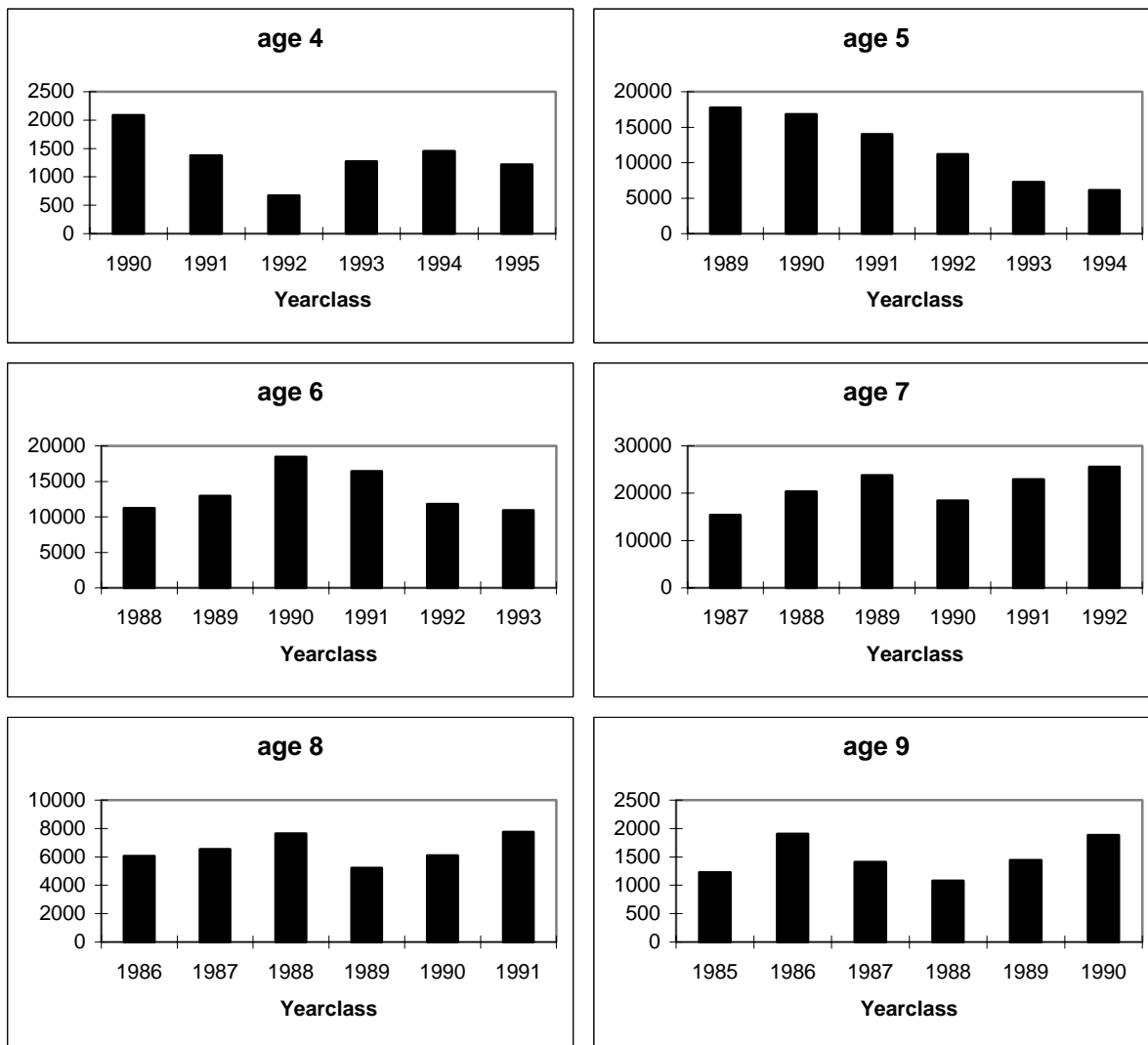


Table E1 GREENLAND HALIBUT in Sub-area I and II. Norwegian bottom-trawl survey indices (numbers in thousands) in the Svalbard area (Division IIb)

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	10,700
1997 ¹	0.8	370	1500	280	+	350	2690	1650	280	260	7,380
1998 ¹	2.2	1997	1950	1891	408	598	1919	2512	1130	733	13,138

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													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13+	
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
1999	-	77	276	243	495	485	1058	555	408	152	75	56	-	3880

B

Year	Age													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13+	
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
1999	41	195	691	825	829	1531	3130	1496	1011	500	115	129	101	10594

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 indices at different age (numbers in thousands).

Year	Age-group													Total
	≤ 3	4	5	6	7	8	9	10	11	12	13	14	15+	
1984	4124	5359	7788	24951	19863	11499	6750	5416	2420	1196	247	146	143	89896
1985	3331	4371	17076	35648	27826	11717	5722	4090	1937	895	311	31	131	113088
1986	2687	6600	15853	25696	16468	5436	3811	2660	974	539	184	72	6	80985
1987	289	6761	9724	12703	7633	3867	1903	1627	721	416	110	0	38	45791
1988	2591	4409	7891	14181	11311	4308	2253	1756	820	307	125	163	54	50168
1989	1429	11310	13124	25881	12782	5989	2381	1285	334	271	98	102	118	75104
1990	2820	8360	16252	15621	11393	4120	1911	1158	307	198	58	36	0	62233
1991*	1422	8455	25408	21843	15235	9419	2369	1211	655	142	95	16	26	86294
1992	685	7461	33341	25498	17272	10178	2720	1262	938	318	67	0	0	99740
1993	114	2166	13317	19752	16528	10305	3370	1868	903	519	103	111	111	69165
1994	49	1604	9868	17549	11533	7746	3401	1876	605	394	114	114	57	54911
1995	19	467	5759	18222	15296	11539	4393	1413	529	312	84	11	32	58076
1996**	0	1670	6680	18722	21714	13354	8512	476	284	106	115	36	20	71689
1997	235	1575	4023	12165	15919	16452	4591	1432	779	162	271	66	88	57758
1998	3917	5542	7768	15589	16842	17727	9676	2548	1752	535	254	85	72	82307

* : Age composition based on combined age-length-keys for 1990 and 1992.

** : Only half of standard area investigated

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, April-May and August 1998. Numbers in thousands

A: Only western area for the years 1988-97; B: Including areas east of Bear Island for the years 1992-98.

Year	Age									Total
	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

¹The length distribution was split on age according to Macdonald and Pitcher (1979).

²An 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.

³An age-length key from the bottom trawl survey for cod at Svalbard in August-September the same year was used to convert the indices from length to age.

Year	Age									Total
	1	2	3	4	5	6	7	8	9+	
	167	144	1268	2127	5224	6544	3378	3370	2314	24536
1993 ³	94	159	+	937	2389	1725	3296	2034	332	10966
1994 ³	+	66	164	531	2699	1865	2510	887	284	9006
1995 ³	69	78	237	640	2680	2168	3793	1501	379	11544
1996 ³	911	77	194	324	1577	3323	5358	1920	452	14136
1997 ³	6699	1121	178	558	644	7480	4953	841	445	22921
1998 ³	3245	2355	2208	1440	1598	3083	3213	1488	1298	19928

Table E5. GREENLAND HALIBUT in Sub-area I and II. Abundance indices on age from the Norwegian stratified bottom trawl survey in August using a hired commercial vessel (numbers in thousands). Trawls were made at 500-1500 m depth along the continental slope from 68-80°N.

year	AGE														total	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		15+
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	0	0	7	1456	7290	11800	22946	6111	1443	4127	1230	955	13	177	19	57574
1999 ¹	0	0	47	1215	6143	10907	25553	7749	1884	5376	1618	1301	21	268	9	62091

¹: Preliminary

Table E6. GREENLAND HALIBUT in Sub-area I and II. Abundance indices on age from the Norwegian bottom trawl survey north and east of Spitsbergen in September (numbers in thousands). * - incl. Russian EEZ.

year	AGE						Total
	1	2	3	4	5	6+	
1996	15655	14510	10025	3487	1593	3349	48619
1997	3415	15356	14097	2746	417	434	36465
1998	8817	19017	9443	5268	1191	961	44697
1998*	10548	28316	17357	6512	1584	961	65278

Table E7 GREENLAND HALIBUT in Sub-areas I and II

Results from a research program using trawlers in a limited commercial fishery 1992-1999.

