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REPORT OF THE

ARCTIC FISHERIES WORKING GROUP

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International Council for the Exploration of the Sea

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1.2 Introduction

At its November 1999 meeting ACFM decided the following:

"The **Arctic Fisheries Working Group** [AFWG] (Chair: Dr R. Bowering, Canada) will meet at ICES Headquarters from 22 August to 31 August 2000 to:

a) assess the status of and provide catch options for the year 2001 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) evaluate the agreed management strategy for cod, fixing F at a level that maintains SSB above 500,000 t (Bpa) and reducing the fishing mortality to F = 0.42;

c) identify major deficiencies in the assessments.

At the request of Norway during the winter of 2000, **shrimp (*Pandalus borealis*)** in Sub-area I and II was also added to the list of stocks identified in ToR (a) above. As well, a recent request from Russia to perform a review of the estimated MBAL for NEA cod was added to the agenda of the Working Group. However, no additional time was given to address these additional items.

The above Terms of Reference are set up to provide ACFM with the information required to respond to requests for advice/information.

AFWG will report to ACFM at its October/November 2000 meeting."

1.3 General Comments

This year the working group made advances on several fronts. The work progressed very well and under a reasonable time schedule. The fact that nearly all the data were available at the beginning of the meeting was largely responsible for being able to do this. In addition, the meeting was well attended and for most stocks there were two or more individuals processing and analysing the data, which helped to speed up the presentation of the assessment results. It also helped that both the NEA cod and haddock had been assessed earlier in the year and set the stage for those assessments at the current meeting. Nevertheless, with the large number of recommendations for new analyses it is anticipated that next year's meeting will have an increased workload and considerably more time may be necessary for plenary discussions.

1.4 Review of the estimated MBAL for Northeast Arctic cod

In response to a request made by the Russian representative to the Joint Russian-Norwegian Fisheries Commission (letter to ICES General Secretary from Mikhail Dementiev dated August 7, 2000) the WG reviewed the use of a biomass reference point for Northeast Arctic cod. The discussions centred on two main issues:

1. revising the historical age-specific values of maturity, weight and natural mortality;
2. developing additional reference points based on reproductive potential.

A brief summary of the discussions on both issues follows.

Revising historical growth and mortality parameters – Current values of SSB use constant values for weight and maturity at age for the years prior to 1981 and 1982, respectively. Consequently, the majority of observations in the stock/recruit relationship do not account for interannual variation in growth. Furthermore, natural mortality at age (M) is assumed to be constant and equal to 0.2. Since 1984 this value has incorporated cannibalism but this does not decrease the uncertainty in the estimation of M. Age-dependent variation in M is not accounted for in the stock dynamics (Tretyak WD 18). These shortcomings in the assessment are being addressed by several initiatives. The historical time series of SSB has been reconstructed using maturity ogives of Jørgensen (1990) and modelled values of weight and M at age (Tretyak *et al*. WD 40). Using data from the Norwegian catches (1900–1945), Russian sources for 1930–1955 and the ogives of Jørgensen (1990), estimates of SSB were reconstructed back to 1900 (Hylen WD 15). Historical values of maturity at age and weight at age are also available from published Russian sources (Ozhigin *et al*. 1994; Ponomarenko and Yaragina 1994). Revision of historical weight and maturity at age (1946–1981) is also being undertaken at IMR using data from the Lofoten fishery and international sampling programs. Scientists at IMR will present a new time series for SSB at the next meeting of the WG. At that time, the effect of using these revised time series on estimates of SSB will be determined and, if necessary, the B_{pa} will be recalculated. With respect to incorporating age- and time-dependent variation in M into the assessment, it was agreed that is more complex task (consistency of incorporating cannibalism, differences between males and females in M at age). Therefore, this is a long-term goal of the assessment.

Developing reference points based on stock reproductive potential – the utility of the current B_{pa} for Northeast Arctic cod is questionable due to the weakness of the stock/recruit relationship (Borisov WD 41). There is a growing body of research into the reproduction of long-lived gadoid stocks which suggests that SSB may not be indicative of the reproductive potential either of individuals or of the stock (Marshall WD 29). More precise estimates of the reproductive potential of the Northeast Arctic cod stock are currently being developed through collaborations between scientists at PINRO and IMR (Marshall *et al*. WD 13). These estimates combine information on abundance, stock structure (age, size, and maturity composition) and reproductive status of individuals over the full time period (1946-present). This research program is also investigating the effect of fishing mortality on the reproductive potential of the stock (Marshall and Yaragina WD 14). The Russian ichthyoplankton survey database (1959–1993) is also being used to describe interannual variation in egg abundance in relation to recruitment (Mukhina 1999). On the basis of progress that is being made on this issue, reference points which are specifically designed to conserve the reproductive potential of the stock will be provided to the next WG meeting. This goal will benefit from the ongoing activities of the NAFO Working Group on Reproductive Potential (2000–2001).

Related issues – data on variation in length at age is central to research on growth and reproductive potential. Developing a joint database describing interannual variation in mean length at age or age length keys would be useful. Towards this goal, it was agreed that Russian scientists would investigate the possibility of assembling annual age/length keys or mean length at age which could be combined with Norwegian data from the Lofoten fishery.

1.5 Stock structure of cod in the NorthEast Arctic Region

In spite of the fact that biological peculiarities of cod allocated in the coastal regions of the Norwegian and Barents Seas have been studied for more than 50 years, the validity of separation of the independent coastal cod stock from the NEA cod stock is still disputable.

The study of cod spawning regions, eggs and larvae drift, migration (by tagging), rates of growth and maturation, parasites composition, genetic markers (Rollefsen, 1933; Jakobsen, 1987; Fevolden and Pogson, 1995, 1996; Mork and Giaever, 1999) indicate the ecological variation of cod in the NEA Region (Borisov *et al*, 1999).

Nevertheless, taking into account the certain isolation of cod living in the coastal zone, the specifics of the coastal fishery, it was decided to consider the coastal cod (in the framework of ICES) as isolated from NEA cod. Scientific investigation should continue in order to further elucidate the stock structure of this important cod resource in the NEA region.

1.6 ICES Quality Policy

The Fisheries Adviser presented the adopted ICES Quality Policy to the Working Group. In particular, he noted the need for transparency in the assessment and advisory process. This requires a better defined and a more strict policy on how data should be documented. He also noted that it is the entire chain from sampling to advice that needs to be transparent but that significant parts of that chain lies with the national fisheries research institutes. ICES will discuss with the national laboratories the need for such documentation and are aware that there are initiatives both nationally and regionally to improve documentation of the basic data for fish stock assessments. Finally, the Fisheries Adviser introduced the concept of having an assessment manual and assessment handbooks as part of the documentation of the assessments.

ICES sees this as a longer term project and has started the work by improving the working procedures in ACFM. This work is done in parallel with the Bureau work on revising the advisory structures of the Council.

In the discussion that followed the presentation it was pointed out that much of the requirements for documentation are met through the working documents presented to the working groups. It was also noted that fish stock assessment is a dynamic area where the interpretation of data varies between meetings.

1.7 Reliability of Catch Statistics

Accurate catch statistics are a prerequisite for reliable catch at age analysis (like VPA) and for reliable predictions of catch and stock. Any kind of underreporting (discards, black landings, reporting under other species name) preclude the use of a converged VPA as an absolute estimate of stock size. If the proportion of underreporting vary on an annual basis, even the usage of the converged VPA as a stock index is precluded.

The accuracy of the official catch statistics available to this Working Group has never been quantified, and all the analytical assessments are based on the rather poorly supported assumption that catch figures are reasonably accurate.

There is growing evidence that both discarding and black landings could have been serious in the Barents Sea in recent years (Nakken WD8). A report from an observer on a trawler fishing cod in autumn 1998 indicated about 20% discard rate (Schöne WD4, 1999 WG). The same observer also reported considerable discards of saithe in the trawl fishery for cod.

There is still no basis for properly quantifying the underreporting of catches in the Arctic, and at present inaccurate catch statistics could represent a serious error in the assessments of the Arctic stocks. Putting more weight on survey results could improve the evaluation of current state of the stocks. The problem would still remain in the forecast: How to predict the real catches and stock development caused by a certain quota setting? As long as these problems persist, there is a strong need for additional precaution when setting quotas.

1.8 Scientific Presentations

WD 1 (presented by T. Marshall) – statistical models predicting mean Kola section temperature were developed and used to predict monthly values for 1997 and 1998 from observed values six months earlier. The prognosis indicates similar temperatures in 2001 as in the past two years.

WD 2 (presented by T. Marshall) – a time series of ambient temperature for each age class for the time period 1978 to 2000 was presented. Ambient temperatures experienced by cod ages 1,2 and 3 were lower than those at the fixed Kola section while ambient temperatures for cod age 6 and older are higher than those at the Kola section.

WD3 (presented by A. Aglen) – logbook data from Norwegian trawlers were standardized between individual vessels and used to calculate cpue per day. For each month those values were used to calculate an area-weighted average. The annual average was calculated from the monthly averages. It was not considered for use in the present assessment, since no further comparisons with other stock indicators were presented.

WD4 (presented by A. Aglen) – Based on suggested improvements in the xsa tuning of NEA cod, the following modifications to the May assessment were examined: 1) reduce the plus group from 15 to 13; 2) leave out the Svalbard survey, because it covers a rather small part of the total cod area and it shows unusual catchability trends; 3) Leave out ages 1 and 2 in tuning, since they could be subject to variable unaccounted natural mortality, discarding, and mesh size changes in some tuning fleets; and 4) Reduce time tapering from 20 to 10 years (see WD 3 at May 2000 meeting). The four modifications combined gave a valuable improvement to the retrospective pattern in the sense that the tendency of underestimating most recent F was not evident any longer. This modified procedure was therefore considered to be better and was therefore accepted.

WD5 (presented by A. Aglen) – Growth predictions of cod based on estimated consumption and a bioenergetic model were presented. The document comments that the predictions might be too pessimistic in the present situation when fishing mortality is expected to decline considerably. Therefore the results were not used in the stock predictions.

WD 6 (presented by M. Aschan) – the shrimp stock biomass seems to respond on the landings (128,000 t) but does not show a response to high cod consumption (>300,000 t) in 94–99. Consumption of shrimp may have been overestimated because: 1) cod may be feeding in the trawl: 2) cod stomachs are pooled by age groups; 3) cod stomachs have not been consistently sampled in the spring; and 4) ambient temperatures are not used in the consumption estimates.

WD 7 (presented by B. Bogstad) – knowledge of the selection factors in use in the various fisheries (gear, area and season) together with information on size/age distributions from Norwegian surveys and reported catches (landings) and/or TACs were used to predict catch numbers at age for the years 1995–2000. Estimated catch at age was generally considerably higher than observed. In particular, the estimates of catches of 4 and 5 year olds in 1995 and 1996 were much higher than observed catch numbers.

WD 8 (presented by B. Bogstad) - a review of available reports on reliability of catch (landings) statistics for Northeast Arctic cod in recent years is given. These may have been substantial. The editor of a Norwegian fishing magazine has indicated some 300,000 tonnes of black landings of cod in Norway as a total over the period 1995–1998. This was based on crude comparisons of landings (both domestic and foreign vessels), exports, and domestic consumption. It is argued that recent year's landings should be neglected completely in the assessment of this stock.

WD 9 (presented by B. Bogstad) – attention is drawn to the fact that the estimated fishing mortality in the assessment year tends to be a considerable underestimate (on average 25%) compared to the converged VPA values obtained some years later. This fact should be specifically mentioned in the advice.

WD 10 (presented by B. Bogstad) - the main features of the new assessment model for Northeast Arctic cod (Fleksibest) are described. The data used in the model runs are described. Further work with the model and possible applications to other stocks are briefly described.

WD 11 (presented by B. Bogstad) – an overview of recent research aimed at predicting recruitment of Northeast Arctic cod is given. The aim is to construct models, which predict the abundance and average length of a cohort at the recruitment age. Both survey data, data on predation on cod and environmental information (zooplankton, temperature etc.) should be utilised in such predictions.

WD 12 (presented by T. Marshall) – updated time series for weight-at-length, liver condition, maturity at length, fecundity at length, total egg production and proportion repeat spawners for Northeast Arctic cod were presented. Values for 2000 suggest that the reproductive potential of individual spawners is near average values but that the reproductive potential of the stock is constrained by the low abundance of spawners.

WD 13 (presented by T. Marshall) – total lipid energy in the livers of mature females (units of kJ) was proposed as an additional measure of the reproductive potential of the Northeast Arctic cod stock. Total lipid energy (1946 to 1996) shows a significant, positive relationship with recruitment to age 3 and, combined with environmental data, can be used to predict recruitment.

WD14 (presented by T. Marshall) – to better resolve fishery effects on stock dynamics of Northeast Arctic cod, separate indices of the potentially harvestable biomass and reproductive potential in the stock were estimated for 1946 to 1996.

WD 15 (presented by K. Nedreaas) – shows the variation in abundance, year-class strength and fishing mortality of North-East Arctic cod during the twentieth century. A VPA for the time period 1913–1999 was run using new historic data until 1946 and the current ICES database for the later years. A relationship of CPUE vs. stock size for the years 1913–1929 was used to estimate stock size from available CPUE data for the years 1900–1912. The results were considered very useful for revising the biological reference points of this stock.

WD 17 (presented by V.Tretyak) – notes a methodological shortcoming concerning relationship between the values of F and SSB. The current procedure for estimating F_{pa} for NEA cod uses the relationship between SSB and F of the same year. It seems more reasonable to use the correspondence between SSB value and of fishing mortality in the previous years (for example, average F for 3 previous years), the values of fishing mortality which in fact determine the value of SSB in the year under consideration.

WD 18 (presented by V.Tretyak) – presents a mathematical model, suggesting that instantaneous coefficients of the cod natural mortality (M) change with increasing from 3 years and older. The model explicit reflects a conceptual relationship between M of cod, maturity age and theoretical maximum possible lifetime of fish, and implicit, linear and weight growth. Theoretical premises of the model are formulated, and a method of estimating its parameters is suggested. The values of M can be used for assessing the stock, setting biological reference points and TAC of the cod.

WD 19 (presented by M. Aschan) – presents the history of the fishery, regulation, catch and effort data and the status of the shrimp research in the Barents Sea and Svalbard area. The status of the stock and assessment methods being investigated are presented. Several problems were identified: age reading, lack of good biological data from commercial catches, logbook statistics do not allow separation of single and multiple trawl data, the cod consumption estimate and available vessel time.

WD 20 (presented by S. Mehl) – new trawl and purse seine CPUE series and an extended acoustic survey index series are presented and tried in exploratory XSA runs for Northeast Arctic saithe. All series seems to perform slightly better than the old ones.

WD 21 (presented by K. Nedreaas) – proposes how to build a maturity model for North-East Arctic haddock. Observed values may be so variable that a modelled ogives would be preferred. In the present procedure data from surveys are combined in order to get an improved model for the haddock population. Maturity is modelled as both proportion mature in numbers and in biomass for sexes combined and for females only.

WD 22 (presented by Å. Høines) – presents a summary of the Norwegian Greenland halibut survey along the continental slope from 68°N to 80°N during 1994 – 1999. The purpose of the cruise is to explore the main distribution area and to estimate the number and biomass of the fishable stock of Greenland halibut in the Norwegian Sea – Barents Sea region.

WD 23 (presented by K. Nedreaas) – presents a summary of the Norwegian juvenile Greenland halibut investigations in the Arctic north and east of Spitsbergen during 1996–1999. The main goal of these surveys are to establish a time series of recruitment indices and to investigate annual variation in distribution pattern.

WD26 (presented by T. Bulgakova) – proposed the procedure of residual mortality *M1* estimation for the Barents Sea shrimp with the help of MSVPA model for 4-species community (cod, capelin, shrimp, herring). Many MSVPA program runs are carried out with different *M1*. Estimated shrimp biomass time series were compared to the results of annual spring surveys. Estimated shrimp stock biomass by years obtained by MSVPA are on the average 3.7 times higher than the survey estimates.

WD27 (presented by Yu. Kovalev) – presents food composition of the Barents Sea cod for 1984–1999 and consumed biomass time series for the same period in tons and in mill. sp. for main prey species (cod, shrimp, capelin, haddock). The main features of cod feeding in 1999 were increasing predominance of shrimp (to 11% by weight as in previous year) and capelin (up to 38%) and a reduction in cannibalism (up to 6%).

WD 28 (presented by B.Berenboim and V. Korzhev) – presents input data for the Barents Sea shrimp: total catches by age groups and years 1980–1999; total landings by years; tuning data for VPA in 1985–1999; catch and effort data by years and quarters for 1984–1999.

WD 40 (presented by Y.Kovalev) – presents a method of reconstructing cod stock weight-at-age data from 1949 to 1984 using variable natural mortality coefficients (WD#18), maturation ogives series for 1949–1981 established by Jorgensen (1990) and reconstructed stock weight-at-ages data for 1949–1982. It was shown that SSB values estimated with using of new data are considerably lower in period 1949–1980. The mean SSB value for 1949–1999 was 329 thousand tones against 502 thousand tones according to the current assessment made by AFWG.

WD 41 (presented by V.Borisov) – compared the values of cod SSB and abundance of year classes at age 3 over the full time period (1946–present). The relationship between cod SSB and recruitment is absent. Therefore the using of MBAL principal for NEA cod stock management is doubtful. Strong year classes appear both in the years of high SSB and low SSB and vice versa. The reason is that the abundance of cod at age 3 (by VPA) depends mainly on survival conditions, but not on SSB. On this basis, one should not follow the MBAL-criterion for cod fishery management.

1.9 Nomination for New Chair

The Working Group was pleased to unanimously endorse the nomination of Mr. Sigbjørn Mehl as the new chairman of the Arctic Fisheries Working Group.

1.10 Time and Venue of Next Meeting

The Working Group supports the ICES proposal to move the annual meeting of the AFWG to spring time. In order to allow sufficient time for both data preparation and sufficient lead time for the ensuing ACFM meeting in May, the Working Group proposes the dates of April 24–May 3, 2001 for it's next meeting. Given that ICES headquarters will be undergoing substantial renovations during spring of 2001, Norway kindly has offered to host the next meeting of the Working Group in Bergen.

2 NORWEGIAN COASTAL COD IN SUB-AREAS I AND II

2.1 Status of the Fisheries

2.1.1 Historical development of the fisheries

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

2.1.2 Landings prior to 1999 (Table 2.1)

From 1996, the Norwegian Institute of Fisheries and Aquaculture Ltd (Fiskerforskning) has separated the catches into the two types based on biological sampling (Berg et al. 1998). The method is based on otolith-typing. This is the same method as is used in separating the two stocks in the surveys targeting NEAC. The catches of Norwegian Coastal cod (NCC) have been calculated back to 1984. During this period the catches have been between 25,000 and 75,000 t. The estimated landings of NCC in 1998 reported to the Working Group is 51,572 t and the provisional figure for 1999 is 40,732 t (Table 2.1).

In addition, the landings of NCC calculated using the old method (only based on time and area of capture) are given in Table 2.1.

2.1.3 Expected landings in 2000

No estimate of expected landings for 2000 is available for NCC. However, assuming that the catch of NCC is proportional to the Norwegian catch of NEAC and applying a linear regression over the nine last years (1991–1999) such that; Catch NCC=12,734 + 0.1426* Norwegian catch NEAC (R^2 = 0.85), the expected landings of NCC in 2000 are 40,313t. This is about the same level as in 1998. However, taking into account the declining stock of NCC this could be an overestimate.