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	1999*
1								
2								
3	0.1			0.1		0.0	0.0	0.0
4	4.6	4.2	3.2	0.7	0.5	0.9	0.2	0.7
5	19.1	25.0	24.7	22.5	19.5	24.8	6.6	7.7
6	23.0	18.4	23.8	22.6	31.6	22.9	25.5	23.0
7	25.9	27.1	26.8	30.2	35.6	30.5	44.5	39.6
8	13.3	12.4	11.2	11.0	8.7	10.1	15.5	14.5
9	1.7	0.7	1.0	2.7	1.3	2.6	4.5	1.6
10	6.8	7.4	5.9	6.6	2.0	5.0	2.0	9.7
11	2.9	3.1	2.4	2.0	0.5	1.9	0.8	1.0
12	1.7	1.0	0.6	1.1	0.2	0.8	0.3	1.8
13	0.5	0.4	0.2	0.3	0.0	0.3		0.2
14	0.2	0.2	0.1	0.2	0.1	0.2		0.2
15	0.1					0.0		0.0

Mean individual weight (kg)								
Age	1992	1993	1994	1995	1996	1997	1998	1999*
1								
2								
3	0.26			0.40		0.39		
4	0.50	0.53	0.52	0.47	0.48	0.45	0.41	0.51
5	0.71	0.76	0.73	0.70	0.74	0.69	0.76	0.74
6	0.96	0.98	0.95	0.94	0.94	0.88	0.96	0.92
7	1.29	1.33	1.28	1.24	1.23	1.15	1.19	1.25
8	1.77	1.85	1.79	1.71	1.66	1.55	1.79	1.64
9	2.00	2.28	2.23	2.03	2.00	1.87	2.26	2.18
10	2.46	2.65	2.55	2.50	2.50	2.34	2.54	2.38
11	3.10	3.43	3.37	3.28	3.16	2.95	3.47	3.17
12	3.86	4.32	4.22	3.71	3.70	3.46	4.16	3.79
13	4.44	5.18	5.01	4.62		4.52		5.07
14	6.00	6.44	6.29	5.59		5.47		5.60
15	5.22							

CPUE (N) on age								
	1992	1993	1994	1995	1996	1997	1998	1999*
1								
2								
3	0			1	0	0	0	0
4	19	30	26	7	7	11	2	7
5	80	176	198	219	286	298	59	72
6	97	130	191	220	463	275	229	214
7	109	191	215	294	521	366	400	369
8	56	87	90	107	127	121	139	135
9	7	5	8	26	19	31	40	15
10	29	52	47	64	29	60	18	90
11	12	22	19	19	7	23	7	9
12	7	7	5	11	3	10	3	17
13	2	3	2	3	0	4	0	2
14	1	1	1	2	1	2	0	2
15	0			0	0	0	0	0

CPUE (kg) on age								
	1992	1993	1994	1995	1996	1997	1998	1999*
1								
2								
3	0			0	0	0	0	0
4	10	16	13	3	4	5	1	3
5	57	134	145	153	211	207	45	53
6	93	127	182	207	435	243	220	197
7	140	254	276	364	641	423	476	461
8	99	162	161	183	211	189	249	221
9	14	11	18	53	38	59	91	32
10	70	138	121	161	73	141	46	215
11	38	75	65	64	23	68	25	30
12	28	30	20	40	11	33	11	64
13	9	15	8	13	0	16	0	9
14	5	9	5	11	0	13		10
15	2			0	0	0		

Overall mean individual weight (kg)	1.35	1.38	1.27	1.29	1.12	1.16	1.30	1.39
CPUE (kg round weight per trawlh hour)**	567	973	1020	1255	1640	1393	1169	1294
CPUE (Number fish per trawlh hour)**	420	705	803	973	1464	1201	899	931
Catch (in tonnes)	695	862	811	368	436	274	272	269

*) Preliminary

* *) Average for freezer- and factorytrawler

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	UK	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	-	6	-	-	921
1995	+	706	165	2	460	-	52	283	-	1668
1996	+	-	249	1	2015 ¹	-	105	159	-	2529
1997	+	-	316	3	1028 ¹	-	1	162	-	1510
1998 ¹	+	-	71	10	804	-	-	-	471	1356

¹ Provisional figures

9 ALTERNATIVE ASSESSMENT METHODS

A new assessment method - Fleksibest - was presented to the Working Group. This method was developed as an attempt to introduce assessment methods where a self-contained parametric model is used for the mortalities, and the parameters are estimated by non-linear optimisation of an objective function, for use in the assessment of boreal stocks, in particular North-East Arctic cod. This is the same principle as in ADAPT (Gavaris 1988) and ICA (Patterson and Melvin 1996), which is currently used for many stocks in ICES.

A major concern when applying this principle to stocks in the North-East Arctic was that the assumption of separable fishing mortality might be violated because of growth variations from year to year, as well as variable participation by fleets with different selection properties. Therefore, a population model was designed which is disaggregated both by length and age, and the fishing mortalities are defined by fleet and length. Moreover, cannibalism is included through a consumption model, natural mortality can be allowed to vary, and mature and immature fish are treated as two separate stocks. The model runs in quarterly time steps. The model is implemented as an extension and modification of the BORMICON model developed by MRI in Reykjavik (Stefansson and Palsson, 1997). A more detailed description was presented as a Working Document to the Working Group (Bogstad, Frøysa and Skagen, WD#20).

The model has been operative since late 1998, but has been developed further since then. There are still some elements that are not implemented, or need to be further developed. During the Working Group meeting, a range of exploratory runs were made. A selection of these are assembled in a Working Document prepared during the meeting (Skagen and Åsnes, WD#32).

The general impression is that this method picks up the same trends in population abundance and mortalities as the XSA. Since the population estimates backwards in time are not totally determined by the catches in the same way as in VPA based methods, trends as seen in the surveys are better preserved. Hence, the stock estimates fluctuate more, and are a good deal higher than estimated by XSA in some periods, in particular in the early 1990's. The fishing mortality fluctuates correspondingly. The estimated catches are consistently higher than the observed catches, which is a matter of concern. Giving increased weight to the surveys generally lowers the stock estimates and increases the F-estimates. Residual natural mortality was estimated for fish larger than 90 cm, which gave values in the range 0.3 - 0.4 for the oldest fish. Predation mortality due to cannibalism was also estimated. No attempt was made to estimate residual natural mortality for fish < 90 cm, and it is uncertain whether this can be done with confidence. Giving different weight to different sources of information did not lead to large differences in the final results, suggesting that the apparent conflict between data from different sources may have been resolved by the way they are interpreted by the model. Retrospective runs indicated that the perception of the state of the stock changes less when new data are added, than is the case with the present XSA estimates for cod, as shown in Figure 9.1. With Fleksibest, the tendency is to underestimate the stock slightly in the most recent assessment years.

The Working Group considers this to be a promising approach to future assessments, and would encourage further development of the model.

The method has some advantages compared to the XSA:

- The perception of the state of the stock backwards in time is influenced by all sources of data, not only the catches.
- The method allows for excluding data of doubtful quality, and gives considerable freedom to emphasise certain data according to the judgement of the analyst.
- It allows for estimating the residual natural mortality for at least parts of the age/length range.
- It allows for estimating predation mortality using consumption data within the model.

On the other hand, the Working Group identified several points that need further elaboration before Fleksibest can be regarded as a true alternative to the XSA:

- The objective function used at present has no statistical justification, i.e. it is not a likelihood function under any stated assumptions about the distribution of the noise in the data.
- There is no objective, statistically founded way of weighting the contributions to the objective function from different sources of data.
- The present objective function is very sensitive to skewed length distributions, in particular in the youngest ages. The way of modelling length distributions is not satisfactory at present.
- The model does not at present have facilities for estimating uncertainty.

Based on the experience from the trial runs,, a final run was made which the Working Group considers the best estimate with this method at present. This is presented as an experimental run for further consideration, and should not be regarded as an alternative to the ordinary assessment. This run was made for the full age range, and retrospectively with final years back to 1994.

The following data were included:

Catches in numbers at age and length by quarter:

- *Danish seine (Norway)*
- *Gillnet (Norway)*
- *Hand line (Norway)*
- *Long line (Norway)*
- *Trawlers (Norway)*
- *Trawlers (Russia)*

In addition, two fleets contribute to the fishing mortality in the model, with assumed mortality parameters, but without data to support estimation of these parameters

Third countries. Assumed to have a fishing mortality level at 40% of the Norwegian trawler fleet (corresponding to a catch of about 40% on average of the Norwegian trawler fleet in previous years), but with the selection pattern of the Russian trawler fleet.

Overfishing. Assumed selection as the Russian trawlers. The partial fishing mortality levels for the fleet overfish were assumed for the years 1990 - 1994. The values were derived from the assumed overfishing compared to the total catch, and previous XSA estimates of the fishing mortality, but should be considered as uncertain.

9.1 Survey fleets

Norwegian winter survey in the Barents Sea - bottom trawl indices (applied to immature stock). This survey is split into two, because of the change of gear in 1994:

1983 - 1993
1994 - 1999

Norwegian winter survey in the Barents Sea - acoustic estimates (applied to immature stock). This survey is split into two, because of the change of echosounder in 1990:

1983 - 1989
1990 - 1999

Lofoten acoustic survey (applied to the mature stock)

Svalbard bottom trawl survey (applied to combined immature and mature stock)

Russian survey data have so far not been included because they for the time being are not available disaggregated by age and length.

Consumption data. (biomass of cod of length l consumed by cod of age a per time step). These data were calculated from stomach data outside the model.

The objective function was the Pearson function: $\sum(X_{obs}-X_{mod})^2/X_{mod}$. Catch data were aggregated over quarters before applying this function. The contribution from the catch data were upweighted by a factor of 10 in the objective function, compared to the surveys, in order to bring the contributions from these sources on the same order of magnitude. Likewise, the Lofoten survey was upweighted by a factor of 10 and the consumption data by a factor of 15000.

The output of the run for the full range of years is presented in Table 9.1. Summary plots for this run and the retrospective runs, together with the results of the standard XSA assessment are shown in Figure 9.1

The results show that the trends in fishing mortality and SSB found in the XSA assessment are found also with Fleksibest, with somewhat more pronounced fluctuations. This may be because the stock abundance in previous years are not fixed by the catch data as in a VPA with fixed natural mortality. Rather, Fleksibest will interpret the reduction with age in the survey indices and the catches as expressing the total mortality, and allocate this to fishing mortality and natural mortality to give an optimal fit to the catches.

Table 9.1**Results of assessment of North-East Arctic cod using Fleksibest**

runid -nohostname- Tue Aug 31 10:14:11 1999
 stocks cod.imm cod.mat
 areas 0

Total fishing mortality at age

Year	1983	1984
------	------	------

Age

2	0.0111	0.0111
3	0.0323	0.0740
4	0.1324	0.1394
5	0.2668	0.2892
6	0.3968	0.4230
7	0.5785	0.5392
8	0.6513	0.6789
9	0.7162	0.7155
10	0.6995	0.7413
11	0.7706	0.7514
12	0.7711	0.7748
13	0.7711	0.7751
14	0.7711	0.7751
15+	0.7711	0.7751

F 5-10	0.5515	0.5645
--------	--------	--------

Total fishing mortality at age

Year	1985	1986	1987	1988	1989	1990	1991
------	------	------	------	------	------	------	------

Age

2	0.0040	0.0062	0.0051	0.0097	0.0091	0.0098	0.0095
3	0.0652	0.0509	0.0704	0.0305	0.0525	0.0532	0.0694
4	0.1858	0.2481	0.2404	0.1623	0.0980	0.1097	0.1539
5	0.2497	0.4377	0.5662	0.3304	0.2259	0.1358	0.2032
6	0.3662	0.5137	0.7743	0.5724	0.3216	0.1806	0.2207
7	0.4590	0.6341	0.8422	0.7327	0.4422	0.2034	0.2489
8	0.5296	0.7098	0.9330	0.7915	0.5333	0.2258	0.2633
9	0.6005	0.7556	0.9761	0.8782	0.5704	0.2392	0.2774
10	0.6140	0.7940	0.9963	0.9226	0.6257	0.2437	0.2852
11	0.6269	0.8016	1.0110	0.9455	0.6548	0.2503	0.2887
12	0.6282	0.8066	1.0133	0.9591	0.6656	0.2524	0.2913
13	0.6378	0.8072	1.0149	0.9615	0.6728	0.2533	0.2923
14	0.6379	0.8120	1.0151	0.9632	0.6741	0.2539	0.2927
15+	0.6379	0.8121	1.0168	0.9637	0.6751	0.2540	0.2931

F 5-10	0.4698	0.6408	0.8480	0.7046	0.4532	0.2047	0.2498
--------	--------	--------	--------	--------	--------	--------	--------

Total fishing mortality at age

Year	1992	1993	1994	1995	1996	1997	1998	1996-1998
------	------	------	------	------	------	------	------	-----------

Age

2	0.0050	0.0025	0.0023	0.0027	0.0032	0.0048	0.0027	0.0036
3	0.0673	0.0471	0.0348	0.0268	0.0340	0.0547	0.0465	0.0451
4	0.1770	0.1835	0.1791	0.1292	0.1354	0.2074	0.1849	0.1759
5	0.2476	0.2864	0.3480	0.2946	0.2981	0.4035	0.3559	0.3525
6	0.2799	0.3402	0.4382	0.4256	0.4439	0.5905	0.5007	0.5117
7	0.2911	0.3661	0.4838	0.5047	0.5402	0.7318	0.6254	0.6325
8	0.3094	0.3756	0.5051	0.5530	0.5973	0.8281	0.7246	0.7167
9	0.3184	0.3910	0.5125	0.5770	0.6301	0.8841	0.7940	0.7694
10	0.3266	0.3984	0.5230	0.5847	0.6434	0.9131	0.8313	0.7959
11	0.3312	0.4052	0.5297	0.5991	0.6517	0.9269	0.8511	0.8099
12	0.3324	0.4079	0.5331	0.6044	0.6578	0.9314	0.8574	0.8155
13	0.3336	0.4087	0.5347	0.6080	0.6606	0.9360	0.8600	0.8189
14	0.3341	0.4096	0.5352	0.6097	0.6625	0.9380	0.8624	0.8210
15+	0.3344	0.4100	0.5358	0.6104	0.6635	0.9396	0.8637	0.8223

F 5-10	0.2955	0.3596	0.4684	0.4899	0.5255	0.7252	0.6387
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Table 9.1 cont.