2.2 Status of Research

2.2.1 Fishing effort and CPUE

There are no available data on fishing effort and CPUE for this stock.

2.2.2 Survey results (Tables 2.2, 2.3, 2.4, 2.5, 2.8)

A Norwegian trawl-acoustic survey was conducted along the coast from Varanger to Stadt in October-November 1999 using RV Jan Mayen. In 1999 the survey covered the same areas as the coastal surveys in 1995–1998.

The trawl-acoustic coastal survey in 1999 estimated a total survey biomass of NCC of about 64,000 t (52 million fish) for the coastal area from Varanger to Stadt at 62^{o} N (Tables 2.2, 2.3, 2.8). The spawning biomass accounted for 24,000 t (9 million fish) of this total (Tables 2.4, 2.5). Thus, spawners make up about 38% of the total biomass. Eighty percent of the total coastal biomass was distributed from the Russian border to 67^{o} N and 20% south of 67^{o} N (Norwegian statistical areas 06 and 07). The bulk of the biomass was comprised of age classes 3–5 (Table 2.3).

The data indicated a higher proportion of NCC in the fjords and to the South compared with the northern and outer areas. In the Norwegian statistical areas 06 and 07 (south of 67^{o} N) nearly all otoliths collected were of the NCC type, which is similar to the results of the 1995–1998 surveys (ICES 1996; ICES 1997; ICES 1998; ICES 1999; ICES 2000).

The numbers of NCC per age-class from all the coastal surveys is given in Table 2.8. The total numbers decreased in 1999 compared with the 1998 survey.

The Norwegian 2000 coastal survey (October-November) will be conducted in a similar way as the previous ones to further extend the time series for NCC over its distribution area.

2.2.3 Age reading and stock separation

Age readings of the NCC both from the surveys and from the catches, are done the same way as for the NEAC. Co-operation between the Fiskeriforskning in Tromsø, Institute of Marine Research in Bergen and PINRO in Murmansk regarding the otolith reading is continuing.

A total of 2734 cod otoliths were sampled during the 1999 survey. These were separated into NCC type (2021) and NEAC (713). As in previous years, NCC were found throughout the survey area. The 1999 survey data shows the same pattern as the 1995 and 1996 surveys. The proportion of the NCC increases going from north to south along the Norwegian coast. The NCC type otoliths dominate south of 67^{o} N (Norwegian statistical areas 06 and 07). Although the proportion is lower, there is significant biomass of NCC north of 67^{o} N. It must be emphasised that the Norwegian coastal surveys have been conducted in August-November, and therefore there may be more NEAC in this southern area at other times of the year, especially during the spawning season in the winter time.

2.2.4 Weight at age (Table 2.6)

The weight-at-age (weighted average) from the trawl-acoustic survey in 1999 was at the same level as in 1998 for ages younger than 7 years. Weight at age for ages older than 7 years are uncertain due to the limited number of age samples. A running average for the 5 most recent years for cod 7 years and older was therefore used in the assessment. Weight at age for NCC is well above the present level for NEAC. There is a general tendency for cod to be heavier when caught further south along the coast (Table 2.6). The same tendency was found for the surveys in 1995–1998 (ICES 1996; ICES 1997; ICES 1998; ICES 1999; ICES 2000).

2.2.5 Maturity at age (Table 2.7)

The maturity at age is estimated from the data collected at the Norwegian coastal survey. This is not an optimal way to do it because the survey is conducted in the early autumn when the stage at the maturity scale is hard to define. Further improvement of maturity ogives is recommended. The age at 50% maturity (M_{50}) for the NCC was estimated to be slightly above 5 years old on average for the surveyed area in 1999 (Table 2.7). There are some variations between the different areas. The 1999 data show that the average M_{50} is at about the same level to that found in the 1998 survey (ICES 1999). The average M_{50} for the NEAC in 1997 is close to 7 years old (ICES 1999).

2.3 Data Used in the Assessment

2.3.1 Catch-at-age (Table 2.10)

A detailed breakdown of the catches of NCC for the period 1984 to 1999 has been done to form the basis of a VPA. This was carried out by analysing Norwegian landings of cod by vessel size, area caught, landed as given by the Norwegian Directorate for Fisheries, and cod samplings from commercial catches done by the Institute of Marine Research, Bergen to separate NCC and NEAC by otolith type.

The separation of the Norwegian catches into NEAC and NCC is based on:

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

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

The catch-at-ge for the period 1984–1999 is given in Table 2.10.

2.3.2 Weight-at-age (Table 2.11, 2.12)

The weight-at-age in the stock, used in the assessment, is obtained from the Norwegian coastal survey. However, few cod older than 7 years were caught, and a five years running average is therefore used from 1995 and onwards. From

1984–1994 the weight-at-age in the stock is the same as weight-at-age in the catch because no survey data from this period are available.

2.3.3 Natural mortality

A fixed natural mortality of 0.2 was used.

2.3.4 Maturity-at-age (Table 2.13)

The maturity-at-age data from 1995–1999 are obtained from the Norwegian coastal survey. From 1984–1994 the maturityat-age data are obtained from the commercial catch data because no survey data from this period are available. The proportion mature at age is given in Table 2.13.

2.3.5 Tuning data (Table 2.8)

The acoustic indices (age 2–10+) from the Norwegian coastal survey conducted late autumn (1995–1999) have been used in the tuning (Table 2.8).

2.3.6 Recruitment indices (Table 2.8)

The only recruitment indices (ages 0 and 1) available for this stock is the acoustic index from the Norwegian coastal survey (Table 2.8).

2.4 Methods Used in the Assessment

2.4.1 VPA and tuning (Table 2.09)

Tuning of the VPA was carried out using Extended Survival Analysis (XSA), using the default settings for the XSA with the following exceptions: (1) catchability was set to be stock size dependent for ages younger than 3, and age dependent for ages 7 and older; (2) The survivors estimate was shrunk towards the mean F of the final 2 years or the 4 oldest ages (Table 2.9).

2.4.2 Recruitment

The only recruitment indices (<2 year) available for this stock is the acoustic estimate from the Norwegian coastal survey. However, the abundance of cod less than 25 cm is difficult to estimate from a trawl acoustic survey because this length group tends to inhabit shallow water close to the shore where trawling is impossible. Therefore the estimates are rather uncertain.

2.5 Results of the Assessment

Considering the shortness of the time series of the tuning data the WG was concerned that small changes in the XSA settings would produce highly variable results with respect to absolute values of fishing mortality and population estimates. Nevertheless, it was felt that the assessment did illustrate true trends in the fishing mortality and population size.

2.5.1 Fishing mortality and VPA (Tables 2.14–2.20)

The average age 4–7 fishing mortalities in 1999 were estimated to be 0.45 (Table 2.14). 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). However, the fishing mortality has increased steadily from 1991 onwards. At present the $F_{(4–7)}$ =0.45.

The total biomass of the stock in the period from 1984–1999 has been between 150,000 t and 310,000 t (Tables 2.18, 2.20). At the end of 1999 the biomass was estimated to be the lowest observed and only about half the biomass estimated five years ago in 1995. The spawning stock biomass has been between 86,000 t and 226,000 t (Tables 2.19, 2.20). As for the total stock biomass, the lowest observed SSB was estimated in 1999. The SSB has declined steadily from 1994 to present. The SSB at the end of 1999 was only about half the average in the period 1984–1999.

A summary of landings, fishing mortality, stock biomass, spawning stock biomass and recruitment since 1984 is given in Table 2.20.

Although no reference points regarding F-values and SSB have been calculated for NCC the status of this stock has to be considered far from optimal because both the total biomass and SSB at present are at the lowest observed level. In addition, the recruitment (age 2) has steadily decreased since the early nineties, and was in 1999 (1997 year class) at the lowest observed level in the time series. Results from the 1999 Norwegian coastal survey also indicate year classes below average for 1998–1999. The low recruitment level will further decrease both the total biomass and the SSB for at least 3–4 years unless the fishing mortality is considerably decreased for the next years.

2.5.2 Recruitment (Table 2.8, 2.16)

Both the survey in 1999 (age 0–3, Table 2.8) and the XSA-estimate (age 2 and 3, Table 2.16) indicate lower than average year classes from 1996–1999.

2.6 Comments to the Assessment

2.6.1 General comments

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

2.6.2 A comparison of the assessment results and the survey results (Figures 2.1–2.3)

Both the assessment and the surveys from 1995–1999 show a declining stock. The estimated number of cod 2 year and older in the surveys is approximately 60 percent of the estimated number from the XSA in four of the five years (Figure 2.1). It therefore seems like the survey and the XSA assessment reflect the changes in the stock number quite well. For ages 2–4 year the survey indexes and the XSA estimates are very well correlated. For ages 5–7 the correlation is good except in 1997 for 5 and 6 years old cod. The proportion of cod estimated in the survey was at a higher level this year. The correlation for ages older than 8 year is somewhat worse mainly due to few individuals caught in the surveys. There is a general trend towards decreasing catchability with increasing age, except for cod older than 7–8 years (Figure 2.1–2.3).

Table 2.1 Landings of Norwegian Coastal cod in Sub-areas I and II.

Year	Landings in '000 t.	
	As calculated from samples and reported to AFWG	By area and time of capture
1960	-	43
1961	-	32
1962	-	30
1963	-	40
1964	-	46
1965	-	24
1966	-	29
1967	-	33
1968	-	47
1969	-	52
1970	-	49
1971	-	*)
1972	-	*)
1973	-	*)
1974	-	*)
1975	-	*)
1976	-	*)
1977	-	*)
1978	-	*)
1979	-	*)
1980	-	40
1981	-	49
1982	-	42
1983	-	38
1984	74	33
1985	75	28
1986	69	26
1987	61	31
1988	59	22
1989	40	17
1990	28	24
1991	25	25
1992	42	35
1993	53	44
1994	55	48
1995	57	39
1996	62	32
1997	63	36
1998	52	29
1999	41	23**)
Average	54	35

*) No data

**) Provisional data

Table 2.2 Estimated survey number (x1000) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 1999.

	Age											
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**Total**
03 East Finnmark	20	1044	2006	2174	2389	1263	465	88	25	25	25	9524
04 West Finnmark/Tromsø	14	4829	5295	3842	3368	3324	1229	313	68	24	29	22335
05 Lofoten/Vesterålen		476	1449	2323	2038	1229	585	182	86			8368
00 Vestfjord		173	1098	1750	1078	454	212					4765
06 Nordland		220	580	1052	629	766	549	94	63	63		4016
07 Møre		108	881	1030	621	161	12	173				2986
Total	34	6850	11309	12171	10123	7197	3052	850	242	112	54	51994

Table 2.3 Estimated survey biomass (tonnes) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 1999.

	Age											
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**Total**
03 East Finnmark	0	63	484	1640	3421	2401	1209	299	81	201	230	10029
04 West Finnmark/Troms	0	320	1568	3169	5238	7081	3465	1379	527	146	337	23230
05 Lofoten/Vesterålen		32	426	1951	3405	2812	1693	1016	875			12210
00 Vestfjord		13	401	1327	2319	1312	934					6306
06 Nordland		26	159	717	747	1481	1334	397	614	873		6348
07 Møre		23	612	1429	1830	687	85	1632				6298
Total	0	477	3650	10233	16960	15774	8720	4723	2097	1220	567	64421

Table 2.4 Estimated survey spawning stock number (x1000) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 1999.

	Age											
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**Total**
03 East Finnmark	0	0	40	152	549	632	307	88	25	25	25	1843
04 West Finnmark/Troms	0	0	53	115	909	1728	971	228	68	24	29	4125
05 Lofoten/Vesterålen	0	0	0	0	346	430	380	182	86	0	0	1424
00 Vestfjord	0	0	66	53	248	195	123	0	0	0	0	685
06 Nordland	0	0	0	32	57	123	209	54	63	63	0	601
07 Møre	0	0	0	31	56	26	5	99	0	0	0	217
Total	0	0	159	383	2165	3134	1995	651	242	112	54	8895

Table 2.5 Estimated survey spawning stock biomass (tonnes) of Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 1999.

	Age											
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**	**Total**
03 East Finnmark	0	0	10	115	787	1201	798	299	81	201	230	3722
04 West Finnmark/Troms	0	0	16	95	1414	3682	2737	1007	527	146	337	9961
05 Lofoten/Vesterålen	0	0	0	0	579	984	1100	1016	875	0	0	4554
00 Vestfjord	0	0	24	40	533	564	542	0	0	0	0	1703
06 Nordland	0	0	0	22	67	237	507	226	614	873	0	2546
07 Møre	0	0	6	43	164	110	32	930	0	0	0	1285
Total	0	0	56	315	3544	6778	5716	3478	2097	1220	567	23771

Table 2.6 Weight (gram) at age (year) for Norwegian Coastal cod from the Norwegian coastal survey during the autumn 1999.

	Age										
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**
03 East Finnmark	12	60	241	754	1432	1901	2600	3398	3240	8040	9200
04 West Finnmark/Troms	8	66	296	825	1555	2130	2819	4406	7750	6083	12036
05 Lofoten/Vesterålen		67	294	840	1671	2288	2894	5582	10174	0	0
00 Vestfjord		75	365	758	2151	2890	4406	0	0	0	0
06–07 Nordland/Møre		149	528	1031	2062	2339	2529	7599	9746	13857	0
Weighted average	10	70	323	841	1675	2192	2857	5556	8665	10893	10500

Table 2.7 Percent mature at age for Norwegian Coastal cod at age from the Norwegian coastal survey during the autumn 1999.

	Age										
Area	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10+**
03 East Finnmark	0	0	2	7	23	50	66	100	100	100	100
04 West Finnmark/Troms	0	0	1	3	27	52	79	73	100	100	100
05 Lofoten/Vesterålen	0	0	0	0	17	35	65	100	100	100	100
00 Vestfjord	0	0	6	3	23	43	58	75	100	100	100
06–07 Nordland/Møre	0	0	0	3	9	16	38	57	100	100	100
Weighted average	0	0	1	3	21	44	65	77	100	100	100

Table 2.8 Estimated survey numbers at age (x1000) of Norwegian Coastal cod from the coastal surveys from 1995–1999.

	Age											
YEAR	0	1	2	3	4	5	6	7	8	9	10+	TOTAL
1995	2157	28707	20191	13633	15636	16219	9550	3174	1158	781	579	111785
1996	-	1756	17378	22815	12382	12514	6817	3180	754	242	5	77843
1997	5632	30694	18827	28913	17334	12379	10612	3928	1515	26	663	130523
1998	35098	14455	13659	15003	13239	7415	3137	1578	315	169	128	104197
1999	34	6850	11309	12171	10123	7197	3052	850	242	112	54	51994

Table 2.9

```
Lowestoft VPA Version 3.1

   25/08/2000  15:07

 Extended Survivors Analysis

 Coastal cod (run: XSANCC10/X10)

 CPUE data from file fleet

 Catch data for  16 years. 1984 to 1999. Ages  2 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                      ,    year, year,  age ,  age
 FLT04: Norw. Coast. ,   1995, 1999,   2,     9,   .750,   .850


 Time series weights :

      Tapered time weighting applied
      Power =    3 over  20 years

 Catchability analysis :

      Catchability dependent on stock size for ages <    3

         Regression type = C
         Minimum of   5 points used for regression
         Survivor estimates shrunk to the population mean for ages <  3

      Catchability independent of age for ages >=    7


 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   2 years or the   4 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 had not converged after  100 iterations


 Total absolute residual between iterations
 99 and 100 =     .00088

 Final year F values
 Age         ,      2,      3,      4,      5,      6,      7,      8,      9
 Iteration 99,  .0179,  .1090,  .1961,  .4474,  .4998,  .6695,  .5776,  .5882
 Iteration **,  .0179,  .1090,  .1960,  .4473,  .4996,  .6694,  .5775,  .5879


 Regression weights
       ,  .976,  .990,  .997, 1.000, 1.000


 Fishing mortalities
    Age,  1995,  1996,  1997,  1998,  1999

      2,  .026,  .036,  .056,  .035,  .018
      3,  .049,  .100,  .137,  .161,  .109
      4,  .134,  .186,  .186,  .286,  .196
      5,  .244,  .459,  .258,  .383,  .447
      6,  .333,  .361,  .445,  .449,  .500
      7,  .453,  .450,  .596,  .554,  .669
      8,  .417,  .590,  .804,  .620,  .577
      9,  .364,  .495,  .602,  .587,  .588


 XSA population numbers (Thousands)

                                AGE
 YEAR ,          2,         3,         4,         5,         6,         7,         8,         9,

 1995 ,    3.47E+04, 2.07E+04, 2.07E+04, 2.65E+04, 2.16E+04, 9.92E+03, 4.71E+03, 2.02E+03,
 1996 ,    3.77E+04, 2.77E+04, 1.61E+04, 1.48E+04, 1.70E+04, 1.27E+04, 5.16E+03, 2.54E+03,
 1997 ,    2.70E+04, 2.98E+04, 2.05E+04, 1.10E+04, 7.66E+03, 9.68E+03, 6.62E+03, 2.34E+03,
 1998 ,    1.79E+04, 2.09E+04, 2.12E+04, 1.40E+04, 6.94E+03, 4.02E+03, 4.37E+03, 2.43E+03,
 1999 ,    1.57E+04, 1.42E+04, 1.46E+04, 1.31E+04, 7.79E+03, 3.63E+03, 1.89E+03, 1.92E+03,

 Estimated population abundance at 1st Jan 2000

     ,     0.00E+00, 1.26E+04, 1.04E+04, 9.80E+03, 6.84E+03, 3.87E+03, 1.52E+03, 8.70E+02,

 Taper weighted geometric mean of the VPA populations:

     ,     3.37E+04, 2.99E+04, 2.52E+04, 1.92E+04, 1.25E+04, 7.42E+03, 3.59E+03, 1.64E+03,

 Standard error of the weighted Log(VPA populations) :

     ,       .4336,     .3977,     .3628,     .3581,     .3701,     .3931,     .4840,     .6414,
```

Table 2.9 (continued)

Log catchability residuals.

Fleet : FLT04: Norw. Coast.