Residual natural mortality (M1)

Year	1983	1984
Age		
2	0.2000	0.2000
3	0.2000	0.2000
4	0.2000	0.2000
5	0.2000	0.2000
6	0.2000	0.2000
7	0.2005	0.2003
8	0.2021	0.2036
9	0.2307	0.2126
10	0.2485	0.2472
11	0.3847	0.2784
12	0.4764	0.4242
13	0.4764	0.5150
14	0.4765	0.5151
15+	0.4766	0.5156

Residual natural mortality (M1)

Year	1985	1986	1987	1988	1989	1990	1991
Age							
2	0.2000	0.1999	0.1999	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2002	0.2002	0.2001	0.2001	0.2001	0.2001	0.2003
8	0.2017	0.2014	0.2010	0.2005	0.2011	0.2013	0.2012
9	0.2116	0.2058	0.2045	0.2031	0.2029	0.2063	0.2063
10	0.2265	0.2235	0.2132	0.2101	0.2108	0.2113	0.2177
11	0.2693	0.2436	0.2397	0.2238	0.2259	0.2296	0.2287
12	0.2954	0.2877	0.2616	0.2553	0.2453	0.2512	0.2531
13	0.4533	0.3116	0.3070	0.2786	0.2838	0.2757	0.2794
14	0.5402	0.4794	0.3280	0.3237	0.3090	0.3197	0.3069
15+	0.5405	0.5624	0.5349	0.3823	0.3685	0.3553	0.3706

Residual natural mortality (M1)

Year	1992	1993	1994	1995	1996	1997	1998	1996-1998
Age								
2	0.2000	0.2000	0.1999	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.1999	0.1999	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2001	0.2001	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2003	0.2008	0.2007	0.2004	0.2002	0.2001	0.2001	0.2001
8	0.2020	0.2020	0.2036	0.2032	0.2024	0.2016	0.2009	0.2016
9	0.2056	0.2070	0.2063	0.2094	0.2094	0.2079	0.2058	0.2077
10	0.2167	0.2143	0.2150	0.2137	0.2191	0.2205	0.2180	0.2192
11	0.2364	0.2329	0.2280	0.2289	0.2281	0.2363	0.2379	0.2341
12	0.2497	0.2567	0.2505	0.2442	0.2468	0.2467	0.2567	0.2501
13	0.2790	0.2724	0.2775	0.2701	0.2651	0.2689	0.2691	0.2677
14	0.3084	0.3050	0.2947	0.2993	0.2937	0.2895	0.2940	0.2924
15+	0.3620	0.3513	0.3448	0.3341	0.3329	0.3303	0.3218	0.3283

Predation mortality (M2)

Year	1983	1984
Age		
2	0.0844	0.0968
3	0.0470	0.0204
4	0.0092	0.0089

Predation mortality (M2)

Year	1985	1986	1987	1988	1989	1990	1991
Age							
2	0.2816	0.5839	0.8613	0.3974	0.2482	0.1847	0.2129
3	0.0398	0.1648	0.2036	0.2078	0.0616	0.0355	0.0486
4	0.0062	0.0167	0.0445	0.0294	0.0282	0.0069	0.0068

Table 9.1 cont.

Predation mortality (M2)								
Year	1992	1993	1994	1995	1996	1997	1998	1996-1998
Age								
2	0.3224	0.6858	1.1730	1.1224	0.6923	0.4494	0.3742	0.5053
3	0.0870	0.2359	0.4865	0.5534	0.3327	0.1957	0.1138	0.2141
4	0.0140	0.0431	0.1141	0.1516	0.1096	0.0635	0.0319	0.0683

Stock numbers (thousands) at age by Jan. 1

Year	1983	1984	1985
Age			
2	724185	853785	2670300
3	223310	538909	627556
4	167390	168894	401449
5	119188	118906	119128
6	50936	74598	72803
7	33070	28021	39990
8	29626	15169	13370
9	5557	12615	6275
10	2223	2293	5028
11	776	720	810
12	487	244	257
13	168	140	74
14	18	48	38
15+	15	10	16
Total	1356949	1814351	3957094

Stock numbers (thousands) at age by Jan. 1

Year	1986	1987	1988	1989	1990	1991	1992
Age							
2	1187090	1180410	378925	471446	709617	1315240	2178460
3	1642820	538610	406157	206497	298422	478291	862084
4	462548	1084055	335268	261972	150836	223579	348010
5	271095	290307	665063	225931	188711	109852	155850
6	75783	142946	134242	388744	147019	134448	73308
7	41308	37074	53895	61910	230459	100416	88209
8	20678	17927	13048	21176	32541	153860	64057
9	6432	8311	5760	4826	10150	21219	96642
10	2835	2471	2569	1974	2260	6578	13209
11	2120	1013	716	802	817	1350	3839
12	331	745	290	223	332	506	805
13	102	111	208	86	89	201	293
14	25	33	30	60	33	53	113
15+	17	11	11	11	26	33	46
Total	3713183	3304023	1996182	1645657	1771313	2545626	3884925

Stock numbers (thousands) at age by Jan. 1

Year	1993	1994	1995	1996	1997	1998	1999
Age							
2	2696200	3057130	1866650	2159810	3075820	3699380	1364300
3	1285507	1108203	768891	495475	881741	1598355	2070425
4	604893	793113	538633	352236	281058	561935	1114562
5	235306	394574	483563	332210	225065	175038	369409
6	99448	143817	224300	286545	196788	120830	99428
7	45349	57897	75797	119511	149809	88873	59748
8	53938	25718	29187	37419	56938	58912	38857
9	38395	30257	12658	13696	16809	20315	23313
10	57444	22234	15210	6056	6004	5683	7526
11	7401	29951	10131	6538	2462	1883	1927
12	2177	3910	14041	4426	2713	769	634
13	450	1120	1786	6010	1791	835	253
14	159	228	497	742	2381	537	270
15+	82	116	147	258	380	805	415
Total	5126750	5668267	4041491	3820931	4899760	6334149	5151066

Table 9.1 cont.

Spawning stock biomass (tons) at Jan. 1

Year	1983
Age	
4	4716
5	53194
6	26353
7	55077
8	55386
9	35943
10	14154
11	11377
12	8262
13	2852
14	314
15+	255

SSB total 267883

Spawning stock biomass (tons) at Jan. 1

Year	1984	1985	1986	1987	1988	1989	1990	1991
Age								
4	0	0	0	0	0	0	0	0
5	27816	22612	55207	47274	34015	17008	22423	32263
6	77451	62612	41962	103990	55277	108266	70369	82478
7	48878	87129	64873	48229	70919	68963	240804	150011
8	61609	46012	61792	49398	26620	54860	81218	378074
9	68301	37918	27262	36128	21396	17071	43923	89193
10	18843	36494	17523	14006	13456	10764	11835	38449
11	7654	8062	15626	7936	4832	5910	6202	9630
12	4121	2814	2976	6636	2489	1923	2990	4318
13	2699	1201	983	1184	2004	915	922	1961
14	931	697	339	377	333	705	407	573
15+	186	289	250	184	142	151	359	427

SSB total 318488 305840 288792 315341 231483 286536 481452 787375

Spawning stock biomass (tons) at Jan. 1

Year	1992	1993	1994	1995	1996	1997	1998	1999
Age								
4	0	0	0	0	0	0	0	0
5	58420	77034	92842	60796	29155	17971	15388	32094
6	85281	127510	152284	162625	140724	74172	42151	34837
7	152986	114683	142626	151886	193833	183965	91538	53196
8	199858	175337	97925	106410	123161	161801	142670	74961
9	414839	185787	135535	63435	68218	78839	88906	81857
10	78786	343811	123621	83542	35903	37711	35346	39593
11	29886	58366	211332	73018	45987	18978	15204	13632
12	6854	20099	32152	114802	35952	22641	7071	5271
13	2890	4498	10471	16990	54176	17060	8227	2334
14	1245	1810	2272	5375	7580	24966	5930	2642
15+	580	1073	1340	1790	2988	4613	9831	4679

SSB total 1031625 1110007 1002400 840667 737675 642716 462261 345095

Table 9.1 cont.

Total stock biomass (tons) at Jan. 1

Year	1983
Age	
2	141195
3	82070
4	162412
5	207480
6	134822
7	139831
8	160176
9	43898
10	19011
11	11377
12	8262
13	2852
14	314
15+	255
Total	1113956

Total stock biomass (tons) at Jan. 1

Year	1984	1985	1986	1987	1988	1989	1990	1991
Age								
2	185509	331868	100662	89496	40578	74468	155988	237034
3	346804	369500	520822	171820	85680	89812	193571	338950
4	164080	496896	424656	748241	200712	168330	170747	301262
5	208440	197306	435269	412646	667706	274237	267407	215139
6	195670	189503	153037	318749	236621	676436	311472	309316
7	101146	144437	121521	100297	143073	168231	632122	314202
8	81930	62658	80182	67714	41551	81624	126032	590662
9	84054	41117	31060	40412	25200	21768	52403	106902
10	20769	38652	18156	14728	14210	11722	13288	41363
11	7654	8062	15626	7936	4832	5910	6202	9630
12	4121	2814	2976	6636	2489	1923	2990	4318
13	2699	1201	983	1184	2004	915	922	1961
14	931	697	339	377	333	705	407	573
15+	186	289	250	184	142	151	359	427
Total	1403993	1885000	1905537	1980419	1465132	1576230	1933911	2471739

Total stock biomass (tons) at Jan. 1

Year	1992	1993	1994	1995	1996	1997	1998	1999
Age								
2	294351	191618	157769	99096	131161	181430	184613	73808
3	501414	560029	361320	209069	147794	282712	504610	525812
4	448631	693550	734100	394923	239365	201846	408220	779715
5	332899	477396	704426	685138	410930	270358	212584	446758
6	214475	301079	395358	514293	571886	361107	214775	175144
7	295792	178616	218869	251014	362779	407086	227910	142644
8	278723	238696	120242	129932	157896	222396	216025	125298
9	498288	212943	155496	69123	74513	88024	102969	100841
10	84743	369115	135568	90374	38467	39421	37180	42472
11	29886	58366	211332	73018	45987	18978	15204	13632
12	6854	20099	32152	114802	35952	22641	7071	5271
13	2890	4498	10471	16990	54176	17060	8227	2334
14	1245	1810	2272	5375	7580	24966	5930	2642
15+	580	1073	1340	1790	2988	4613	9831	4679
Total	2990770	3308888	3240716	2654934	2281473	2142637	2155148	2441047

Table 9.1 cont.

Weight (kg) in catch (Observed)						
Year	1983	1985	1986	1987	1988	1989
Age						
1	0.02	0.09	0.11	0.13	0.09	0.07
2	0.45	0.38	0.32	0.30	0.27	0.37
3	0.84	0.98	0.70	0.56	0.56	0.62
4	1.37	1.43	1.33	0.94	0.87	0.89
5	2.08	2.15	1.99	1.70	1.36	1.30
6	2.86	3.26	3.10	2.63	2.19	1.99
7	3.99	4.68	4.55	4.28	3.47	3.14
8	5.58	6.05	5.80	6.20	5.93	4.72
9	7.76	7.77	6.68	8.69	8.61	7.41
10	9.30	9.88	7.56	9.74	9.60	9.08
11	11.55	11.99	9.75	12.39	10.95	11.73
12	16.19	14.24	10.69	13.80	14.20	12.41
13	16.42	14.17	12.86	15.29	18.97	15.23
14	16.97	13.52	9.59	10.43	12.89	19.47
15+	24.45	15.34	16.31	19.96	10.16	14.68

Weight (kg) in catch (Observed)										
Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1996-1998
Age										
1	0.05	0.16	0.10	0.06	0.06	0.11	0.04	0.11	0.11	0.09
2	0.48	0.60	0.43	0.55	0.49	0.46	0.34	0.33	0.35	0.34
3	0.76	1.28	1.00	1.10	0.79	0.84	0.86	0.83	0.63	0.78
4	1.07	1.64	1.56	1.57	1.38	1.26	1.22	1.15	1.01	1.13
5	1.45	2.03	2.25	2.26	2.14	1.83	1.73	1.62	1.55	1.63
6	1.91	2.51	2.98	3.16	2.97	2.68	2.46	2.34	2.18	2.33
7	2.99	3.29	3.95	4.24	4.17	3.38	3.87	3.44	3.27	3.53
8	4.64	4.59	5.06	5.26	5.62	5.05	5.60	5.35	4.84	5.27
9	7.37	6.08	6.19	6.10	6.84	6.32	6.63	7.40	6.93	6.99
10	9.49	8.93	8.11	7.12	7.51	7.98	8.12	7.74	9.35	8.40
11	13.17	12.05	10.50	7.89	8.02	8.99	9.41	8.53	10.32	9.42
12	17.62	16.22	12.02	10.15	9.62	9.27	10.71	11.16	15.81	12.56
13	7.96	-	19.30	16.03	12.29	11.68	11.42	8.06	14.44	11.31
14	14.62	14.20	15.80	19.50	11.45	17.77	9.51	13.09	13.89	12.17
15+	-	16.60	16.50	17.70	19.77	21.10	24.20	-	15.90	-

Table 9.1 cont.

Weight (kg) in catch (Model)						
Year	1983	1985	1986	1987	1988	1989
Age						
1	-	-	-	-	-	-
2	0.57	0.40	0.39	0.29	0.28	0.46
3	0.87	1.01	0.88	0.78	0.69	0.82
4	1.44	1.60	1.51	1.19	1.10	1.19
5	2.12	2.08	2.07	1.85	1.57	1.57
6	3.00	2.95	2.59	2.50	2.28	2.19
7	4.50	3.87	3.44	3.10	2.98	3.09
8	5.82	4.89	4.29	4.13	3.68	4.00
9	8.66	6.51	5.31	5.21	4.81	4.78
10	9.61	7.60	6.73	6.54	5.93	6.02
11	16.52	9.66	7.51	8.13	7.39	7.28
12	19.32	10.52	8.72	9.25	8.83	8.71
13	19.32	14.89	8.88	10.32	10.04	10.13
14	19.43	16.67	11.12	10.26	11.15	10.98
15+	19.26	16.89	12.84	12.42	12.21	11.76