Age	1995	1996	1997	1998	1999
2	.09	-.25	.26	.07	-.16
3	-.24	.02	.22	-.07	.07
4	-.02	.04	.13	-.09	-.05
5	-.23	.27	.39	-.26	-.17
6	-.26	-.33	.97	-.14	-.25
7	-.05	-.30	.30	.23	-.19
8	-.34	-.73	-.11	-1.41	-.87
9	.07	-1.23	-3.29	-1.47	-1.65

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

Age	3	4	5	6	7	8	9
Mean Log q	.0251	.0077	.0936	-.1319	-.5662	-.5662	-.5662
S.E(Log q)	.1700	.0873	.3061	.5504	.2613	.9241	2.0826

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	1.78	-2.579	-7.42	.79	5	.24	-.27

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	.86	.505	1.37	.82	5	.16	.03
4	.94	.206	.55	.82	5	.09	.01
5	1.93	-1.050	-9.08	.30	5	.58	.09
6	1.89	-.863	-7.99	.24	5	1.07	-.13
7	1.08	-.296	-.13	.81	5	.32	-.57
8	.69	.825	3.48	.70	5	.36	-1.26
9	-.47	-.570	10.37	.05	5	.62	-2.09

Terminal year survivor and F summaries :

Age 2 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
FLT04: Norw. Coast.	10735.	.308	.000	.00	1	.501	.021
P shrinkage mean	29875.	.40				.306	.008
F shrinkage mean	4907.	.50				.193	.045

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
12617.	.22	.47	3	2.140	.018

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

Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT04: Norw. Coast.	11132.	.212	.002	.01	2	.830	.102
F shrinkage mean	7413.	.50				.170	.150

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
10390.	.20	.12	3	.605	.109

Table 2.9 (continued)

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

Year class = 1995

Fleet,                  Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT04: Norw. Coast. ,      10152.,   .174,       .103,    .59,   3,  .858,     .190

  F shrinkage mean  ,      7930.,    .50,,,,                         .142,     .237

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     9803.,       .17,      .09,    4,    .572,   .196



Age  5   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
FLT04: Norw. Coast. ,       6326.,   .157,       .098,    .62,   4,  .834,     .476

  F shrinkage mean  ,     10134.,    .50,,,,                         .166,     .323

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     6841.,       .15,      .12,    5,    .797,   .447



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

Year class = 1993

Fleet,                  Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT04: Norw. Coast. ,       3748.,   .153,       .082,    .53,   5,  .798,     .512

  F shrinkage mean  ,      4412.,    .50,,,,                         .202,     .450

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     3873.,       .16,      .07,    6,    .461,   .500



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

Year class = 1992

Fleet,                  Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT04: Norw. Coast. ,       1435.,   .163,       .111,    .68,   5,  .769,     .698

  F shrinkage mean  ,      1845.,    .50,,,,                         .231,     .580

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     1521.,       .17,      .10,    6,    .601,   .669



Age  8   Catchability constant w.r.t. time and age (fixed at the value for age)  7

Year class = 1991

Fleet,                  Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT04: Norw. Coast. ,       1029.,   .193,       .190,    .98,   5,  .639,     .507

  F shrinkage mean  ,       646.,    .50,,,,                         .361,     .719