Weight (kg) in catch (Model)										
Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1996-1998
Age										
1	-	-	-	-	-	-	-	-	-	-
2	0.61	0.66	0.61	0.41	0.29	0.26	0.27	0.28	0.30	0.28
3	1.08	1.20	1.22	1.05	0.93	0.78	0.76	0.75	0.78	0.76
4	1.36	1.79	1.89	1.70	1.55	1.31	1.21	1.20	1.23	1.21
5	1.80	2.21	2.62	2.49	2.27	1.94	1.77	1.68	1.69	1.72
6	2.25	2.79	3.12	3.36	3.20	2.81	2.57	2.35	2.28	2.40
7	3.15	3.46	3.86	3.94	4.18	3.89	3.64	3.27	3.13	3.35
8	4.15	4.37	4.68	4.71	4.86	4.96	4.85	4.45	4.22	4.51
9	5.12	5.52	5.65	5.58	5.67	5.60	6.05	5.75	5.52	5.77
10	5.93	6.60	6.83	6.57	6.60	6.43	6.67	6.90	6.87	6.82
11	7.18	7.43	7.99	7.89	7.61	7.48	7.75	7.68	8.13	7.85
12	8.22	8.59	8.58	9.03	8.91	8.62	8.71	8.45	8.77	8.64
13	8.64	9.68	9.48	9.63	10.05	9.82	10.06	9.03	9.54	9.54
14	8.28	10.34	10.45	10.56	10.84	10.95	11.23	10.57	10.02	10.60
15+	10.50	11.50	11.02	11.63	12.32	11.95	12.61	11.45	11.60	11.89

Table 9.1 cont.

Weight (kg) in stock at Jan. 1									
Year	1983	1984	1985	1986	1987	1988	1989	1990	
Age									
2	0.19	0.22	0.12	0.08	0.08	0.11	0.16	0.22	
3	0.37	0.64	0.59	0.32	0.32	0.21	0.43	0.65	
4	0.97	0.97	1.24	0.92	0.69	0.60	0.64	1.13	
5	1.74	1.75	1.66	1.61	1.42	1.00	1.21	1.42	
6	2.65	2.62	2.60	2.02	2.23	1.76	1.74	2.12	
7	4.23	3.61	3.61	2.94	2.71	2.65	2.72	2.74	
8	5.41	5.40	4.69	3.88	3.78	3.18	3.85	3.87	
9	7.90	6.66	6.55	4.83	4.86	4.37	4.51	5.16	
10	8.55	9.06	7.69	6.40	5.96	5.53	5.94	5.88	
11	14.66	10.63	9.95	7.37	7.83	6.75	7.37	7.59	
12	16.97	16.89	10.95	8.99	8.91	8.58	8.63	9.01	
13	16.98	19.28	16.23	9.64	10.67	9.64	10.64	10.36	
14	17.43	19.40	18.35	13.56	11.42	11.11	11.75	12.32	
15+	17.03	18.57	18.04	14.71	16.72	12.94	13.71	13.80	

Weight (kg) in stock at Jan. 1										
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	1996-1998
Age										
2	0.18	0.14	0.07	0.05	0.05	0.06	0.06	0.05	0.05	0.06
3	0.71	0.58	0.44	0.33	0.27	0.30	0.32	0.32	0.25	0.31
4	1.35	1.29	1.15	0.93	0.73	0.68	0.72	0.73	0.70	0.71
5	1.96	2.14	2.03	1.79	1.42	1.24	1.20	1.21	1.21	1.22
6	2.30	2.93	3.03	2.75	2.29	2.00	1.84	1.78	1.76	1.87
7	3.13	3.35	3.94	3.78	3.31	3.04	2.72	2.56	2.39	2.77
8	3.84	4.35	4.43	4.68	4.45	4.22	3.91	3.67	3.22	3.93
9	5.04	5.16	5.55	5.14	5.46	5.44	5.24	5.07	4.33	5.25
10	6.29	6.42	6.43	6.10	5.94	6.35	6.57	6.54	5.64	6.49
11	7.13	7.78	7.89	7.06	7.21	7.03	7.71	8.07	7.07	7.61
12	8.53	8.51	9.23	8.22	8.18	8.12	8.35	9.19	8.31	8.55
13	9.76	9.86	9.99	9.35	9.51	9.01	9.53	9.85	9.22	9.46
14	10.81	11.02	11.38	9.96	10.81	10.21	10.49	11.04	9.79	10.58
15+	12.93	12.62	13.09	11.55	12.17	11.58	12.14	12.21	11.28	11.98

Table 9.1 cont.

Proportion mature at age									
Year	1983	1984	1985	1986	1987	1988	1989	1990	
Age									
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
4	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
5	0.256	0.133	0.115	0.127	0.115	0.051	0.062	0.084	
6	0.195	0.396	0.330	0.274	0.326	0.234	0.160	0.226	
7	0.394	0.483	0.603	0.534	0.481	0.496	0.410	0.381	
8	0.346	0.752	0.734	0.771	0.730	0.641	0.672	0.644	
9	0.819	0.813	0.922	0.878	0.894	0.849	0.784	0.838	
10	0.744	0.907	0.944	0.965	0.951	0.947	0.918	0.891	
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
15+	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

Proportion mature at age										
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	1997-1999
Age										
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000
5	0.150	0.175	0.161	0.132	0.089	0.071	0.066	0.072	0.072	0.0700
6	0.267	0.398	0.424	0.385	0.316	0.246	0.205	0.196	0.199	0.2000
7	0.477	0.517	0.642	0.652	0.605	0.534	0.452	0.402	0.373	0.4090
8	0.640	0.717	0.735	0.814	0.819	0.780	0.728	0.660	0.598	0.6620
9	0.834	0.833	0.872	0.872	0.918	0.916	0.896	0.863	0.812	0.8570
10	0.930	0.930	0.931	0.912	0.924	0.933	0.957	0.951	0.932	0.9467
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.0000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.0000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.0000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.0000
15+	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.0000

Table 9.1 cont.

fleets danish_seinedD.cod gillnetD.cod handlineD.cod longlineD.cod
 nortrawlD.cod rustrawltotalD.cod

Model catch in numbers (thousands) at age

Year	1983	1985	1986	1987	1988	1989	1990
Age							
1	0	0	0	0	0	0	0
2	5544	5196	5343	3575	1975	2005	2970
3	5213	21702	41422	45925	16484	6886	8749
4	16434	37644	63514	128576	110642	27048	16491
5	22943	17206	52963	87880	125184	87128	28340
6	14154	15942	20525	45925	53940	65084	53135
7	12781	10937	13667	15759	21797	19441	23545
8	12628	4346	7210	8270	7184	7014	5308
9	2540	2391	2518	3556	3452	2092	1530
10	994	1827	1296	1184	1376	943	448
11	362	302	798	603	443	349	174
12	222	95	131	294	235	110	59
13	77	28	40	49	98	55	19
14	8	14	10	14	17	23	10
15+	7	6	6	5	6	5	4
Total	93906	117634	209441	341615	342830	218184	140781

Model catch in numbers (thousands) at age

Year	1991	1992	1993	1994	1995	1996	1997	1998
Age								
1	0	0	0	0	0	0	0	0
2	3232	5728	3834	3008	2265	2309	5162	7385
3	8948	19939	27564	33110	19043	10780	17881	40898
4	10320	22002	38496	79441	83005	43538	37098	55496
5	11634	14873	25298	60595	99744	86700	67077	56218
6	13115	13946	13893	29636	55846	73071	80120	59849
7	17536	13406	11218	14022	23761	33805	54310	50866
8	12521	16392	10608	10802	10534	12566	21964	27013
9	2238	10098	11815	9667	7771	5129	7391	9368
10	689	1721	8036	10844	7145	3653	2909	2972
11	162	472	1226	6057	7175	3074	1857	1089
12	63	115	339	940	4124	3062	1595	780
13	23	43	79	248	619	1804	1536	616
14	6	15	28	58	159	259	898	629
15+	4	7	14	29	54	86	163	329
Total	80490	118753	152449	258456	321243	279835	299960	313507