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      870.,       .22,      .18,    6,    .846,   .577
```

Table 2.9 (continued)

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT04: Norw. Coast. ,	795.,	.224,	.285,	1.27,	5,	.453,	.632
F shrinkage mean ,	948.,	.50,,,,				.547,	.553

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
876.,	.29,	.18,	6,	.621,	.588

Table 2.10

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,
AGE						
2,	829,	396,	4095,	170,	110,	41,
3,	3478,	7848,	4095,	940,	1921,	1159,
4,	6954,	7367,	12662,	8236,	3343,	1434,
5,	7278,	8699,	8906,	12430,	6451,	2299,
6,	6004,	7085,	5750,	4427,	6626,	5197,
7,	4964,	3066,	3868,	2649,	4687,	2720,
8,	2161,	705,	1270,	1127,	1461,	949,
9,	819,	433,	342,	313,	497,	236,
+gp,	624,	264,	407,	149,	333,	86,
TOTALNUM,	33111,	35863,	41395,	30441,	25429,	14121,
TONSLAND,	74824,	75451,	68905,	60972,	59294,	40285,
SOPCOF %,	100,	100,	100,	100,	100,	100,

Table 2.10 (continued)

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	7,	125,	40,	4,	332,	810,	1193,	1326,	554,	252,
3,	349,	607,	665,	369,	573,	896,	2376,	3438,	2819,	1322,
4,	1233,	1452,	3160,	1706,	1693,	2345,	2480,	3150,	4786,	2346,
5,	1330,	3114,	4422,	2343,	4302,	5188,	4930,	2258,	4023,	4263,
6,	1129,	1873,	2992,	2684,	2467,	5546,	4647,	2490,	2272,	2773,
7,	3456,	1297,	1945,	3072,	3337,	3270,	4160,	3935,	1546,	1602,
8,	773,	873,	898,	1871,	1514,	1455,	2082,	3312,	1826,	751,
9,	141,	132,	837,	627,	777,	557,	898,	959,	975,	774,
+gp,	73,	94,	279,	690,	798,	433,	543,	684,	343,	320,
TOTALNUM,	8491,	9567,	15238,	13366,	15793,	20500,	23309,	21552,	19144,	14403,
TONSLAND,	28127,	24822,	41690,	52557,	54562,	57207,	61776,	63319,	51572,	40732,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	99,	100,

Table 2.11

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,
AGE						
2,	.2480,	.2140,	.2270,	.3310,	.2460,	.3000,
3,	.6190,	.7120,	.5250,	.6730,	.6340,	.6610,
4,	1.1490,	1.4150,	1.0800,	1.1200,	1.1700,	1.8360,
5,	1.7340,	2.0360,	1.7060,	1.6930,	1.7270,	2.1700,
6,	2.3250,	2.7370,	2.2560,	2.3590,	2.3280,	2.4480,
7,	3.4860,	4.0120,	3.3530,	3.7430,	3.2560,	4.3910,
8,	4.8450,	6.1160,	4.8380,	5.3260,	4.7000,	4.8990,
9,	5.6080,	6.4600,	5.8380,	6.1290,	5.4500,	6.6610,
+gp,	8.8400,	10.7550,	7.0530,	11.6230,	8.2020,	11.6080,
SOPCOFAC,	1.0002,	1.0000,	1.0001,	1.0001,	1.0001,	1.0000,

Table 2.11 (continued)

Table 2 Catch weights at age (kg)

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	.3450,	.1640,	.1680,	.2410,	.2540,	.3020,	.2740,	.2770,	.3760,	.4670,
3,	1.1740,	.9220,	.5560,	.6450,	.8050,	.7100,	.9210,	.9700,	.9780,	1.1550,
4,	1.5150,	1.6080,	1.3590,	1.7100,	1.4760,	1.3350,	1.4640,	1.5540,	1.5180,	1.6330,
5,	1.6780,	2.1080,	2.2670,	2.5910,	2.0970,	1.8420,	1.9790,	1.9700,	2.2810,	2.1710,
6,	2.7080,	2.5070,	2.9570,	3.5880,	3.2870,	2.4670,	2.5160,	2.8970,	3.1250,	3.2490,
7,	3.8980,	3.4690,	3.9030,	4.3660,	4.0950,	4.1910,	3.4610,	3.7160,	3.9000,	4.0950,
8,	6.5150,	4.9760,	5.3170,	5.8990,	5.5920,	5.7780,	4.8660,	4.8290,	5.5200,	5.0130,
9,	7.2990,	5.7340,	4.5580,	6.4940,	7.2170,	6.3760,	5.3910,	6.3490,	6.3330,	6.0180,
+gp,	13.9240,	11.0590,	7.0320,	7.5090,	8.3310,	9.9030,	8.8540,	9.2670,	9.3370,	6.2550,
SOPCOFAC,	1.0002,	1.0003,	1.0001,	1.0000,	1.0000,	1.0001,	1.0001,	1.0003,	.9919,	1.0002,

Table 2.12

Table 3 Stock weights at age (kg)

AGE	1984,	1985,	1986,	1987,	1988,	1989,
2,	.3210,	.3210,	.3210,	.3210,	.3210,	.3210,
3,	.7580,	.7580,	.7580,	.7580,	.7580,	.7580,
4,	1.4790,	1.4790,	1.4790,	1.4790,	1.4790,	1.4790,
5,	2.1370,	2.1370,	2.1370,	2.1370,	2.1370,	2.1370,
6,	2.8140,	2.8140,	2.8140,	2.8140,	2.8140,	2.8140,
7,	4.7220,	4.7220,	4.7220,	4.7220,	4.7220,	4.7220,
8,	6.6850,	6.6850,	6.6850,	6.6850,	6.6850,	6.6850,
9,	6.9800,	6.9800,	6.9800,	6.9800,	6.9800,	6.9800,
+gp,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,

Table 2.12 (continued)

Table 3 Stock weights at age (kg)

AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
2,	.3210,	.3210,	.3210,	.3210,	.3210,	.3900,	.2520,	.2400,	.3720,	.3230,
3,	.7580,	.7580,	.7580,	.7580,	.7580,	.7910,	.7240,	.6830,	.8830,	.8410,
4,	1.4790,	1.4790,	1.4790,	1.4790,	1.4790,	1.5250,	1.4330,	1.3640,	1.4560,	1.6750,
5,	2.1370,	2.1370,	2.1370,	2.1370,	2.1370,	2.2220,	2.0530,	1.8930,	2.1070,	2.1920,
6,	2.8140,	2.8140,	2.8140,	2.8140,	2.8140,	2.8810,	2.7480,	2.8160,	2.9500,	2.8570,
7,	4.7220,	4.7220,	4.7220,	4.7220,	4.7220,	4.6650,	4.7220,	4.4260,	4.3190,	4.5400,
8,	6.6850,	6.6850,	6.6850,	6.6850,	6.6850,	6.9790,	6.6850,	6.4060,	5.6250,	6.5790,
9,	6.9800,	6.9800,	6.9800,	6.9800,	6.9800,	6.7590,	6.9320,	7.8050,	8.3230,	9.4540,
+gp,	9.7230,	9.7230,	9.7230,	9.7230,	9.7230,	9.8970,	9.7230,	10.8270,	12.4680,	12.9020,

Table 2.13

Table 5 Proportion mature at age

AGE	1984,	1985,	1986,	1987,	1988,	1989,
2,	.0100,	.0100,	.0100,	.0100,	.0500,	.0000,
3,	.1500,	.1500,	.1500,	.1500,	.1900,	.1300,
4,	.4100,	.4100,	.4100,	.4100,	.4500,	.2900,
5,	.6900,	.6900,	.6900,	.6900,	.7200,	.5900,
6,	.8900,	.8900,	.8900,	.8900,	.8600,	.9000,
7,	.9300,	.9300,	.9300,	.9300,	.9200,	.8700,
8,	.9600,	.9600,	.9600,	.9600,	.9500,	.9800,
9,	1.0000,	1.0000,	1.0000,	1.0000,	.9800,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.13 (continued)

Table 5 Proportion mature at age

AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0200,	.0100,
3,	.1500,	.0000,	.0000,	.0200,	.0000,	.0100,	.0300,	.0600,	.1500,	.0300,
4,	.3600,	.4600,	.3300,	.2500,	.4300,	.2000,	.2400,	.2900,	.2500,	.2100,
5,	.7100,	.7400,	.6700,	.5600,	.6800,	.4700,	.5600,	.4500,	.5300,	.4400,
6,	.9200,	.8300,	.8700,	.9100,	.9500,	.6700,	.8000,	.7600,	.7400,	.6500,
7,	.9600,	.9800,	.9400,	.9500,	.9400,	.8500,	.9200,	.9700,	.8700,	.7700,
8,	1.0000,	.9300,	1.0000,	.9600,	1.0000,	.8600,	.9900,	1.0000,	.8900,	1.0000,
9,	1.0000,	1.0000,	1.0000,	.9900,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 2.14

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

AGE	1984,	1985,	1986,	1987,	1988,	1989,
2,	.0105,	.0059,	.1353,	.0051,	.0030,	.0010,
3,	.0744,	.1298,	.0774,	.0415,	.0730,	.0397,
4,	.2169,	.2229,	.3189,	.2202,	.2032,	.0716,
5,	.3336,	.4621,	.4599,	.5986,	.2688,	.2098,
6,	.6283,	.6366,	.6429,	.4378,	.7628,	.3615,
7,	1.3095,	.7882,	.9001,	.7083,	1.2391,	.8526,
8,	1.0723,	.6332,	.9336,	.7329,	1.1851,	.9328,
9,	.8447,	.6357,	.7413,	.6249,	.8731,	.5943,
+gp,	.8447,	.6357,	.7413,	.6249,	.8731,	.5943,
FBAR 4- 7,	.6221,	.5275,	.5805,	.4913,	.6185,	.3739,

Table 2.14 (continued)

Table 8 Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97–99
AGE											
2,	.0002,	.0023,	.0009,	.0001,	.0144,	.0261,	.0356,	.0558,	.0348,	.0179,	.0362,
3,	.0108,	.0189,	.0149,	.0097,	.0248,	.0490,	.0996,	.1366,	.1614,	.1090,	.1357,
4,	.0541,	.0565,	.1293,	.0483,	.0563,	.1339,	.1860,	.1857,	.2863,	.1960,	.2227,
5,	.0878,	.1879,	.2436,	.1335,	.1655,	.2443,	.4589,	.2580,	.3833,	.4473,	.3628,
6,	.1508,	.1718,	.2779,	.2288,	.2030,	.3333,	.3606,	.4450,	.4489,	.4996,	.4645,
7,	.4366,	.2593,	.2716,	.5137,	.4950,	.4530,	.4500,	.5961,	.5535,	.6694,	.6063,
8,	.6295,	.1850,	.2882,	.4566,	.5179,	.4171,	.5900,	.8045,	.6198,	.5775,	.6673,
9,	.3282,	.2019,	.2718,	.3352,	.3475,	.3636,	.4946,	.6020,	.5874,	.5879,	.5925,
+gp,	.3282,	.2019,	.2718,	.3352,	.3475,	.3636,	.4946,	.6020,	.5874,	.5879,	
FBAR 4- 7,	.1823,	.1689,	.2306,	.2311,	.2299,	.2911,	.3639,	.3712,	.4180,	.4531,	

Table 2.15

Terminal Fs derived using XSA (With F shrinkage)

Table 9 Relative F at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,
AGE						
2,	.0168,	.0111,	.2330,	.0104,	.0049,	.0027,
3,	.1196,	.2460,	.1333,	.0844,	.1181,	.1062,
4,	.3486,	.4226,	.5495,	.4483,	.3285,	.1915,
5,	.5363,	.8761,	.7924,	1.2186,	.4346,	.5611,
6,	1.0100,	1.2069,	1.1076,	.8912,	1.2333,	.9670,
7,	2.1050,	1.4944,	1.5506,	1.4419,	2.0036,	2.2805,
8,	1.7238,	1.2004,	1.6084,	1.4920,	1.9161,	2.4948,
9,	1.3578,	1.2052,	1.2771,	1.2721,	1.4118,	1.5895,
+gp,	1.3578,	1.2052,	1.2771,	1.2721,	1.4118,	1.5895,
REFMEAN,	.6221,	.5275,	.5805,	.4913,	.6185,	.3739,

Table 2.15 (continued)

Table 9 Relative F at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	MEAN 97–99
AGE											
2,	.0010,	.0135,	.0037,	.0006,	.0626,	.0897,	.0980,	.1503,	.0833,	.0395,	.0911,
3,	.0590,	.1119,	.0648,	.0421,	.1077,	.1683,	.2736,	.3681,	.3861,	.2405,	.3316,
4,	.2965,	.3345,	.5607,	.2092,	.2448,	.4600,	.5113,	.5003,	.6849,	.4327,	.5393,
5,	.4817,	1.1126,	1.0565,	.5777,	.7199,	.8391,	1.2610,	.6949,	.9169,	.9872,	.8663,
6,	.8273,	1.0174,	1.2052,	.9901,	.8827,	1.1448,	.9910,	1.1988,	1.0740,	1.1027,	1.1252,
7,	2.3946,	1.5354,	1.1777,	2.2230,	2.1526,	1.5561,	1.2368,	1.6059,	1.3242,	1.4774,	1.4692,
8,	3.4528,	1.0953,	1.2497,	1.9759,	2.2522,	1.4328,	1.6214,	2.1672,	1.4828,	1.2745,	1.6415,
9,	1.7999,	1.1956,	1.1786,	1.4506,	1.5113,	1.2490,	1.3592,	1.6218,	1.4054,	1.2976,	1.4416,
+gp,	1.7999,	1.1956,	1.1786,	1.4506,	1.5113,	1.2490,	1.3592,	1.6218,	1.4054,	1.2976,	
REFMEAN,	.1823,	.1689,	.2306,	.2311,	.2299,	.2911,	.3639,	.3712,	.4180,	.4531,	

Table 2.16

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,
AGE						
2,	87957,	74666,	35770,	37001,	40322,	44095,
3,	53615,	71263,	60773,	25581,	30140,	32913,
4,	39418,	40749,	51244,	46052,	20093,	22939,
5,	28353,	25981,	26697,	30498,	30252,	13426,
6,	14224,	16628,	13400,	13799,	13723,	18931,
7,	7515,	6213,	7203,	5768,	7292,	5240,
8,	3631,	1661,	2313,	2398,	2326,	1729,
9,	1587,	1017,	722,	744,	943,	582,
+gp,	1191,	613,	847,	350,	622,	210,
TOTAL,	237491,	238792,	198970,	162191,	145712,	140064,

Table 2.16 (continued)

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 84–97	AMST 84–97
AGE													
2,	43788,	60639,	51536,	31622,	25663,	34742,	37655,	26997,	17896,	15689,	0,	42396,	45175,
3,	36065,	35845,	49534,	42158,	25887,	20711,	27712,	29750,	20904,	14151,	12617,	36350,	38710,
4,	25898,	29212,	28798,	39953,	34182,	20676,	16146,	20538,	21246,	14564,	10390,	29376,	31136,
5,	17483,	20088,	22603,	20718,	31167,	26454,	14806,	10975,	13965,	13065,	9803,	21769,	22821,
6,	8912,	13110,	13629,	14504,	14843,	21625,	16964,	7661,	6942,	7794,	6841,	13985,	14425,
7,	10797,	6275,	9039,	8451,	9447,	9920,	12687,	9684,	4020,	3628,	3873,	8002,	8252,
8,	1829,	5713,	3964,	5641,	4140,	4715,	5163,	6623,	4368,	1892,	1521,	3334,	3703,
9,	557,	798,	3887,	2433,	2925,	2019,	2544,	2343,	2426,	1924,	870,	1355,	1650,
+gp,	286,	565,	1288,	2658,	2982,	1558,	1523,	1652,	844,	787,	1233,		
TOTAL,	145616,	172244,	184277,	168139,	151235,	142419,	135199,	116225,	92611,	73493,	47148,		

Table 2.17

Table 11 Spawning stock number at age (spawning time) Numbers*10**-3

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,
AGE						
2,	880,	747,	358,	370,	2016,	0,
3,	8042,	10689,	9116,	3837,	5727,	4279,
4,	16161,	16707,	21010,	18881,	9042,	6652,
5,	19564,	17927,	18421,	21044,	21781,	7921,
6,	12660,	14799,	11926,	12281,	11801,	17038,
7,	6989,	5778,	6699,	5364,	6709,	4559,
8,	3486,	1595,	2220,	2302,	2209,	1695,
9,	1587,	1017,	722,	744,	924,	582,
+gp,	1191,	613,	847,	350,	622,	210,

Table 2.17 (continued)

Table 11 Spawning stock number at age (spawning time) Numbers*10**-3

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	358,	157,
3,	5410,	0,	0,	843,	0,	207,	831,	1785,	3136,	425,
4,	9323,	13437,	9503,	9988,	14698,	4135,	3875,	5956,	5312,	3058,
5,	12413,	14865,	15144,	11602,	21194,	12433,	8291,	4939,	7402,	5748,
6,	8199,	10882,	11857,	13199,	14101,	14489,	13571,	5823,	5137,	5066,
7,	10365,	6150,	8497,	8029,	8880,	8432,	11672,	9394,	3497,	2794,
8,	1829,	5313,	3964,	5415,	4140,	4055,	5111,	6623,	3888,	1892,
9,	557,	798,	3887,	2409,	2925,	2019,	2544,	2343,	2426,	1924,
+gp,	286,	565,	1288,	2658,	2982,	1558,	1523,	1652,	844,	787,

Table 2.18

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,
AGE						
2,	28239,	23969,	11483,	11878,	12944,	14154,
3,	40647,	54019,	46069,	19392,	22848,	24948,
4,	58309,	60270,	75795,	68114,	29720,	33926,
5,	60600,	55522,	57054,	65178,	64652,	28692,
6,	40034,	46793,	37710,	38833,	38618,	53271,
7,	35491,	29340,	34015,	27239,	34435,	24742,
8,	24276,	11104,	15462,	16029,	15548,	11559,
9,	11080,	7101,	5040,	5196,	6584,	4063,
+gp,	11578,	5958,	8240,	3405,	6048,	2039,
TOTALBIO,	310254,	294075,	290867,	255263,	231397,	197394,

Table 2.18 (continued)

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	14058,	19471,	16545,	10150,	8238,	13551,	9490,	6481,	6603,	5068,
3,	27342,	27178,	37550,	31954,	19622,	16384,	20064,	20325,	18309,	11903,
4,	38310,	43217,	42596,	59088,	50555,	31534,	23138,	28022,	30684,	24399,
5,	37367,	42941,	48307,	44273,	66604,	58787,	30399,	20781,	29186,	28643,
6,	25083,	36904,	38356,	40813,	41768,	62308,	46621,	21580,	20314,	22270,
7,	50991,	29640,	42687,	39905,	44607,	46282,	59911,	42875,	17220,	16475,
8,	12227,	38200,	26502,	37707,	27673,	32908,	34517,	42437,	24373,	12450,
9,	3889,	5570,	27135,	16981,	20419,	13650,	17633,	18294,	20024,	18196,
+gp,	2785,	5498,	12522,	25844,	28995,	15418,	14809,	17891,	10433,	10150,
TOTALBIO,	212051,	248618,	292199,	306715,	308481,	290822,	256582,	218684,	177147,	149555,

Table 2.19

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

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,
AGE						
2,	282,	240,	115,	119,	647,	0,
3,	6097,	8103,	6910,	2909,	4341,	3243,
4,	23907,	24711,	31076,	27927,	13374,	9839,
5,	41814,	38310,	39368,	44973,	46549,	16928,
6,	35630,	41646,	33562,	34561,	33212,	47944,
7,	33006,	27286,	31634,	25332,	31680,	21525,
8,	23305,	10660,	14843,	15387,	14771,	11328,
9,	11080,	7101,	5040,	5196,	6452,	4063,
+gp,	11578,	5958,	8240,	3405,	6048,	2039,
TOTSPBIO,	186700,	164014,	170787,	159809,	157074,	116909,

Table 2.19 (continued)

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	0,	0,	0,	0,	0,	0,	0,	0,	132,	51,
3,	4101,	0,	0,	639,	0,	164,	602,	1219,	2746,	357,
4,	13791,	19880,	14057,	14772,	21739,	6307,	5553,	8126,	7671,	5124,
5,	26531,	31776,	32365,	24793,	45291,	27630,	17023,	9352,	15469,	12603,
6,	23076,	30630,	33370,	37140,	39679,	41746,	37297,	16401,	15033,	14476,
7,	48951,	29047,	40126,	37909,	41930,	39340,	55118,	41588,	14981,	12686,
8,	12227,	35526,	26502,	36198,	27673,	28301,	34172,	42437,	21692,	12450,
9,	3889,	5570,	27135,	16811,	20419,	13650,	17633,	18294,	20024,	18196,
+gp,	2785,	5498,	12522,	25844,	28995,	15418,	14809,	17891,	10433,	10150,
TOTSPBIO,	135351,	157927,	186076,	194107,	225726,	172556,	182207,	155308,	108182,	86092,

Table 2.20

Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

YEAR,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 4- 7,
1984,	87957,	310254,	186700,	74824,	.4008,	1.0002,	.6221,
1985,	74666,	294075,	164014,	75451,	.4600,	1.0000,	.5275,
1986,	35770,	290867,	170787,	68905,	.4035,	1.0001,	.5805,
1987,	37001,	255263,	159809,	60972,	.3815,	1.0001,	.4913,
1988,	40322,	231397,	157074,	59294,	.3775,	1.0001,	.6185,
1989,	44095,	197394,	116909,	40285,	.3446,	1.0000,	.3739,
1990,	43788,	212051,	135351,	28127,	.2078,	1.0002,	.1823,
1991,	60639,	248618,	157927,	24822,	.1572,	1.0003,	.1689,
1992,	51536,	292199,	186076,	41690,	.2240,	1.0001,	.2306,
1993,	31622,	306715,	194107,	52557,	.2708,	1.0000,	.2311,
1994,	25663,	308481,	225726,	54562,	.2417,	1.0000,	.2299,
1995,	34742,	290822,	172556,	57207,	.3315,	1.0001,	.2911,
1996,	37655,	256582,	182207,	61776,	.3390,	1.0001,	.3639,
1997,	26997,	218684,	155308,	63319,	.4077,	1.0003,	.3712,
1998,	17896,	177147,	108182,	51572,	.4767,	.9919,	.4180,
1999,	15689,	149555,	86092,	40732,	.4731,	1.0002,	.4531,
Arith. Mean	41627,	252507,	159927,	53506,	.3436		.3846,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

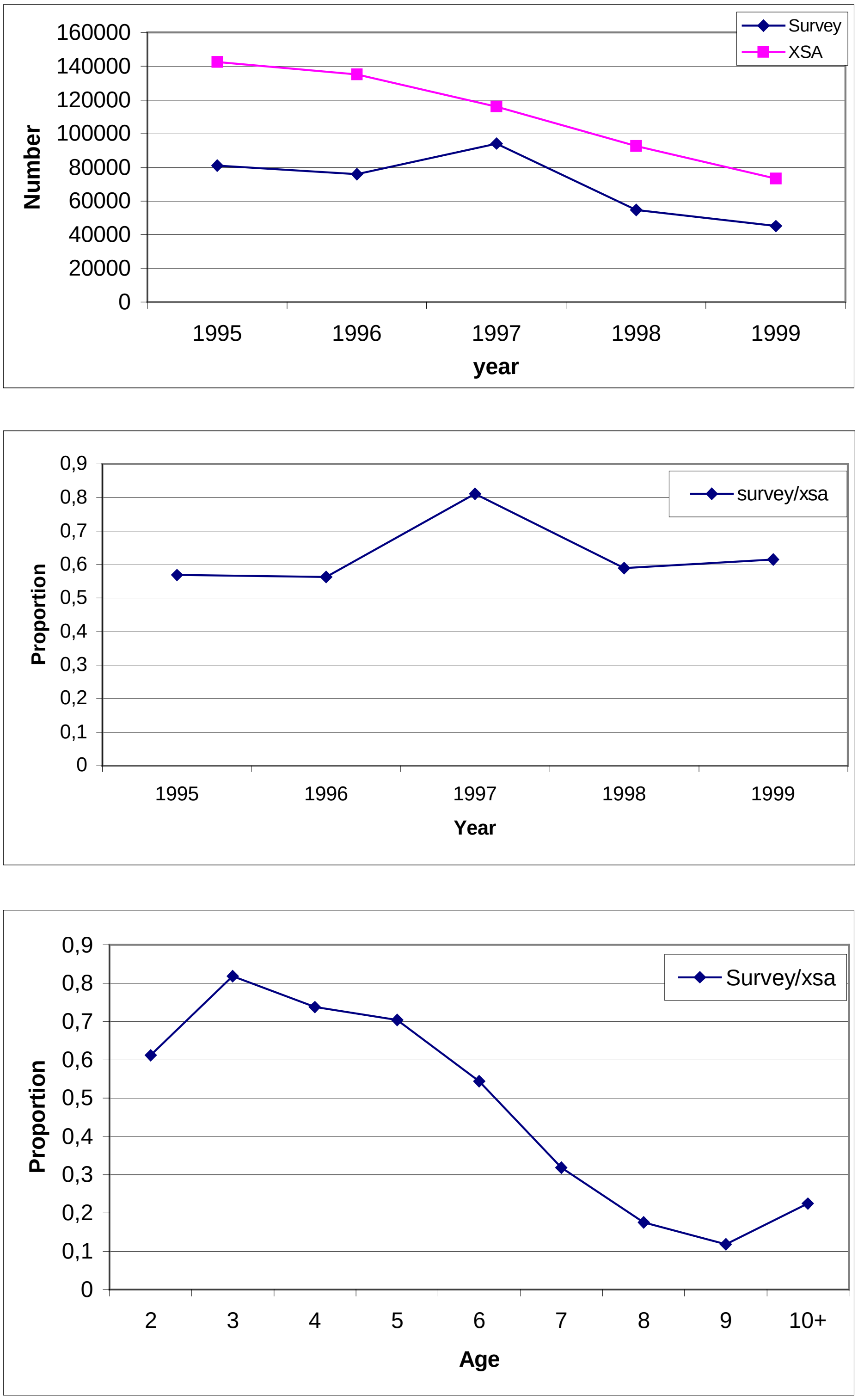

Figure 2.1 Comparison of the estimated total number coastal cod (2–10 year) from theNorwegian coastal survey and the XSA from 1995–1999.

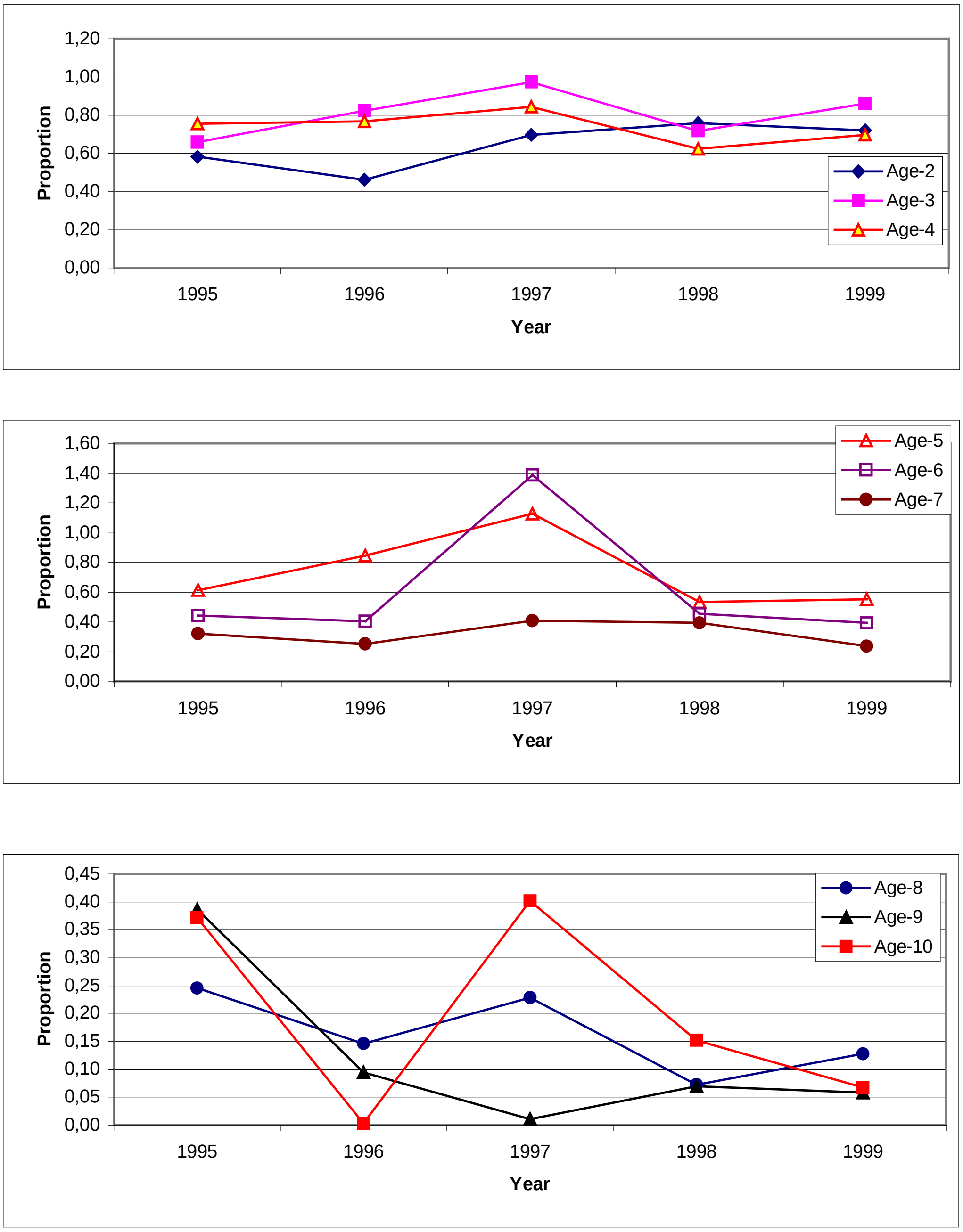

Figure 2.2 Estimated number of coastal cod (2-10 year) from the Norwegian coastal surveys divided with the estimated number from the XSA for age 2-10+ (1995-1999).

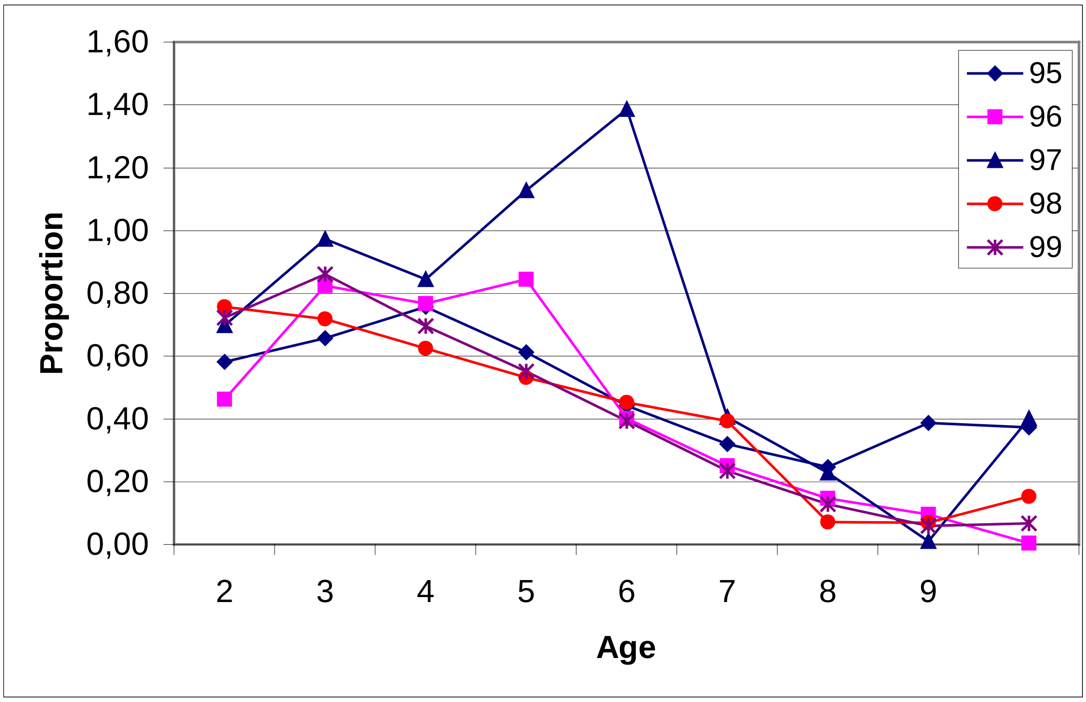

Figure 2.3 Estimated number of coastal cod (2–10 year) from the Norwegian coastal surveys divided with the estimated number from the XSA for age 2–10+ (1995–1999).

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 480,000 t in 1999. The fishery is conducted both with an international trawler fleet and with coastal vessels using traditional fishing gears. Quotas were introduced in 1978 for the trawler fleets and in 1989 for the coastal fleets. In addition to quotas, the fishery is regulated by a minimum catch size, a minimum mesh size in trawls and Danish seines, a maximum by-catch of undersized fish, closure of areas having high densities of juveniles and by seasonal and area restrictions.

3.1.2 Landings prior to 2000 (Tables 3.1–3.3, Figure 3.1A)

Final reported landings for 1998 amount to 592,624 t (Table 3.1), excluding 29,283 t of Norwegian coastal cod. The provisional figures for 1999 are 484,910 t, excluding 23,397 t of Norwegian coastal cod. This is 1,300 t higher than the provisional figure used in the assessment in May 2000, and it is 4,900 t higher than the catch assumed by the Working Group last year (480,000 t, equal to the TAC). 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 1998 to 1999, catches decreased in Sub-area I and Division IIa, but increased in Division IIb (Table 3.1).

3.1.3 Expected landings in 2000

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

The Working Group has no information on the size of expected unreported landings in 2000 but believes this could continue to be a problem (see Section 1.7). The catch predictions are based on a catch constraint (equal to the TAC) for the current year (2000).

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 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 since 1995. The Russian CPUE indices in 1998–1999 were about 30–40 % of the levels observed in 1994–1996 in all areas (Table A1).

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

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

Norwegian Barents Sea winter survey (bottom trawl and acoustics)

The preliminary swept area estimates and acoustic estimates from the Norwegian survey on demersal fish in the Barents Sea in winter 2000 are given in Tables A2 and A3. Compared to 1999, both the swept area estimates and the acoustic estimates show decreased abundance of ages 1 and 2 and some increase for ages 3–6. The swept area estimates of older fish show a considerable decrease. The development of the fishable stock appears more optimistic in the acoustic estimate than in the swept area estimate.

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

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

Lofoten acoustic survey on spawners

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

Norwegian summer/autumn survey

Tables A5 and A17 give the results of the Norwegian bottom trawl survey in the Barents Sea and Svalbard area in August/September. The values for 1997 and 1998 are adjusted for the lack of coverage of the Russian EEZ in those years by assuming the same area distribution as in 1996 and 1999, respectively. The 1999 results are similar to the 1999 winter survey. The results for the Svalbard area (Division IIb) have been used earlier in the XSA tuning, but are now left out (see Section 3.4.1).

Russian autumn survey

Abundance estimates from the Russian autumn survey (November-December) are given in Table A10 (acoustic estimates) and Table A11 (bottom trawl estimates). The main results here parallel the Norwegian swept area estimates in winter 2000. Compared to this the Russian survey indicate slightly higher abundance of the 1993 year class and older fish. The time series has been revised since the last WG meeting (Gusev and Yaragina WD 35).

International 0-group survey

Abundance indices of 0-group cod from the International 0-group survey are provided in Tables A14 and A15. It should be noted that in 1985 some gear changes were made, and the earlier part of the time series is not fully comparable to the later part. The abundance of 0-group cod has decreased since 1997. The same pattern is observed for age 1 of the same year-classes in the groundfish surveys. The 0-group abundance in the years 1992–1997 is rather outstanding in the time series. Among those year-classes only 1994 and 1995 appear to be above average at age 3 in other surveys.

3.2.3 Age-reading

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

3.2.4 Length and weight-at-age (Tables A6-A9, A12-A13)

Length at age is shown in Table A6 for the Norwegian survey in the Barents Sea in winter, in Table A8 for the Lofoten survey and in Table A12 for the Russian survey in October-December. Weight-at-age is shown in Table A7 for the Norwegian survey in the Barents Sea in winter, in Table A9 for the Lofoten survey and in Table A13 for the Russian survey in October-December.

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

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

3.2.5 Maturity-at-age (Table 3.5)