Table 9.1 cont.

fleets danish_seined.cod gillnetD.cod handlineD.cod longlineD.cod
 nortrawlD.cod rustrawltotalD.cod

Observed catch in numbers (thousands) at age

Year	1983	1985	1986	1987	1988	1989	1990
Age							
1	382	10	98	22	14	3	2
2	475	640	1204	698	289	156	236
3	5275	15728	17893	18151	11175	4425	3609
4	14129	24891	55669	91538	57555	16008	14260
5	18164	18117	40464	87963	91646	74221	23139
6	14398	15669	14336	34300	65160	55553	34552
7	12598	10035	8759	7213	20665	20030	26586
8	13092	3372	3520	3242	2324	5403	4162
9	2148	1445	880	832	848	1097	543
10	580	721	667	414	264	443	125
11	227	150	501	169	89	83	46
12	60	40	130	204	66	25	9
13	26	26	25	18	41	3	5
14	3	27	34	59	14	11	4
15+	2	8	13	18	5	16	0
Total	81559	90879	144193	244841	250155	177477	107278

Observed catch in numbers (thousands) at age

Year	1991	1992	1993	1994	1995	1996	1997	1998
Age								
1	5	21	89	21	7	78	112	71
2	216	449	578	303	125	406	629	709
3	2318	6712	12556	6533	4657	7806	6603	13039
4	6131	12385	28023	41857	44442	28985	26540	49674
5	10174	13880	26712	75783	80296	75191	67388	61131
6	13250	16774	18282	41381	68705	76452	77857	63041
7	13804	15347	12892	13449	36801	42584	54695	39999
8	15561	8723	10229	7143	7420	9406	20792	24630
9	2119	9768	7023	5304	3052	2117	3074	6293
10	248	1148	8725	3680	1691	998	882	836
11	34	148	1296	5367	832	474	355	181
12	9	40	247	727	1685	192	144	49
13	0	1	40	80	171	602	86	32
14	1	2	6	12	37	61	183	16
15+	1	1	1	4	1	1	0	35
Total	63871	85399	126699	201644	249922	245353	259340	259736

Table 9.1 cont.

fleets danish_seined.cod gillnetD.cod handlineD.cod longlineD.cod
nortrawlD.cod rustrawltotalD.cod

Model catch in biomass (tons) at age

Year	1983	1985	1986	1987	1988	1989	1990
Age							
1	0	0	0	0	0	0	0
2	3166	2070	2077	1031	560	931	1815
3	4535	21856	36642	35660	11437	5667	9454
4	23624	60214	96109	152736	122095	32218	22470
5	48558	35812	109761	162949	196779	136430	50924
6	42398	47058	53133	114615	122916	142680	119292
7	57534	42346	46954	48824	65060	60101	74164
8	73457	21233	30896	34195	26432	28091	22006
9	22004	15566	13368	18521	16594	9993	7834
10	9552	13890	8719	7740	8157	5677	2657
11	5974	2917	5992	4903	3271	2542	1249
12	4299	1002	1143	2716	2074	955	486
13	1484	410	351	508	985	559	161
14	163	230	113	142	185	254	82
15+	133	95	81	65	71	58	40
Total	296880	264699	405339	584602	576618	426153	312633

Model catch in biomass (tons) at age

Year	1991	1992	1993	1994	1995	1996	1997	1998
Age								
1	0	0	0	0	0	0	0	0
2	2147	3471	1586	878	581	627	1426	2192
3	10744	24254	28952	30863	14797	8143	13396	31930
4	18487	41564	65406	123164	109001	52866	44580	68048
5	25687	39034	63070	137558	193043	153807	112619	95196
6	36550	43529	46711	94754	157046	187468	188143	136462
7	60696	51785	44146	58568	92326	122957	177819	159059
8	54711	76641	49922	52522	52292	60989	97828	113953
9	12359	57022	65889	54839	43525	31041	42485	51703
10	4550	11756	52800	71585	45928	24378	20084	20425
11	1205	3769	9668	46092	53637	23811	14271	8853
12	538	984	3062	8383	35567	26673	13483	6833
13	221	406	762	2489	6080	18155	13874	5876
14	66	154	301	629	1738	2903	9487	6298
15+	48	73	159	362	643	1080	1869	3818
Total	228010	354440	432434	682685	806204	714896	751363	710645

Table 9.1 cont.

fleets danish_seined.cod gillnetD.cod handlineD.cod longlineD.cod
 nortrawlD.cod rustrawltotalD.cod

Observed catch in biomass (tons) at age							
Year	1983	1985	1986	1987	1988	1989	1990
Age							
1	8	1	11	3	1	0	0
2	214	243	387	209	79	58	113
3	4457	15471	12450	10208	6273	2740	2747
4	19398	35495	74067	86334	50065	14222	15255
5	37870	38979	80493	149538	124244	96184	33520
6	41142	51057	44493	90158	142750	110374	66041
7	50245	46941	39821	30859	71703	62825	79499
8	72992	20399	20408	20107	13785	25493	19303
9	16675	11224	5875	7230	7302	8132	4004
10	5395	7126	5044	4031	2534	4022	1186
11	2621	1798	4883	2095	975	974	606
12	972	570	1390	2814	937	310	159
13	427	368	322	275	778	46	40
14	51	365	326	615	180	214	58
15+	49	123	212	359	51	235	0
Total	252514	230160	290181	404835	421656	325829	222530

Observed catch in biomass (tons) at age								
Year	1991	1992	1993	1994	1995	1996	1997	1998
Age								
1	1	2	5	1	1	3	12	8
2	129	194	317	149	57	139	210	247
3	2974	6728	13836	5188	3892	6747	5504	8202
4	10048	19360	43942	57732	55851	35317	30636	50306
5	20650	31263	60451	162227	147020	129741	108996	94551
6	33244	49923	57811	123084	184472	188153	181891	137630
7	45450	60667	54600	56056	124557	164769	188381	130822
8	71371	44179	53825	40164	37446	52692	111328	119322
9	12883	60509	42827	36287	19291	14032	22757	43593
10	2214	9314	62082	27627	13488	8099	6826	7815
11	410	1554	10223	43049	7482	4460	3028	1868
12	146	481	2507	6996	15624	2056	1607	774
13	0	19	641	984	1998	6874	693	462
14	14	32	117	137	657	580	2396	222
15+	17	16	18	79	21	24	0	556
Total	199550	284242	403201	559761	611856	613686	664264	596379