Russian maturity ogives from the autumn survey are available from 1984 until present. For the years 1985–1999 Norwegian maturity-at-age ogives have been obtained by combining the Barents Sea and Lofoten surveys according to the method described in Marshall *et al*. (1998). The Norwegian maturity ogives tend to give a higher percent mature at age compared to the Russian ogives, which is consistent with the generally higher growth rates observed in cod sampled by the Norwegian surveys. To represent the maturity composition of the stock, the percent mature at age for the Russian and Norwegian surveys have been arithmetically averaged for 1985 and later years. This is consistent with the approach used to estimate the weight-at-age in the stock (described in Section 3.3.2). At the May 2000 assessment meeting errors were discovered in the Norwegian maturity data for 2000. Therefore only the Russian ogives were used for 2000. Revised values were available at the present meeting (Marshall and Aglen WD30). Those were combined with the Russian values (as in the years 1985–1999), giving some increase in proportion mature for ages 6 and 7, compared to the May meeting.

As in previous assessments, Russian ogives were used for 1984, Norwegian ogives were used for 1982–1983 and knife-edge maturation at age 8 was assumed for the historical period prior to 1982.

3.2.6 Condition (Figure 3.2)

In terms of the reproductive potential, the liver condition index (LCI) reflects the amount of lipid energy reserves (Lambert and Dutil 1997). The LCI time series for five 10-cm length classes which encompass the majority of spawners is shown in Fig. 3.2. These values represent the annual average of monthly values (Yaragina and Marshall 2000). Values of LCI in 1999 (the most recent year for which annual averages are available) showed an increase from the 1998 values. This is most likely due to the increase in capelin stock biomass in the Barents Sea.

3.2.7 Fecundity at length of pre-spawning females

Methods for rapid determination of fecundity have recently been developed (A. Thorsen, Institute of Marine Research, Bergen, personal comm.) making it more feasible to estimate the fecundity/length relationship on an annual basis. The fecundity/length relationships for 1999 and 2000 are: Potential fecundity (million eggs) = 1.704×10^{-7} (Length $^{3.694}$) ($r^2 = 0.77$) (1999) and 1.196×10^{-7} (Length $^{3.781}$) ($r^2 = 0.77$) (2000). These relationships can be compared to those for the years 1986–1989, and 1991 (Table 3 of Kjesbu *et al*. 1998). The potential fecundity of a 70 cm female was highest in 1991 (1.6 million eggs). In comparison, the potential fecundity of a 70 cm female in 1999 and 2000 was lower (1.1 million eggs in both years).

1.1.8 Total egg production by the stock (Figure 3.3)

Estimates of total egg production by the stock were calculated using year-specific fecundity information (Section 3.2.7) and survey-based estimates of stock abundance at length according to the method described in Marshall *et al*. (1998). Total egg production by the stock in 2000 (36×10^{12}) was lower than that of 1999 (52×10^{12}) and approximately one order of magnitude lower than values for 1992 and 1993 (Figure 3.3). Given that condition and fecundity values are intermediate relative to historical values, the low values of total egg production in 2000 are primarily a result of the reduction in the overall number of large (> 70 cm) cod.

1.3 Data Used in the Assessment

1.3.1 Catch-at-age (Tables 3.7 and 3.8)

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

Table 3.7 show available catch-at-age data for all ages 1–15+. The catch numbers shown in Table 3.8 together with cannibalism figures (text table in section 3.3.7) were used in the XSA tuning.

1.3.2 Weight-at-age (Tables 3.4 and 3.9–3.10)

The weights-at-age in stock and catches for the age group 13+ was calculated by the IFAP system when ages 13,14 and 15+ were merged.

Catch weights

For 1999, 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, Germany and Spain. The weight-at-age in the catch for these countries is given in Table 3.4. The weight-at-age in the catch in 1999 was lower for all ages than what was assumed by the Working Group last year.

Stock weights

Stock weights-at-age a (W_a) at the start of year y for 1983–2000 (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 stock weights were used as for the period 1946–1981. The stock weights-at-age in 2000 are in good agreement with the prognosis made by ACFM last year.

1.3.3 Natural mortality

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

1.3.4 Maturity-at-age (Tables 3.5 and 3.11)

As noted in Section 3.2.5, arithmetic averages of the Russian and Norwegian maturity-at-age values were used for 1985–2000.

1.3.5 Tuning data (Table 3.12)

In all assessments of this stock since 1997 the following surveys and commercial CPUE data series have been used in the tuning:

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

In the present assessment the Svalbard survey was left out. The age groups 1 and 2 were excluded from the tuning and age groups 13 and 14 were included in the plus group (see section 3.4.1). The Russian bottom trawl survey was somewhat revised since last assessment (Gusev and Yaragina WD 35).

As in earlier assessments the surveys that were conducted during winter were allocated to the end of the previous year. This was done so that data from the surveys in 2000 could be included in the assessment. Some of the survey indices have been multiplied by a factor 10 or 100. This was done to keep the dynamics of the surveys even for very low indices, because XSA adds 1.0 to the indices before the logarithm is taken.

Tuning of the VPA was carried out using XSA using default settings with the following exceptions:

1. Catchability dependent of stock size for ages less than 6.

2. Catchability independent of age for age 11 and older (formerly used age 13 and older).

3. F of the 2 oldest age groups used in F shrinkage (formerly used 5 oldest ages).

4. Standard error of the mean to which estimates are shrunk set to 1.0.

5. Tapered time weighting power 3 over 10 years (formerly used 20 years).

Changes in points 2 and 3 is a consequence of reducing oldest true age from 14 to 12.

1.3.6 Recruitment indices (Table 3.6)

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

1.3.7 Predation and cannibalism

Because the final assessment of the 3+ stock was close to the one made in May, the cod consumption estimated at the May meeting was not revised (Table A16), and the estimated number of cod and haddock eaten by cod was taken from the May report. The method used for calculation of the consumption is described by Bogstad and Mehl (1997). The estimates in May were obtained as follows:

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

The 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 is 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 consumed is given in the text table below (values in millions):

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	153	212	2	0	0	0
1992	4312	1029	155	4	0	0	0
1993	3881	20246	509	53	1	+	0
1994	8922	7192	673	134	54	9	+
1995	8330	15498	740	248	85	3	+
1996	10450	22354	1511	142	55	20	1
1997	3050	17476	1991	180	17	1	+
1998	80	5332	649	262	37	3	1
1999	0	1836	530	101	6	+	0

The consumption by cod of various prey species is shown in Table A16. The consumption of capelin increased from 1996 to 1999. This is consistent with the increase in capelin biomass from 1996 to 1999 (ICES C.M. 2000/ACFM:16). The consumption of cod by cod has decreased, and is now at a fairly low level.

1.3.8 Prediction data (Table 3.22, Figure 3.4)

The input data to the short-term prediction with management option table (2000–2002) are given in Table 3.22. For 2000 stock weights and maturity were taken from surveys as described in Sections 3.3.2 and 3.3.4. An increase in weight-at-age for cod has been expected in 1999/2000 due to recovery of the capelin stock. The observations so far give no evidence for any clear increase, and it is assumed that the weights remain stable in the near future.

Stock weights and maturity in 2001 and later years were set equal to the 1998–2000 average, while catch weights and exploitation pattern in 2000 and later years were set equal to the 1997–1999 average.

The stock number at age in 2000 was taken from the final VPA (Table 3.18) for ages 4 and older. The number at age 3 in 2000 was taken from the May assessment. The recruitment at age 3 in year 2001 was calculated by applying the predicted natural mortality at age 2 in 2000 to the May XSA estimate of age 2 fish in the beginning of 2000. The abundance of the 1999 year class at age 3 (in 2002) was estimated to 165 million (see Section 3.5.2).

The natural mortality due to cannibalism, *M2(a,y)* was predicted by the following model:

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

Where $M_2(a,y)$ is the mortality of fish in year y of age a; $l(a,y)$ is the mean length of fish of age a in year y;

$C(y)$ is the capelin biomass at year y; and $B(2a+,y)$ is the biomass of cod of age $2a$ and older (which we assume is able to prey on cod of age a, in year y (Bogstad *et al.* 1994).

This model was fitted to the calculated predation mortalities at ages 2 and 3 in the XSA by minimizing

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

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

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 1984–1999, as well as the predicted values for 2000.

1.4 Methods Used in the Assessment

1.4.1 VPA and tuning

For several years each new assessment of this stock has shown a considerable downward revision in population size. This has been clearly shown both in Control Quality Diagrams and in retrospective analysis. Since 1997 the same tuning fleets and the same XSA settings have been used at each assessment. Several improvements have been suggested at various reviews of the assessments:

- reduce oldest true age (due to poor statistics on the oldest fish)
- leave out doubtful tuning fleets (poor diagnostics, covering variable proportion of stock, showing peculiar catchability trends)
- leave out doubtful age groups (not fully recruited to the tuning fleets, subject to discards or subject to variable natural mortality)
- shorten or split tuning periods with apparent time trends or shifts in catchability (changes in survey methodology, changes in misreporting, discards and predation)

Such changes have been discussed by the Working Group, but the consequences were never sufficiently explored to justify applying the changes. At the present meeting a working document (Aglen WD4) relating to this topic was presented. Based on this analysis the following changes were made:

1. The oldest true age group was reduced from 14 to 12.
2. The Svalbard survey was left out because it covers a rather small part of the total cod area and it shows rather peculiar catchability trends (Figures 3.9.1–3.9.3 in the 1999 WG report).
3. The ages 1 and 2 were not included in the tuning because they could be subject to variable unaccounted natural mortality and discarding. In addition they could be influenced by mesh size changes in some tuning fleets.
4. Time span for tapering was reduced from 20 to 10 years (WD 3 at May 2000 meeting). The reason for using this gradual downweighting of all old data instead of only cutting tuning fleets in accordance with known changes in the surveys, is that there are reasons to believe that both predation by sea mammals and the reliability of catch statistics has changed over the years. In addition there could be some years of "learning" associated with each change in the surveys.

Reducing the oldest true age group and keeping the same F-shrinkage (over 5 age groups) caused some reduction in F for the age groups 12 and 13+ for most of the time series and a corresponding increase in SSB mainly in the early part of the time series. To reduce this effect, the shrinkage was made over 2 age groups. Then the deviation from last year's assessment was less than 5 % for all but one year (1948) for SSB and less than 5 % for all but three years (1975, 1981, 1988) for F.

Before implementing those changes, the effect of the catch revisions since May and the revision of the Russian survey fleet were applied with the same tuning settings as in the May assessment. Compared to the May assessment this caused a 1 % increase in F in 1999 and a 2 % increase in SSB in 1999.

1.4.2 Recruitment (Table 3.6)

The new tuning settings gave results close to the May 2000 assessment. Recruitment estimates was therefore taken from the May assessment. When ages 1 and 2 are omitted in the tuning, the formerly used procedure for estimating recruitment has to be re-examined. This requires some further investigations before the next meeting (Section 3.9).

1.4.3 Including cannibalism in the VPA (Tables 3.13–3.16)

Since the XSA result with the new tuning settings gave results close to the May assessment the May estimates of cod consumed by cod and M2 values were used without further iterations.

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

In order to build a matrix of natural mortality which includes predation, the fishing mortality estimated in the final XSA analyses was split into the mortality caused by the fishing fleet (true F) and the mortality caused by cod cannibalism (M2 in) 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 M2. This new M matrix (Table 3.16) was used together with the new true Fs to run the final VPA on ages 3–13+. M2 and F values for ages 1–6 in 1984–1999 are given in the text tables below.

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

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

Year	F age 1	F age 2	F age 3	F age 4	F age 5	F age 6
1984	0.0000	0.0017	0.0194	0.1250	0.3097	0.6303
1985	0.0001	0.0015	0.0532	0.1716	0.3800	0.6078
1986	0.0001	0.0017	0.0330	0.2132	0.4958	0.7118
1987	0.0000	0.0011	0.0555	0.2291	0.5101	0.9355
1988	0.0000	0.0009	0.0546	0.1275	0.3706	0.5967
1989	0.0000	0.0009	0.0330	0.1292	0.2666	0.4017
1990	0.0000	0.0004	0.0087	0.0628	0.1352	0.2319
1991	0.0000	0.0007	0.0134	0.0631	0.1889	0.3226
1992	0.0004	0.0011	0.0341	0.1277	0.2227	0.4452
1993	0.0000	0.0006	0.0129	0.0942	0.3467	0.4638
1994	0.0000	0.0003	0.0098	0.1065	0.3155	0.6445
1995	0.0000	0.0003	0.0106	0.0997	0.3287	0.5790
1996	0.0000	0.0006	0.0241	0.1205	0.3264	0.5375
1997	0.0000	0.0006	0.0226	0.2075	0.5544	0.7000
1998	0.0000	0.0015	0.0475	0.2739	0.5120	0.7573
1999	0.0000	0.0003	0.0155	0.1939	0.5534	0.7454

1.5 Results of the Assessment

1.5.1 Fishing mortalities and VPA (Tables 3.17–3.21, Figures 3.1A-B, and 3.7–3.9)

The average age 5–10 fishing mortalities (F_{5-10})for the years 1981–1989 were in the range 0.67 to 0.98 (Table 3.21). The lowest value occurred during 1989 and the highest in 1988. In 1990, fishing mortality dropped to 0.28 mainly as a result of management measures brought into effect to control the amount of fishing effort. F_{5-10} then increased, reaching 1.04 in 1997 before dropping to 0.93 in 1998. The estimated for F_{5-10} in 1999 is higher than predicted last year (0.96 vs. 0.73), and the spawning stock biomass in 1999 is estimated to be 266,000 t, compared to 298,000 t in last year's ACFM assessment. The fishing pattern in 1999 indicates a lower exploitation rate of ages 3 and 4 than predicted.

Figures 3.7–3.9 show 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 discrepancies in sum of products (SOP), 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. Revised maturity ogives and revised catch and stock weights at age for the period 1946–1981 are expected to be ready for the AFWG meeting in 2001 (see section 1.4).

1.5.2 Recruitment

Recruitment at age 3 of the 1997 (711 mill) and 1998 year-classes (474 mill) are taken from the May assessment.

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

1.6 Reference Points and Safe Biological Limits

The changes of historical F and SSB values caused by the new tuning settings were regarded to be too small to make significant impact on the reference points currently used.

1.6.1 Biomass reference points (Figure 3.5)

Jakobsen (1993) discusses past, present and future management of Northeast 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). It was proposed at the ACFM meeting in 1998 to use 500,000 t as B_{pa} and 112,000 t as B_{lim}. The Working Group will postpone a revision of the values until the historical time series on weight and maturity-at-age has been revised (Section 3.5.1).

1.6.2 Fishing mortality reference points

At the 1998 WG meeting, the following values were estimated for the fishing mortality references points $F_{0.1} = 0.13$, $F_{max} = 0.24$, $F_{low} = 0.27$, $F_{med} = 0.46$ and $F_{high} = 0.91$ (median values). This was done using the PASoft program package (MRAG 1997). Data input and analysis performed were described by Motos (WD 1998).

The 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 5 th percentile of this value was adopted as a precautionary reference fishing mortality ($F_{pa} = 0.42$) by the WG in 1998. Since 1998 ACFM has used $F_{lim} = F_{loss} = 0.70$ and $F_{pa} = 0.42$. This value of F_{pa} corresponds both to the lower 5 percentile of F_{loss} and to $\sigma = 0.3$ in the equation above.

At the present meeting only $F_{0.1}$ and F_{max} have been recalculated (Tables 3.24–3.25 and Figure 3.1.c). The new estimate of $F_{0.1}$ is 0.11 and the one for F_{max} is 0.21. The present exploitation level is $F_{99} = 0.96$ (*status quo*) which is above F_{high} and well above F_{lim}.

1.7 Catch Options (Table 3.23)

The management option table (Table 3.23) assumes a TAC constraint of 390,000 t in 2000. The corresponding $F_{5–10}$ in 2000 is 0.63. Fishing at F_{pa} (0.42) in 2001 gives a catch of 330,000 t and a spawning stock of 455,000 t. Rebuilding SSB to above 500,000 t in 2002 requires a catch less than 250,000 t in 2001. Fishing at $F_{status\ quo}$ in 2001 will cause the spawning stock to remain low.

In Figure 3.1D the catch level in 2001 and spawning stock biomass level in 2002 are plotted against the fishing mortality in 2001.

1.8 Medium-Term Forecasts and Management Scenarios

1.8.1 Input data (Table 3.22)

The input data were the same as used for the short-term predictions, using the same data for the years after 2001 as for 2001 (Table 3.22).

1.8.2 Methods

It was decided to limit the risk analysis for North-east Arctic cod to a single-species analysis, where only uncertainty in the initial stock estimate and the recruitment is taken into account. The simulation period was 2000–2003.

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

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

1.8.3 Results

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

F	Basis	Landings 2001	SSB 2002	P (SSB< B_{pa}) in 2003
0.21	F_{max}	179	541	< 5 %
0.32	5 % probability of SSB < B_{pa} in 2003	263	495	5 %
0.42	F_{pa}	334	456	17 %
0.63	F_{2000}	470	386	56 %
0.96	F_{99}	649	298	91 %

1.8.4 Management considerations

The spawning stock in 2000 is well below B_{pa}, and not far from historical low levels. The fishing mortality has been above F_{lim} throughout the 6 latest years. The F in 2000 induced by the agreed TAC should result in a large reduction in F from 1999 to 2000, but the resulting SSB in 2001 will be well below B_{pa}. A further reduction of the fishing mortality at all ages and rebuilding of the SSB is required. Given that the incoming year classes are expected to be weak, a rapid rebuilding of the spawning stock is strongly recommended.

In November 1999, ACFM estimated that a fishing mortality of 0.13 would result in rebuilding the stock to above B_{pa} already in 2001, while a fishing mortality of 0.32 would imply a low risk of SSB< B_{pa} by 2003. This year's estimates suggest that a fishing mortality of 0.32 would imply a low risk of SSB< B_{pa} by 2003. It is noted, however, that this risk increases very rapidly with increasing F when the 5 % risk is exceeded. It is also important to remember that the actual F has generally been higher than that estimated in the assessment year, and this should be taken into consideration. Even if there are some indications that the present stock estimate is better than previous estimates (see Section 3.9), the experience that the realized fishing mortality has tended to be well above the level which is assumed when TACs are decided implies that one should not attempt to apply the highest fishing mortality that appears to be associated with a low risk, but rather apply an ample safety margin.

The agreed TAC for 2000 is 390 000 tonnes, corresponding to a fishing mortality of 0.63. This is well above F_{pa} and continuing this F implies a substantial risk that the SSB will remain below B_{pa}.

1.9 Comments to the Assessment (Figures 3.6–3.9)

According to the plots of retrospective patterns in F(5–10), SSB and recruitment (Figures 3.7–3.9) and the plots of tuning fleet catchabilities (Figures 3.6a-c) there seem to be no obvious reasons for expecting a bias in the present assessment. This is a considerable improvement compared to the assessments made in several recent years.

Schöne (WD 4, 1999 WG) estimated the number of undersized cod caught by a trawler in autumn 1998 to 36 % of the total catch, mainly 3 and 4 year olds when working in the area between Bear Island and Svalbard. If this was representative for the entire fleet, for example, and we assume that 15 % (maximum legal percentage of undersized fish) was landed, the rest, i.e., 21 % are most likely discarded or not reported. In 1998 this would correspond to 20 mill. 3-year-olds and 54 mill. 4-year-olds, or about 70 000 t unreported catch. In addition come other sorts of misreporting described in Section 1.7. The Working Group expresses serious concerns that mis-reporting and discarding of similar magnitude still continues. This creates uncertainties in the catch statistics and undermines the basis for the assessment and catch predictions. This is a strong reason for additional precaution when setting future quotas. It also calls for an evaluation of the current management and catch control systems.

The new assessment procedure does not give estimates of the age groups 1 and 2. Such values are needed as input recruitment at age 3 in the short-term predictions. A common procedure in such cases is to regress converged recruitment values in the VPA with survey indices and from there predict recruitment from the most recent surveys. This predicted recruitment will not take into account the variable mortality between the fish is measured in a survey (at age 1 or 2) and the time of recruitment to the assessment (age 3). To bring in relevant information on this, the XSA could include catches and cannibalism on ages 1 and 2 without including the survey indices, thereby obtaining converged population estimates of these age groups. RCT3 could then be used to estimate population values from the most resent surveys. Those values could be projected forward to recruitment at age 3 by assuming or modeling the mortality over the projection period. The robustness of these procedures and alternative procedures should be examined before the next WG meeting.

The temperature prognosis given in Ottersen et al. (WD1) indicates similar temperatures in 2001 as in the past two years, before a short term cooling in 2002 and warming again in 2003. Knowledge on recruitment and larval growth in relation to temperature variability in the Barents Sea (Sætersdal and Loeng, 1987; Ottersen and Loeng, 2000) would then indicate that strong year classes of cod and haddock can not be expected before 2003 or 2004. Models for predicting recruitment which integrate abundance indices for pre-recruit fish with ecological and environmental data should be developed (Bogstad, WD 11).

Ajiad (WD 5) presented individual growth predictions for Northeast Arctic cod based on a bioenergetic model. These predictions indicate that the growth may decline even if the consumption rate is unchanged. In order to improve growth predictions, it is crucial to be able to predict the cod's consumption based on predictions of prey availability and temperature.

It is essential that research pertaining to the influence of environmental and ecological factors upon recruitment, growth, maturation, fecundity, and mortality be continued with the aim of making the results of practical use in stock assessment.

1.10 Alternative Assessment Methods (Fleksibest)

1.10.1 Background

There have been large problems with the assessment of Northeast Arctic cod in the recent years. Part of the reason for the problems is believed to be the assessment method (XSA) used. Among other things, XSA has little flexibility and does not provide an overall measure of how well the model fits to the data is.

The development of a new assessment method (Fleksibest) started at IMR, Bergen, in 1997. A preliminary version was presented at a workshop in Bergen in 1998 (Pennington, 1999), and some illustrative runs with the model were presented in last year's report. This year a complete assessment with Fleksibest is presented for comparison with the XSA assessment.

1.10.2 Model description

A complete description of the mathematical formulations used in Fleksibest is given in Frøysa *et al*. (2000). Fleksibest is a forward simulation model based on the Icelandic multispecies, multiarea, multifleet model BORMICON (Stefánsson and Pálsson, 1997, 1998), which is age- and length structured. This is a framework within which different mathematical formulations of biological processes can be tested and compared. Fleksibest belongs to the type of age structured assessment models sometimes termed 'statistical catch at age analysis' (Fournier and Archibald, 1982; Deriso *et al*., 1985).

The main features of Fleksibest are:

1. A population model, which describes the numbers at age and length in the stock, and the associated mortalities, over time.
2. All the main population dynamics processes except recruitment (growth, maturation, natural mortality, fishing mortality) are explicitly modelled. They are modelled as functions of length, not of age, since most biological processes are more dependent on length (weight) than on age. This is particularly important because of the large variation in size-at-age in this stock.
3. The stock is divided into an immature and a mature stock, which may have different population dynamics. A length-dependent maturation function is used to describe the transition from the immature to the mature stock.
4. Models for relating observations to population numbers. The observations may be catches in numbers at age and length, survey indices at age and length, or number of fish consumed due to cannibalism.
5. In Fleksibest, both the population and the catches (for each fleet) are modelled, and compared to observations. Both survey and catch data are uncertain. There is uncertainty associated with both the catch and survey data. The uncertainty in catch data may be associated with both the catch sampling and the landings in tonnes. This means that the model will give deviations between observed and modelled catches. Fleksibest will not 'converge' like VPA-based methods do.
6. Fleksibest has comprehensive diagnostics tools (graphics, tables).

As a minimum, stock numbers in the initial year, annual recruitments, partial fishing mortalities for each fleet and survey catchabilities have to be estimated. Growth, natural mortality, mean length and standard deviation of mean length of cohorts in the first year and at the youngest age, maturation, fleet selectivity and cannibalism parameters may be estimated, or they may be taken from other sources.

1.10.3 Stock assessment using Fleksibest

1.10.3.1 Time period

A quarterly time step is used. The model is run for the period 1.quarter 1983- 1 quarter 2000. A model with a shorter time step than a year (e.g., quarter) makes it possible to make use of survey indices and catch data from the assessment year in the same way as data for earlier years are used, i.e., no shifting of data to the end of the previous year is needed. Extension of assessments made by Fleksibest to the period previous to the start year can be done by running a traditional VPA up to 1983 with terminal Fs set to give the same stock abundance in 1983 as obtained by Fleksibest.

1.10.3.2 Model stock, length and age structure

The cod stock is divided into an immature (ages 2–10, lengths 5–135 cm) and a mature part (ages 4–12+, lengths 45–135 cm). Maturation takes part in the fourth quarter each year. 2.5 cm wide length groups are used in the model, and 5 cm wide length groups in the data files.

1.10.3.3 Data used

Surveys:

- Norwegian winter survey in the Barents Sea – bottom trawl indices (applied to the immature stock). This survey was split into two time periods because of the change of gear and increase in area coverage in 1994 (Jakobsen et al., 1997):
    - 1983–1993
    - 1994–2000
    - Ages: 2–10, Lengths: 5–90 cm.
- Norwegian winter survey in the Barents Sea – acoustic indices (applied to the immature stock). This survey was split into two because of the change of gear and increase in area coverage in 1994 (Jakobsen *et al.,* 1997):
    - 1983–1993
    - 1994–2000
    - Ages: 2–10, Lengths: 5–90 cm.
- Lofoten acoustic survey (Korsbrekke 1997), applied to the mature stock. Data for 1985–2000. Ages 5–12+, Lengths 55–110 cm.
- Russian bottom trawl survey – note revised data (WD 35), applied to the immature and mature stock combined (Lepesevich and Shevelev, 1997) data for 1983–1999.
    - Ages 2–12, Lengths 5–110 cm.
- Norwegian summer survey in the Barents Sea (applied to the immature and mature stock combined) (Aglen, 1999):
    - Ages 2–12, Lengths 5–110 cm.

Catches

Catch in numbers at age and length by quarter from the following fleets:

- Norway: Danish seine, gillnet, handline, longline and trawl.
- Russia: Trawl
- Data for 1983–1999 (1984 missing), length 5–135 cm, ages 2–12+.

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. The ratio between partial F for this fleet and of Norwegian trawl is the same as the ratio between the catch in tonnes for these fleets, for each year.

- Overfishing. In 1990–1994, the Working Group included estimates of unreported landings (assumed to have the same age distribution as the total reported landings) in the assessment. To account for this we have introduced an 'overfishing' fleet which fishes (with a given selection and F) in these years.

Consumption data

Data on the consumption (kg/time step) of cod (prey) of length l by cod (predator) of age a, calculated in the same way as in Bogstad and Mehl (1997).

1.10.3.4 Model assumptions

The Pearson function, which is scale dependent, was used as an objective function.

The Norwegian bottom trawl and acoustic survey for the period 1983–1993 was downweighted compared to this survey for the period 1994–2000 because of incomplete area coverage in the former period (Jakobsen et al., 1997). The Russian bottom trawl survey was heavily downweighted because for many age-length cells the discrepancy between model and data was large. Consumption data were downweighted. This was done because the length, but not the age, of prey is known and thus it is unknown whether this prey was within the model age range or not. The values of the objective function for catches have to be upweighted with approximately a factor of 10 compared to the surveys in order to get approximately the same contribution to the total value of the objective function for both groups of data sources (called 'equal weighting').

Attempts with introducing a curvilinear relationship between survey indices and population numbers gave an exponent close to 1. Thus, a linear relationship has been used in all the runs presented here.

Runs were made with both age 2 and 3 as the minimum age. For the key run, minimum age 3 and equal weighting was chosen, and the Norwegian summer survey was not included.

1.10.4 Results from the key run

Input data, parameter estimates and likelihood components for the key run are given in Table 3.26. Fishing mortalities, natural mortalities, stock numbers, stock biomass, spawning stock biomass, maturity-at-age, stock/catch weight-at-age and catch in numbers at age are given in Table 3.27. It should be noted that in Fleksibest, both weight-at-age, maturity-at-age and catch at age is modelled.

Modelled catch in number at age seem to be in good agreement with the observed values in most years (Fig. 3.10), with a tendency to overestimate the catch numbers for the youngest age groups. The modeled weights at age in the catch tend to be higher than the observed ones. The total annual catch in weight as estimated by the model is generally higher than the reported catches. The proportion mature at age in the model results is lower than the observed values. However, maturation parameters were not estimated in the model runs, but taken from a coarse analysis of maturation data for the time period 1993–1996.

A sample residual plot describing the fit between modelled and observed survey indices is given in Figure 3.11.

Results (F, SSB, recruitment, catches) of a retrospective analysis (back to 1995) with the same settings as in the key run are shown in Figures 3.12a-d. Recruitment and catch estimates seem to be fairly consistent. The results show that the fishing mortality is overestimated in the assessment year, which is the opposite of what XSA shows for the most recent years.

Trial runs indicated that a better retrospective fit could be obtained by including the Norwegian summer survey. The reason for this is probably that survey length distributions at more than one time of the year helps to stabilise the model.

1.10.5 Use of Fleksibest for predictions

Predictions can be easily made using Fleksibest software just by extending the time range for the model runs. When using Fleksibest for prediction purposes, much biological knowledge can be included (species interactions, environmental influence etc.) in addition to the knowledge which can be included into the assessment of the present and past stock size (see e.g., Ottersen *et al.,* WD 1, Ottersen and Michalsen, WD 2, Bogstad, WD 11, Ajiad, WD 5).

1.10.6 Data preparation

Historical survey, catch and consumption data for cod should be provided on Fleksibest format, i.e., structured on age and length, for as a long time period as possible. The first goal is to provide all the data back to 1981. Norway and Russia aim to accomplish this before the next WG meeting. Other countries should also aim to provide their historical data at the Fleksibest format. For the future, routines for providing input data to the assessment on Fleksibest format should be established.

1.10.7 Future work

The properties of Fleksibest need to be investigated further. The main issues in the work with Fleksibest before the next meeting of the AFWG will be:

- Choice of objective function.

- Weighting of data sources (both weighting of different surveys/fleets relative to each other and internal weighting of different age/length cells for a given survey/fleet).

- Problems related to fitting observed and modelled length distributions to each other.

- Parameter correlations.

- Reasons for discrepancy between observed and modelled catch (unreported catches, model formulations etc.).

- Test present assumptions about processes being constant over time (e.g., survey and fleet selection/catchability).

- Identify conflicting signals from different data sources.

Fleksibest will be implemented at Norwegian Institute of Fisheries and Aquaculture (NIFA) in Tromsø and at PINRO, Murmansk during autumn 2000. Help for installation at other institutions will be provided by IMR on request. A training course for use of Fleksibest/BORMICON will be held in January/February 2001. The aim is to use Fleksibest as the main assessment model for Northeast Arctic cod at the next meeting of the AFWG.

1.10.8 Practical considerations

Fleksibest at present runs on UNIX (Sun/HP/Origin 2000) and LINUX platforms. Post-processing to tables and figures of model output is carried out using standard UNIX tools. Parameter estimation on a fast UNIX workstation typically takes 1–2 hours.

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	250,815	257,398	84,411		592,624
1999 [1]	159,021	216,898	108,991		484,910

[1] Provisional figures.

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

	Sub-area I		Division IIa		Division IIb	
Year	Trawl	Others	Trawl	Others	Trawl	Others
1967	238.0	84.8	38.7	90.0	121.1	-
1968	588.1	54.4	44.2	118.3	269.2	-
1969	633.5	45.9	119.7	135.9	262.3	-
1970	524.5	79.4	90.5	153.3	85.6	-
1971	253.1	59.4	74.5	245.1	56.9	-
1972	158.1	38.9	49.9	285.4	33.0	-
1973	459.0	33.7	39.4	172.4	88.2	-
1974	677.0	46.5	41.0	83.2	254.7	-
1975	526.3	35.4	33.7	86.6	147.4	-
1976	466.5	60.2	112.3	124.9	103.5	-
1977	471.5	66.7	100.9	156.2	110.0	-
1978	360.4	57.9	117.0	146.2	17.3	-
1979	161.5	33.7	114.9	120.5	8.1	-
1980	133.3	35.4	83.7	115.6	12.5	-
1981	91.5	45.1	77.2	167.9	17.2	-
1982	44.8	51.8	65.1	171.0	21.0	-
1983	36.6	28.2	56.6	143.7	24.9	-
1984	24.5	29.8	46.9	150.7	25.6	-
1985	72.4	40.2	60.7	112.8	21.5	-
1986	109.5	48.1	116.3	86.4	69.8	-
1987	126.3	19.8	167.9	77.5	129.9	1.7
1988	149.1	17.6	122.0	88.0	58.2	0.2
1989	144.4	19.5	68.9	81.2	19.1	0.1
1990	51.4	10.9	47.4	52.1	24.5	0.8
1991	58.9	12.1	73.0	84.0	40.0	1.2
1992	103.7	20.5	79.7	92.8	85.6	0.9
1993	165.1	30.7	155.5	113.9	66.3	0.2
1994	312.1	41.3	165.8	140.6	84.3	1.9
1995	218.1	33.3	174.3	143.3	160.3	10.7
1996	248.9	32.7	137.1	159.0	147.7	6.8
1997	235.6	37.7	150.5	176.2	154.7	7.6
1998	219.8	31.0	127.0	130.4	82.7	1.7
1999 [1]	133.3	25.7	101.9	115.0	107.2	1.8

[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	14,290	1,197	6,388	3,841	284,647	14,212	14,294	244,115	1,423	8,217	592,624
1999 [1]	13,700	2,137	4,093	3,019	223,390	8,994	11,315	210,379	1,985	5,898	484,910

[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
1999	0.46	0.88	1.16	1.65	2.40	3.12	4.26	6.00	6.52	10.64	14.05	12.67	9.20	17.22

Russia (trawl only)

Year	Age												
	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1983	0.65	1.05	1.58	2.31	3.39	4.87	6.86	8.72	10.40	12.07	14.43			
1984	0.53	0.88	1.45	2.22	3.21	4.73	6.05	8.43	10.34	12.61	14.95			
1985	0.33	0.77	1.31	1.84	2.96	4.17	5.94	6.38	8.58	10.28				
1986	0.29	0.61	1.14	1.75	2.45	4.17	6.18	8.04	9.48	11.33	12.35	14.13		
1987	0.24	0.52	0.88	1.42	2.07	2.96	5.07	7.56	8.93	10.80	13.05	18.16		
1988	0.27	0.49	0.88	1.32	2.06	3.02	4.40	6.91	9.15	11.65	12.53	14.68		
1989	0.50	0.73	1.00	1.39	1.88	2.67	4.06	6.09	7.76	9.88				
1990	0.45	0.83	1.21	1.70	2.27	3.16	4.35	6.25	8.73	10.85	13.52			
1991	0.36	0.64	1.05	2.03	2.85	3.77	4.92	6.13	8.36	10.44	15.84	19.33		
1992	0.55	1.20	1.44	2.07	3.04	4.24	5.14	5.97	7.25	9.28	11.36			
1993	0.48	0.78	1.39	2.06	2.62	4.07	5.72	6.79	7.59	11.26	14.79	17.71		
1994	0.41	0.81	1.24	1.80	2.55	2.88	4.96	6.91	8.12	10.28	12.42	16.93		
1995	0.37	0.77	1.21	1.74	2.37	3.40	4.71	6.73	8.47	9.58	12.03	16.99		
1996	0.30	0.64	1.09	1.60	2.37	3.42	5.30	7.86	8.86	10.87	11.80			
1997	0.30	0.57	1.00	1.52	2.18	3.30	4.94	7.15	10.08	11.87	13.54			
1998	0.33	0.68	1.06	1.60	2.34	3.39	5.03	6.89	10.76	12.39	13.61	14.72		
1999	0.24	0.58	0.98	1.41	2.17	3.26	4.42	5.70	7.27	10.24	14.12			

Table 3.4 (Continued)

Germany (Division IIa and IIb)

Year	Age 2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994		0.68	1.04	2.24	3.49	4.51	5.79	6.93	8.16	8.46	8.74	9.48	15.25	
1995		0.44	0.84	1.50	2.72	3.81	4.46	4.81	7.37	7.69	8.25	9.47		
1996		0.84	1.15	1.64	2.53	3.58	4.13	3.90	4.68	6.98	6.43	11.32		
1997		0.43	0.92	1.42	2.01	3.15	4.04	5.16	4.82	3.96	7.04	8.80		
1998	0.23	0.73	1.17	1.89	2.72	3.25	4.13	5.63	6.50	8.57	8.42	11.45	8.79	
1999 [1]		0.85	1.45	2.00	2.65	3.47	4.16	5.45	6.82	5.90		8.01		

[1] Division IIa only

Spain (Division IIb)

Year	Age 2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1994	0.43	1.08	1.38	2.32	2.47	2.68	3.46	5.20	7.04	6.79	7.20	8.04	10.46	15.35
1995	0.42	0.51	0.98	1.99	3.41	4.95	5.52	8.62	9.21	11.42	9.78	8.08		
1996		0.66	1.12	1.57	2.43	3.17	3.59	4.44	5.48	6.79	8.10			
1997 [1]	0.51	0.65	1.22	1.68	2.60	3.39	4.27	6.67	7.88	11.34	13.33	10.03	8.69	
1998	0.47	0.74	1.15	1.82	2.44	3.32	3.71	5.00	7.26					
1999 [1]	0.21	0.69	1.06	1.69	2.50	3.32	4.72	5.76	6.77	7.24	7.63			

[1] IIa and IIb combined

Iceland (Sub-area I)

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

UK (England & Wales)

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1995 [1]			1.47	2.11	3.47	5.57	6.43	7.17	8.12	8.05	10.2	10.1		
1996 [2]			1.55	1.81	2.42	3.61	6.3	6.47	7.83	7.91	8.93	9.38	10.9	
1997 [2]			1.93	2.17	3.07	4.17	4.89	6.46		12.3	8.44			

[1] Division IIa and IIb

[2] Division IIa

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

Norway

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

Russia

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

Norway

	Percentage mature							
	Age							
Year	3	4	5	6	7	8	9	10
1985	-	1	9	38	51	85	100	79
1986	3	7	8	19	50	67	36	80
1987	-	0	4	12	16	31	19	-
1988	-	2	6	41	54	45	100	100
1989	-	1	8	21	43	79	87	100
1990	-	1	4	22	68	93	91	100
1991	-	5	12	34	65	84	99	100
1992	-	1	16	55	77	94	100	100
1993	-	3	12	40	63	94	98	99
1994	-	1	14	36	64	79	98	100
1995	-	1	9	43	63	73	96	98
1996	-	-	2	30	70	84	100	100
1997	-	-	2	17	64	92	100	89
1998	-	1	6	23	40	77	90	100
1999	-	-	-	11	53	83	83	100
2000	-	-	6	26	76	83	99	100

Table 3.6 Recruitment indicies NEA cod.

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