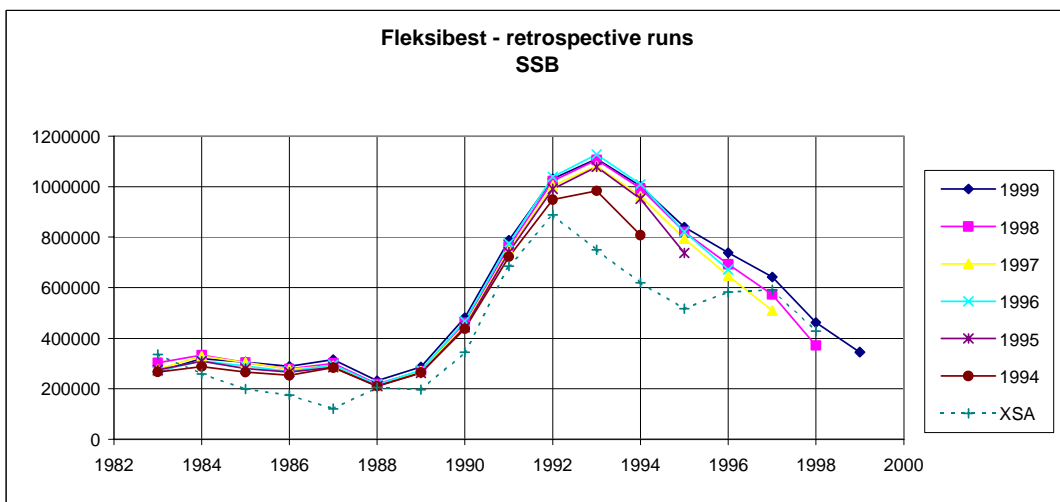
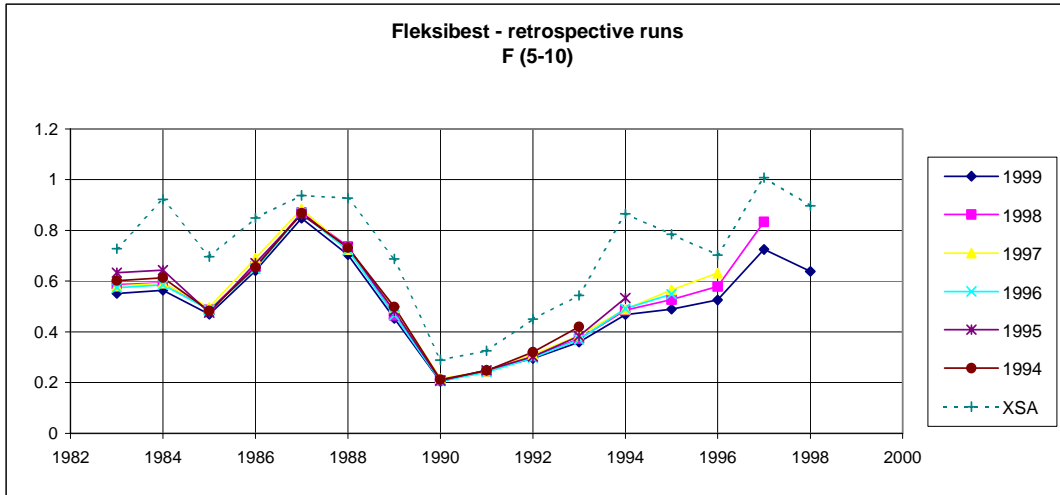


Figure 9.1

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11 WORKING DOCUMENTS

WD Number	WD Title	Author(s)
1	Availability of cod to the international 0-group survey	C.T. Marshall, G. Ottersen, B. Bogstad, K. Helle, K. Michalsen and M. Pennington
2	Condition and reproductive potential of Northeast Arctic cod in 1999 as determined by Norwegian and Russian surveys	C.T. Marshall and N.A. Yaragina
3	Maturity at age of Northeast Arctic cod in 1999 as estimated from Norwegian surveys of the Barents Sea and Lofoten region	C.T. Marshall
4	Biological investigations onboard a German commercial trawler in the NE-Atlantic and observations on the fishery situation	R. Schöne
5	On possibility of the use of the Ricker's model "stock-recruitment" for the estimation of recruitment of North-eastern Arctic cod population	V.L. Tretyak
6	Russian investigations of redfish (<i>Sebastes mentella</i> Travin) from the Norwegian-Barents Sea stock in 1999	K. Drevetnyak
7	The Russian trawl acoustic survey on demersal adult and young fish stock assessment in the Barents Sea in autumn/winter	Y.M. Lepesevich, O.V. Smirnov, and K.V. Drevetnyak
8	Catch-at-age data from the Soviet fishery for Greenland halibut <i>Reinhardtius hippoglossoides</i> (Walbaum) in the Barents Sea in 1964-1969	O.V. Smirnov
9	Results of the Russian survey of Greenland halibut in the Barents Sea in 1998	O.V. Smirnov
10	Scheme of recalculation of cod commercial catches weight into the number of fish of different length-age groups accepted in PINRO (Russia) for the Flexibest model	Y. Kovalev and N.A. Yaragina
11	Sampling and processing of conventional catch data by PINRO	N.A. Yaragina
12	A revision of the catch data for Northeast Arctic cod	B. Bogstad, Å. Fotland, and N.A. Yaragina
13	An evaluation of recruitment indices for Northeast Arctic cod (<i>Gadus morhua</i> L.)	K. Helle, B. Bogstad, C.T. Marshall, K. Michalsen, G. Ottersen, and M. Pennington
14	Growth prognosis of Northeast Arctic cod using a bioenergetics model	A. Ajjad
15	A revision of the abundance indices for cod from the Svalbard bottom trawl survey 1983-1998	B. Bogstad
16	A revision of the abundance indices for cod and haddock from the Norwegian winter survey in the Barents Sea, 1983-1999	B. Bogstad, Å. Fotland, and S. Mehl
17	Prognosis for development of the Barents Sea capelin stock	H. Gjørseter
18	Retrospective review of management advice and TAC's for some stocks	O. Nakken
19	Variability in individual and population fecundity of Northeast Arctic Greenland halibut, 1996-1998	A.C. Gundersen, K.H. Nedreaas, O.S. Kjesbu, and O.T. Albert
20	Fleksibest – an age-length structured assessment tool with application to North-east Arctic cod	B. Bogstad, K. Guldbrandsen Frøysa and D.W. Skagen
21	Acoustic and bottom trawl surveys; how much information do they provide for assessing the Northeast Arctic cod stock?	K. Korsbrekke, S. Mehl, O. Nakken and M. Pennington
22	Inter-sessional assessment Northeast Arctic saithe	S. Mehl
23	Investigations on demersal fish in the Barents Sea winter 1999	S. Mehl

WD Number	WD Title	Author(s)
24	Report to the Norwegian Russian Joint Fisheries Commission November 1996 – The results of investigations on shrimp in the Barents Sea and the Svalbard area	M. Aschan
25	Trawl acoustic indices and catch rates of <i>Sebastes mentella</i> , haddock and saithe from the Norwegian coastal surveys 1995-1998	E. Berg and O.T. Albert
26	Experimental XSA-assessment of Norwegian coastal cod	E. Berg
27	Spanish fishery on cod in 1998	H. Murua, X. Paz and L. Motos
28	Modelling the residual natural mortality rate for the Northeast Arctic cod at different fishing ages	V.L. Tretyak
29	Barents Sea temperatures and cod	G. Ottersen
30	Results from the Russian survey of bottom fish stocks in the Barents Sea and adjacent waters in November 1998 – January 1999	Y. Lepesevich, S. Ratushny, E. Gusev, O. Smirnov and A. Sokolov
31	Analysis of changes of effort and fishing pattern in the catches of Northeast Arctic cod	K. Sunnanå
32	Trial runs with Fleksibest for North-East arctic cod at the Arctic Fisheries Working Group 1999	D.W. Skagen and M.N. Aasnes
33	Corrected survey indices based on assumed consistency of relative indices of year class strength throughout the lifecycle	K. Sunnanå
34	A trial VPA on cod to illustrate some arguments	K. Sunnanå