```
5,34,2             (No. of surveys, No. of years, VPA Column No.),,

1966,   113, -11,  -11,    2,   -11,   -11
1967,   199, -11,  -11,    4,   -11,   -11
1968,   409, -11,  -11,    2,   -11,   -11
1969,  1027, -11,  -11,   25,   -11,   -11
1970,  1837,  23,   64,  251,   -11,   -11
1971,   530,   7,    9,   77,   -11,   -11
1972,   629,   5,    4,   52,   -11,   -11
1973,   621,  16,    5,  148,   -11,   -11
1974,   351,   1,    1,   29,   -11,   -11
1975,   646,  60,    1,   90,   -11,   -11
1976,   201,   1,    1,   13,   -11,   -11
1977,   138,   1,    1,   49,   -11,   -11
1978    152,   1,    1,   40,   -11,   -11
1980,   166,   1,    1,   13,   4.6,     8
1981,   397,   1,    1,   10,   0.8,     4
1982,   523,   1,    8,   59, 152.9,  60.5
1983,  1043,   4,    9,  169,2755.0, 745.4
1984,   287,   1,    1,  155, 149.5,  69.1
1985,   205,   3,   10,  246, 665.8, 353.6
1986,   173,   1,    2,  137,  22.0,   1.6
1987,   243,   1,    1,   17,   3.2,   2.0
1988,   412,   1,    1,   33,   8.2,   7.5
1989,   721,   1,    1,   38, 207.2,  81.1
1990,   899,   6,    1,  123, 460.5, 181.0
1991,   820,   3,    6,  230, 126.6, 241.4
1992,   663,  10,   60,  294, 534.5,  74.0
1993,   441,   2,    5,  209,1035.9, 858.3
1994,   745,  16,    3,  227,5253.1,2619.2
1995,   -11,  25,   36,  240,5768.5,  96.0
1996,   -11,  10,  -11,  287,4815.5, 623.5
1997,   -11, -11,   16,  160,2418.5,3401.3
1998,   -11,   1,    2,   68, 484.6, 358.3
1999,   -11,   1,    2,   21, 128.8, 154.1

R-1–1      Russian Bottom trawl survey, area I,   age 1
R-2B-1     Russian IIb, age 1
INT0GP     International 0-group survey
N-BST1     Norwegian Barents Sea, Bottom trawl survey, age 1
N-BA1      Norwegian Barents Sea Acoustic survey age 1
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Table 3.7
NE Arctic cod. International catch (thousands) at age for ages 1-15+

	AGE														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1946	1	16	4008	10387	18906	16596	13843	15370	59845	22618	10093	9573	5460	1927	750
1947	1	1	710	13192	43890	52017	45501	13075	19718	47678	31392	9348	9330	4622	4103
1948	1	16	140	3872	31054	55983	77375	21482	15237	9815	30041	7945	4491	3899	4205
1949	1	7	991	6808	35214	100497	83283	29727	13207	5606	8617	13154	3657	1895	2167
1950	1	79	1281	10954	29045	45233	62579	30037	19481	9172	6019	4133	6750	1662	1450
1951	1615	1625	24687	77924	64013	46867	37535	33673	23510	10589	4221	1288	1002	3322	611
1952	1	1202	24099	120704	113203	73827	49389	20562	24367	15651	8327	3565	647	467	1044
1953	1	81	47413	107659	112040	55500	22742	16863	10559	10553	5637	1752	468	173	156
1954	1	9	11473	155171	146395	100751	40635	10713	11791	8557	6751	2370	896	268	123
1955	1	322	3902	37652	201834	161336	84031	30451	13713	9481	4140	2406	867	355	128
1956	81	1498	10614	24172	129803	250472	86784	51091	14987	7465	3952	1655	1292	448	166
1957	987	3487	17321	33931	27182	70702	87033	39213	17747	6219	3232	1220	347	299	173
1958	1	2600	31219	133576	71051	40737	38380	35786	13338	10475	3289	1070	252	40	141
1959	590	2601	32308	77942	148285	53480	18498	17735	23118	9483	3748	997	254	161	98
1960	465	7147	37882	97865	64222	67425	23117	8429	7240	11675	4504	1843	354	102	226
1961	1	1699	45478	132655	123458	51167	38740	17376	5791	6778	5560	1682	910	280	108
1962	1	1713	42416	170566	167241	89460	28297	21996	7956	2728	2603	1647	392	280	103
1963	1	4	13196	106984	205549	95498	35518	16221	11894	3884	1021	1025	498	129	157
1964	103	675	5298	45912	97950	58575	19642	9162	6196	3553	783	172	387	264	131
1965	1	2522	15725	25999	78299	68511	25444	8438	3569	1467	1161	131	67	91	179
1966	1	869	55937	55644	34676	42539	37169	18500	5077	1495	380	403	77	9	70
1967	1	151	34467	160048	69235	22061	26295	25139	11323	2329	687	316	225	40	14
1968	1	1	3709	174585	267961	107051	26701	16399	11597	3657	657	122	124	70	46
1969	1	275	2307	24545	238511	181239	79363	26989	13463	5092	1913	414	121	23	46
1970	1	591	7164	10792	25813	137829	96420	31920	8933	3249	1232	260	106	39	35
1971	38	2210	7754	13739	11831	9527	59290	52003	12093	2434	762	418	149	42	25
1972	1	4701	35536	45431	26832	12089	7918	34885	22315	4572	1215	353	315	121	40
1973	1	8277	294262	131493	61000	20569	7248	8328	19130	4499	677	195	81	59	55
1974	115	21347	91855	437377	203772	47006	12630	4370	2523	5607	2127	322	151	83	62
1975	1	1184	45282	59798	226646	118567	29522	9353	2617	1555	1928	575	231	15	37
1976	706	1908	85337	114341	79993	118236	47872	13962	4051	936	558	442	139	26	53
1977	1	11288	39594	168609	136335	52925	61821	23338	5659	1521	610	271	122	92	54
1978	3	802	78822	45400	88495	56823	25407	31821	9408	1227	913	446	748	48	51
1979	0	224	8600	77484	43677	31943	16815	8274	10974	1785	427	103	59	38	45
1980	31	403	3911	17086	81986	40061	17664	7442	3508	3196	678	79	24	26	8
1981	1	212	3407	9466	20803	63433	21788	9933	4267	1311	882	109	37	3	1
1982	2	94	8948	20933	19345	28084	42496	8395	2878	708	271	260	27	5	5
1983	13	86	3108	19594	20473	17656	17004	18329	2545	646	229	74	58	20	5
1984	11	999	6942	14240	18807	20086	15145	8287	5988	783	232	153	49	12	8
1985	92	1805	24634	45769	27806	19418	11369	3747	1557	768	137	36	31	32	8
1986	41	855	28968	70993	78672	25215	11711	4063	976	726	557	136	28	34	14
1987	14	390	13648	137106	98210	61407	13707	3866	910	455	187	227	21	59	20
1988	4	178	9828	22774	135347	54379	21015	3304	1236	519	106	69	43	14	5
1989	3	237	5085	17313	32165	81756	27854	5501	827	290	41	13	1	11	16
1990	6	170	1911	7551	12999	17827	30007	6810	828	179	59	15	6	5	2
1991	24	663	4963	10933	16467	20342	19479	25193	3888	428	48	12	1	1	2
1992	844	1184	21835	36015	27494	23392	18351	13541	18321	2529	264	82	3	9	1
1993	42	634	10094	46182	63578	33623	14866	9449	6571	12593	1749	377	63	22	1
1994	32	312	6531	59444	102548	59766	32504	10019	6163	3671	7528	995	121	19	4
1995	9	212	4879	42587	115329	98485	32036	7334	3014	1725	1174	1920	222	41	1
1996	184	895	7655	28782	80711	100509	54590	10545	2023	930	462	230	809	84	1
1997	79	1228	12827	36491	69633	83017	65768	28392	4651	1151	373	213	144	238	1
1998	97	1596	31887	88874	48972	40493	34513	26354	6583	965	197	69	42	22	53
1999	13	313	7501	77714	92816	31139	15778	15851	8828	1837	195	40	34	8	30

Table 3.8

Run title : Arctic Cod (run: SVPASA04/V04)
At 28/08/2000 14:42

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

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	4008,	710,	140,	991,
4,	10387,	13192,	3872,	6808,
5,	18906,	43890,	31054,	35214,
6,	16596,	52017,	55983,	100497,
7,	13843,	45501,	77375,	83283,
8,	15370,	13075,	21482,	29727,
9,	59845,	19718,	15237,	13207,
10,	22618,	47678,	9815,	5606,
11,	10093,	31392,	30041,	8617,
12,	9573,	9348,	7945,	13154,
+gp,	8137,	18055,	12595,	7719,
0 TOTALNUM,	189376,	294576,	265539,	304823,
TONSLAND,	706000,	882017,	774295,	800122,
SOPCOF %,	67,	57,	62,	68,

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	1281,	24687,	24099,	47413,	11473,	3902,	10614,	17321,	31219,	32308,
4,	10954,	77924,	120704,	107659,	155171,	37652,	24172,	33931,	133576,	77942,
5,	29045,	64013,	113203,	112040,	146395,	201834,	129803,	27182,	71051,	148285,
6,	45233,	46867,	73827,	55500,	100751,	161336,	250472,	70702,	40737,	53480,
7,	62579,	37535,	49389,	22742,	40635,	84031,	86784,	87033,	38380,	18498,
8,	30037,	33673,	20562,	16863,	10713,	30451,	51091,	39213,	35786,	17735,
9,	19481,	23510,	24367,	10559,	11791,	13713,	14987,	17747,	13338,	23118,
10,	9172,	10589,	15651,	10553,	8557,	9481,	7465,	6219,	10475,	9483,
11,	6019,	4221,	8327,	5637,	6751,	4140,	3952,	3232,	3289,	3748,
12,	4133,	1288,	3565,	1752,	2370,	2406,	1655,	1220,	1070,	997,
+gp,	9862,	4935,	2158,	797,	1287,	1350,	1906,	819,	433,	513,
0 TOTALNUM,	227796,	329242,	455852,	391515,	495894,	550296,	582901,	304619,	379354,	386107,
TONSLAND,	731982,	827180,	876795,	695546,	826021,	1147841,	1343068,	792557,	769313,	744607,
SOPCOF %,	78,	88,	75,	84,	78,	82,	84,	83,	88,	86,

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Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	37882,	45478,	42416,	13196,	5298,	15725,	55937,	34467,	3709,	2307,
4,	97865,	132655,	170566,	106984,	45912,	25999,	55644,	160048,	174585,	24545,
5,	64222,	123458,	167241,	205549,	97950,	78299,	34676,	69235,	267961,	238511,
6,	67425,	51167,	89460,	95498,	58575,	68511,	42539,	22061,	107051,	181239,
7,	23117,	38740,	28297,	35518,	19642,	25444,	37169,	26295,	26701,	79363,
8,	8429,	17376,	21996,	16221,	9162,	8438,	18500,	25139,	16399,	26989,
9,	7240,	5791,	7956,	11894,	6196,	3569,	5077,	11323,	11597,	13463,
10,	11675,	6778,	2728,	3884,	3553,	1467,	1495,	2329,	3657,	5092,
11,	4504,	5560,	2603,	1021,	783,	1161,	380,	687,	657,	1913,
12,	1843,	1682,	1647,	1025,	172,	131,	403,	316,	122,	414,
+gp,	682,	1298,	775,	784,	782,	337,	156,	279,	240,	190,
0 TOTALNUM,	324884,	429983,	535685,	491574,	248025,	229081,	251976,	352179,	612679,	574026,
TONSLAND,	622042,	783221,	909266,	776337,	437695,	444930,	483711,	572605,	1074084,	1197226,
SOPCOF %,	88,	91,	92,	78,	82,	90,	94,	88,	96,	87,

Table 3.8 (Continued)

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	7164,	7754,	35536,	294262,	91855,	45282,	85337,	39594,	78822,	8600,
4,	10792,	13739,	45431,	131493,	437377,	59798,	114341,	168609,	45400,	77484,
5,	25813,	11831,	26832,	61000,	203772,	226646,	79993,	136335,	88495,	43677,
6,	137829,	9527,	12089,	20569,	47006,	118567,	118236,	52925,	56823,	31943,
7,	96420,	59290,	7918,	7248,	12630,	29522,	47872,	61821,	25407,	16815,
8,	31920,	52003,	34885,	8328,	4370,	9353,	13962,	23338,	31821,	8274,
9,	8933,	12093,	22315,	19130,	2523,	2617,	4051,	5659,	9408,	10974,
10,	3249,	2434,	4572,	4499,	5607,	1555,	936,	1521,	1227,	1785,
11,	1232,	762,	1215,	677,	2127,	1928,	558,	610,	913,	427,
12,	260,	418,	353,	195,	322,	575,	442,	271,	446,	103,
+gp,	180,	216,	476,	195,	296,	283,	218,	268,	847,	142,
0 TOTALNUM,	323792,	170067,	191622,	547596,	807885,	496126,	465946,	490951,	339609,	200224,
TONSLAND,	933246,	689048,	565254,	792685,	1102433,	829377,	867463,	905301,	698715,	440538,
SOPCOF %,	97,	112,	108,	114,	103,	90,	102,	99,	100,	107,

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	3911,	3407,	8948,	3108,	6942,	24634,	28968,	13648,	9828,	5085,
4,	17086,	9466,	20933,	19594,	14240,	45769,	70993,	137106,	22774,	17313,
5,	81986,	20803,	19345,	20473,	18807,	27806,	78672,	98210,	135347,	32165,
6,	40061,	63433,	28084,	17656,	20086,	19418,	25215,	61407,	54379,	81756,
7,	17664,	21788,	42496,	17004,	15145,	11369,	11711,	13707,	21015,	27854,
8,	7442,	9933,	8395,	18329,	8287,	3747,	4063,	3866,	3304,	5501,
9,	3508,	4267,	2878,	2545,	5988,	1557,	976,	910,	1236,	827,
10,	3196,	1311,	708,	646,	783,	768,	726,	455,	519,	290,
11,	678,	882,	271,	229,	232,	137,	557,	187,	106,	41,
12,	79,	109,	260,	74,	153,	36,	136,	227,	69,	13,
+gp,	58,	41,	37,	83,	69,	71,	76,	100,	62,	28,
0 TOTALNUM,	175669,	135440,	132355,	99741,	90732,	135312,	222093,	329823,	248639,	170873,
TONSLAND,	380434,	399038,	363730,	289992,	277651,	307920,	430113,	523071,	434939,	332481,
SOPCOF %,	97,	110,	108,	90,	95,	102,	102,	102,	100,	99,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	1911,	4963,	21835,	10094,	6531,	4879,	7655,	12827,	31887,	7501,
4,	7551,	10933,	36015,	46182,	59444,	42587,	28782,	36491,	88874,	77714,
5,	12999,	16467,	27494,	63578,	102548,	115329,	80711,	69633,	48972,	92816,
6,	17827,	20342,	23392,	33623,	59766,	98485,	100509,	83017,	40493,	31139,
7,	30007,	19479,	18351,	14866,	32504,	32036,	54590,	65768,	34513,	15778,
8,	6810,	25193,	13541,	9449,	10019,	7334,	10545,	28392,	26354,	15851,
9,	828,	3888,	18321,	6571,	6163,	3014,	2023,	4651,	6583,	8828,
10,	179,	428,	2529,	12593,	3671,	1725,	930,	1151,	965,	1837,
11,	59,	48,	264,	1749,	7528,	1174,	462,	373,	197,	195,
12,	15,	12,	82,	377,	995,	1920,	230,	213,	69,	40,
+gp,	13,	4,	13,	86,	144,	264,	894,	383,	117,	72,
0 TOTALNUM,	78199,	101757,	161837,	199168,	289313,	308747,	287331,	302899,	279024,	251771,
TONSLAND,	212000,	319158,	513234,	581611,	771086,	739999,	732228,	762403,	592624,	484910,
SOPCOF %,	101,	95,	103,	101,	101,	100,	101,	100,	101,	100,

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Table 3.9

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Table 2 Catch weights at age (kg)

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.0620,	13.4270,	13.7680,	13.5460,
0 SOPCOFAC,	.6735,	.5708,	.6152,	.6799,

Table 2 Catch weights at age (kg)

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.1040,	13.7520,	14.0120,	13.2930,	13.0300,	13.1050,	13.0470,	13.5390,	13.4430,	13.4170,
0 SOPCOFAC,	.7781,	.8813,	.7499,	.8396,	.7790,	.8170,	.8448,	.8346,	.8831,	.8562,

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Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Table 2 Catch weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.5380,	13.0100,	13.3380,	13.2310,	13.3910,	14.2060,	13.7030,	12.8260,	13.3880,	13.2750,
0 SOPCOFAC,	.8819,	.9069,	.9175,	.7829,	.8184,	.8965,	.9415,	.8787,	.9561,	.8743,

Table 2 Catch weights at age (kg)

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.2890,	13.0620,	13.0660,	13.6290,	13.4160,	12.9010,	13.2750,	13.4840,	12.7300,	13.6670,
0 SOPCOFAC,	.9734,	1.1182,	1.0788,	1.1430,	1.0271,	.9007,	1.0236,	.9928,	1.0037,	1.0713,

Table 3.9 (Continued)

Table 2 Catch weights at age (kg)

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.6500,	.6500,	.6500,	.8400,	1.4200,	.9400,	.6400,	.4900,	.5400,	.7400,
4,	1.0000,	1.0000,	1.0000,	1.3700,	1.9300,	1.3700,	1.2700,	.8800,	.8500,	.9600,
5,	1.5500,	1.5500,	1.5500,	2.0900,	2.4900,	2.0200,	1.8800,	1.5500,	1.3200,	1.3100,
6,	2.3500,	2.3500,	2.3500,	2.8600,	3.1400,	3.2200,	2.7900,	2.3300,	2.2400,	1.9200,
7,	3.4500,	3.4500,	3.4500,	3.9900,	3.9100,	4.6300,	4.4900,	3.4400,	3.5200,	2.9300,
8,	4.7000,	4.7000,	4.7000,	5.5800,	4.9100,	6.0400,	5.8400,	5.9200,	5.3500,	4.6400,
9,	6.1700,	6.1700,	6.1700,	7.7700,	6.0200,	7.6600,	6.8300,	8.6000,	8.0600,	7.5200,
10,	7.7000,	7.7000,	7.7000,	9.2900,	7.4000,	9.8100,	7.6900,	9.6000,	9.5100,	9.1200,
11,	9.2500,	9.2500,	9.2500,	11.5500,	8.1300,	11.8000,	9.8100,	12.1700,	11.3600,	11.0800,
12,	10.8500,	10.8500,	10.8500,	16.2000,	8.5700,	14.1600,	10.7100,	13.7200,	14.0900,	11.4700,
+gp,	13.4720,	12.6630,	13.0270,	17.0340,	8.6090,	14.0080,	12.0510,	13.3800,	16.7060,	16.4840,
0 SOPCOFAC,	.9731,	1.1050,	1.0767,	.8953,	.9483,	1.0182,	1.0160,	1.0224,	1.0001,	.9879,

Table 2 Catch weights at age (kg)

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	.8100,	1.0500,	1.1600,	.8100,	.8200,	.7700,	.7900,	.6700,	.6800,	.6300,
4,	1.2200,	1.4500,	1.5700,	1.5200,	1.3000,	1.2000,	1.1100,	1.0400,	1.0500,	1.0100,
5,	1.6400,	2.1500,	2.2100,	2.1600,	2.0600,	1.7800,	1.6100,	1.5300,	1.6200,	1.5400,
6,	2.2200,	2.8900,	3.1000,	2.7900,	2.8900,	2.5900,	2.4600,	2.2200,	2.3000,	2.3400,
7,	3.2400,	3.7500,	4.2700,	4.0700,	3.2100,	3.8100,	3.8200,	3.4200,	3.3000,	3.2100,
8,	4.6800,	4.7100,	5.1900,	5.5300,	5.2000,	4.9900,	5.7200,	5.2000,	4.8600,	4.2900,
9,	7.3000,	6.0800,	6.1400,	6.4700,	6.8000,	6.2300,	6.7400,	7.1900,	6.8700,	6.0000,
10,	9.8400,	8.8200,	7.7700,	7.1900,	7.5700,	8.0500,	8.0400,	7.7300,	9.3000,	6.7300,
11,	13.2500,	11.8000,	10.1200,	7.9800,	8.0100,	8.7400,	9.2800,	8.6100,	10.3000,	10.0800,
12,	16.8800,	16.5800,	11.5400,	10.1100,	9.4800,	9.2200,	10.4000,	11.0700,	15.0500,	13.8800,
+gp,	11.6170,	16.6900,	14.3320,	14.1830,	11.9780,	12.3190,	10.9660,	11.1170,	14.5240,	14.0360,
0 SOPCOFAC,	1.0108,	.9521,	1.0270,	1.0127,	1.0090,	1.0030,	1.0147,	1.0004,	1.0072,	.9967,

1

Table 3.10

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Table 3 Stock weights at age (kg)

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.0620,	13.4270,	13.7680,	13.5460,

Table 3 Stock weights at age (kg)

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.1040,	13.7520,	14.0120,	13.2930,	13.0300,	13.1050,	13.0470,	13.5390,	13.4430,	13.4170,

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Run title : Arctic Cod (run: SVPASA01/V01)

At 24/08/2000 20:05

Table 3 Stock weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.5380,	13.0100,	13.3380,	13.2310,	13.3910,	14.2060,	13.7030,	12.8260,	13.3880,	13.2750,

Table 3 Stock weights at age (kg)

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,	.6500,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,	1.5500,
6,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,	2.3500,
7,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,	3.4500,
8,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,	4.7000,
9,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,	6.1700,
10,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,	7.7000,
11,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,	9.2500,
12,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,	10.8500,
+gp,	13.2890,	13.0620,	13.0660,	13.6290,	13.4160,	12.9010,	13.2750,	13.4840,	12.7300,	13.6670,

Table 3.10 (Continued)

Table 3 Stock weights at age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	.6500	.6500	.6500	.3700	.4200	.4100	.3100	.1900	.2100	.3000
4	1.0000	1.0000	1.0000	.9200	1.1600	.8800	.8800	.5100	.4000	.5200
5	1.5500	1.5500	1.5500	1.6000	1.8100	1.6000	1.4700	1.2800	.7900	.8700
6	2.3500	2.3500	2.3500	2.4400	2.7900	2.8100	2.4700	1.9400	1.9000	1.4800
7	3.4500	3.4500	3.4500	3.8200	3.7800	4.0600	3.9200	3.2800	2.9800	2.6900
8	4.7000	4.7000	4.7000	4.7600	4.5700	5.8300	5.8100	5.1700	4.3900	4.6300
9	6.1700	6.1700	6.1700	6.1700	6.1700	7.6900	6.5800	6.5200	7.8100	7.0500
10	7.7000	7.7000	7.7000	7.7000	7.7000	10.1200	6.8300	9.3000	12.1100	9.9800
11	9.2500	9.2500	9.2500	9.2500	9.2500	14.2900	11.0000	13.1500	13.1100	9.2500
12	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500
+gp	13.4720	12.6630	13.0270	12.9880	13.0330	13.4130	13.5870	13.8260	13.0180	14.4790

Table 3 Stock weights at age (kg)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
3	.4000	.5200	.4400	.3400	.2300	.2000	.2000	.2000	.2200	.2000
4	.7100	1.1400	.9300	1.1700	.7500	.4900	.4900	.5200	.5300	.5200
5	1.1800	1.7400	1.8100	1.8200	1.4200	1.1400	.9700	1.0800	1.1600	1.1700
6	1.7200	2.4300	2.7200	2.8200	2.4100	2.1200	2.0500	1.8800	1.9400	2.0300
7	2.4600	3.2100	3.9000	4.0300	3.8300	3.4700	3.5300	3.3700	2.9500	3.0300
8	3.5700	4.5400	5.1800	5.5000	5.4200	4.9400	5.5000	5.2600	4.5700	4.4600
9	4.7100	6.8800	6.7700	6.7700	6.6300	7.1600	7.7700	8.9300	7.4200	6.4800
10	7.8000	10.7200	9.6000	8.5700	7.6300	9.1200	10.1600	12.1500	10.3700	10.2700
11	8.9600	9.4500	12.4300	9.2500	8.1100	10.1000	10.6700	10.9000	11.7400	10.8800
12	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500	10.8500
+gp	13.4230	14.1000	13.6620	12.8870	12.7540	12.7270	12.6340	13.3770	13.8960	13.6970

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Table 3.11

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Table 5 Proportion mature at age

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

Table 5 Proportion mature at age

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

Table 5 Proportion mature at age

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.0000,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0000,	.0000,	.0500,	.0800,	.0500,	.0100,	.0500,	.0100,	.0200,	.0000,
5,	.0000,	.0000,	.1000,	.1000,	.1800,	.0900,	.0800,	.0700,	.0500,	.0500,
6,	.0000,	.0000,	.3400,	.3000,	.3100,	.3600,	.1900,	.1800,	.3300,	.1800,
7,	.0000,	.0000,	.6500,	.7300,	.5600,	.5500,	.5300,	.2200,	.5300,	.4100,
8,	1.0000,	1.0000,	.8200,	.8800,	.9000,	.8500,	.7100,	.4600,	.6200,	.6900,
9,	1.0000,	1.0000,	.9200,	.9700,	.9900,	.9600,	.6200,	.5000,	1.0000,	.8500,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	.9000,	.7500,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+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,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	.0000,	.0000,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.0100,	.0400,	.0100,	.0300,	.0100,	.0000,	.0000,	.0000,	.0100,	.0000,
5,	.0500,	.0600,	.1200,	.0900,	.1100,	.0700,	.0200,	.0200,	.0400,	.0100,
6,	.2100,	.2800,	.4300,	.3000,	.3300,	.3300,	.2600,	.1400,	.1900,	.1000,
7,	.5800,	.6500,	.7500,	.6100,	.6000,	.6200,	.6300,	.5600,	.4400,	.4500,
8,	.7700,	.8300,	.9300,	.9100,	.8100,	.7400,	.8300,	.8200,	.8200,	.7900,
9,	.8600,	.9700,	.9700,	.9700,	.9700,	.9500,	.9800,	.9500,	.9300,	.8800,
10,	.9800,	1.0000,	1.0000,	.9900,	.9900,	.9800,	1.0000,	.9500,	.9800,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	.9900,	1.0000,	1.0000,	.9500,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

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Table 3.12

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North-East Arctic cod (Sub-areas I and II) (run name: XSAASA05)
105
FLT02: Norwegian trawl  catch and effort  age 9 - 14 (Catch: Thous (Catch: Unknown) (Effort:
Unknown)
1985 1999
1 1 0.00 1.00
9 13
   0.45     263      82      15       1      11
   0.58      78     239      83      44       2
   0.95     185      99      34      54       5
   1.14     144      25       4      14      26
   0.76     140      66      18       0       0
   0.51      47      16       3       0       0
   0.66     124       6       1       0       0
   0.42    1434     168      32      12       0
   0.41     811    2007     460      58       3
   0.85     761     458     937     136      12
   0.71     438      70      35     223       0
   0.68     298     185      88      31     131
   1.02     452      96      56      25      59
   1.22    1154     221      22       6       6
   1.10    1510     213      25       2       9
FLT03: Russian trawl  catch and effort  ages 9 - 14 (Catch: Thousa (Catch: Unknown) (Effort:
Unknown)
1985 1999
1 1 0.00 1.00
9 13
   0.70     291      77      30       6       0
   1.52      87      59      22       3       1
   2.10     127      95      37      11       2
   2.75     442     215      53      12       3
   2.12     140      47      11       0       0
   1.11     204      49      14       2       0
   1.56     791      71      16       4       1
   2.50    3852     689      62      10       0
   2.64    2019    1778      68      13       2
   2.96    1237     595     167      40       5
   3.88     684     345     146      21       1
   3.73     364     164      34      10       0
   4.92     488      99      34      10       0
   6.77     559      88      34      13       1
   6.39     882     171       0       0       0
FLT04: NorBarTrSur rev99 (Catch: Unknown) (Effort: Unknown)
1980 1999
1 1 0.99 1.00
3 8
   1      233      400      384       48       10        3
   1      277      236      155      160       14        2
   1      523      433      170       58       32       10
   1      283      214      117       41        4        1
   1     1260      199       77       33        2        1
   1     1439      641       83       19        3        0
   1     3911      543      157       20        5        0
   1      805     1733      205       36        5        0
   1      759      378      902       98        9        1
   1      349      346      206      272       16        4
   1      337      257      215      122      127        6
   1      577      178      128       77       43       27
   1     1401      725      158       62       39       22
   1     3102     1474      506       93       24       16
   1     2414     2559      767      185       24        8
   1     1154     1372     1061      240       29        4
   1      640      704      527      283       57        9
   1     1813      365      259      178       86       10
   1     1732      581      134       65       51       12
   1     1321     1083      269       43       20       12
```

Table 3.12 (Continued)

```
FLT05: NorBarLofAcSur rev99 (Catch: Unknown) (Effort: Unknown)
1984 1999
1 1 0.99 1.00
3 11
   1    1416     203     150     157      33      12      11       5       0
   1    1343     684     116      77      31       2       0       4       1
   1    2049     502     174      15      30       7       0       0       0
   1     355     578     109      39       2       0       1       0       0
   1     344     214     670     166      32       5       1       0       1
   1     206     262     269     668      72       6       4       0       0
   1     346     293     339     367     500      36       2       2       0
   1     658     216     185     284     254     824      44      16       2
   1    1911    1131     354     255     252     277     443      49       7
   1    4045    2174     894     224     120      94      39     179      27
   1    1598    2166    1041     291      43      43      31      26      81
   1     705     872     891     446      64      10       4       9      15
   1     517     497     422     499     205      22       5       0       8
   1    1826     424     338     339     247      49       8       2       0
   1     964     453     123     113     187      92      10       2       2
   1    1588    1456     492     127      68      51      11       6       2
FLT07: RusSurCatch/hr rev00 (ages 1–8) (Catch: Unknown) ( (Catch: Unknown) (Effort: Unknown)
1982 1999
1 1 0.90 1.00
3 8
   1    141     76     94     58     32     11
   1     60     73     48     20      7     11
   1    156     93     49     30     12      5
   1    283    397    181     45     17      6
   1    495    286    140     50     14      2
   1     61    402     78     34      8      2
   1     66     73    193     33     10      2
   1     34     91    109    161    131     55
   1      9     29     65     78     96     43
   1    102     48     58     66     83     71
   1    309     90     45     48     26     23
   1    491    526    377    117     45     32
   1    230    404    383    366    120     42
   1    119    235    247    105     23      7
   1     77    101    126     86     36      9
   1     99     83     62     37     18      5
   1    508    334     97     37     16      7
   1    284    475    162     31     12      8
```

Table 3.13

Lowestoft VPA Version 3.1

24/08/2000 18:51

Extended Survivors Analysis

Arctic Cod (run: XSAASA05/X05)

CPUE data from file fleet

Catch data for 54 years. 1946 to 1999. Ages 3 to 13.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT02: Norwegian tra,	1985,	1999,	9,	12,	.000,	1.000
FLT03: Russian trawl,	1985,	1999,	9,	12,	.000,	1.000
FLT04: NorBarTrSur r,	1980,	1999,	3,	8,	.990,	1.000
FLT05: NorBarLofAcSu,	1984,	1999,	3,	11,	.990,	1.000
FLT07: RusSurCatch/h,	1982,	1999,	3,	8,	.900,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 10 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 2 oldest ages.

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

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

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00102

Final year F values

Age ,	3,	4,	5,	6,	7,	8,	9,	10,	11,	12
Iteration 29,	.1926,	.2072,	.5534,	.7457,	.7850,	.9020,	1.3046,	1.4459,	1.3160,	1.8674
Iteration 30,	.1926,	.2072,	.5534,	.7457,	.7850,	.9020,	1.3047,	1.4458,	1.3160,	1.8684

Regression weights

, .020,	.116,	.284,	.482,	.670,	.820,	.921,	.976,	.997,	1.000

Fishing mortalities

Age,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999
3,	.009,	.018,	.041,	.080,	.208,	.546,	.468,	.339,	.430,	.193
4,	.062,	.062,	.127,	.096,	.202,	.298,	.348,	.303,	.386,	.207
5,	.134,	.188,	.221,	.347,	.340,	.335,	.404,	.563,	.539,	.553
6,	.231,	.321,	.443,	.460,	.647,	.576,	.541,	.701,	.774,	.746
7,	.250,	.425,	.539,	.567,	1.169,	.894,	.750,	.837,	.722,	.785
8,	.373,	.344,	.597,	.597,	.988,	.946,	.870,	1.236,	1.023,	.902
9,	.303,	.378,	.454,	.661,	1.051,	.967,	.757,	1.374,	1.176,	1.305
10,	.380,	.253,	.455,	.658,	1.019,	1.011,	.952,	1.547,	1.378,	1.446
11,	.544,	.164,	.244,	.666,	1.141,	1.176,	.849,	1.511,	1.484,	1.316
12,	.463,	.198,	.466,	.659,	1.072,	1.088,	.769,	1.399,	1.598,	1.868

Table 3.13 (Continued)

1

XSA population numbers (Thousands)

YEAR	3	4	5	6	7	8	9	10	11	12
1990	2.46E+05	1.38E+05	1.14E+05	9.57E+04	1.50E+05	2.42E+04	3.50E+03	6.25E+02	1.56E+02	4.48E+01
1991	4.16E+05	2.00E+05	1.06E+05	8.19E+04	6.22E+04	9.56E+04	1.36E+04	2.12E+03	3.50E+02	7.39E+01
1992	7.30E+05	3.35E+05	1.53E+05	7.22E+04	4.87E+04	3.33E+04	5.55E+04	7.65E+03	1.35E+03	2.43E+02
1993	9.08E+05	5.74E+05	2.41E+05	1.01E+05	3.80E+04	2.32E+04	1.50E+04	2.89E+04	3.97E+03	8.63E+02
1994	8.26E+05	6.86E+05	4.26E+05	1.40E+05	5.21E+04	1.76E+04	1.05E+04	6.35E+03	1.22E+04	1.67E+03
1995	6.64E+05	5.49E+05	4.59E+05	2.49E+05	5.99E+04	1.32E+04	5.38E+03	3.00E+03	1.88E+03	3.20E+03
1996	4.42E+05	3.15E+05	3.34E+05	2.69E+05	1.14E+05	2.01E+04	4.21E+03	1.67E+03	8.92E+02	4.74E+02
1997	7.43E+05	2.27E+05	1.82E+05	1.83E+05	1.28E+05	4.42E+04	6.88E+03	1.62E+03	5.29E+02	3.13E+02
1998	9.27E+05	4.34E+05	1.37E+05	8.49E+04	7.41E+04	4.55E+04	1.05E+04	1.43E+03	2.82E+02	9.56E+01
1999	6.82E+05	4.94E+05	2.41E+05	6.55E+04	3.21E+04	2.95E+04	1.34E+04	2.66E+03	2.94E+02	5.23E+01

Estimated population abundance at 1st Jan 2000

0.00E+00	4.60E+05	3.29E+05	1.14E+05	2.54E+04	1.20E+04	9.79E+03	2.97E+03	5.12E+02	6.47E+01

Taper weighted geometric mean of the VPA populations:

7.01E+05	4.10E+05	2.46E+05	1.33E+05	6.57E+04	2.73E+04	9.09E+03	2.90E+03	9.34E+02	3.47E+02

Standard error of the weighted Log(VPA populations) :

.2696	.3990	.4752	.5756	.5284	.5042	.6332	.9127	1.3148	1.4966

Log catchability residuals.

Fleet : FLT02: Norwegian tra

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
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	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
11	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
12	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	-1.53	-2.14	-.61	.24	-.03	.23	.04	-.19	.07	.25
10	-.77	-3.29	-.70	.57	.03	-.92	.65	-.15	.57	.04
11	-.97	-3.31	-.70	1.09	.14	-1.08	.50	.42	-.07	.06
12	99.99	99.99	.13	.54	.18	.21	.06	.10	-.25	-.54

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
Mean Log q	-1.8664	-1.9452	-1.9534	-1.9534
S.E(Log q)	.4038	.7529	.8002	.3335

Table 3.13 (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

 9,    1.17,    -.478,       .65,     .66,     10,     .51,   -1.87,
10,    1.02,    -.044,      1.84,     .59,     10,     .85,   -1.95,
11,     .95,     .185,      2.20,     .75,     10,     .84,   -1.95,
12,     .84,    3.110,      2.58,     .99,      8,     .17,   -1.96,

Fleet : FLT03: Russian trawl

 Age  ,  1980,  1981,  1982,  1983,  1984,  1985,  1986,  1987,  1988,  1989
    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, 99.99, 99.99, 99.99, 99.99, 99.99
   10 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
   11 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
   12 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99



 Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
    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 ,   .70,   .39,   .13,   .83,   .74,   .51,   .08,  -.15,  -.83,  -.51
   10 ,  1.07,  -.18,   .43,   .08,   .54,   .47,   .32,  -.20,  -.57,  -.44
   11 ,  1.66,   .47,   .05,  -.81,  -.95,   .53,  -.28,   .23,   .53, 99.99
   12 ,   .93,   .66,   .04,  -.94,  -.42, -1.98,  -.90,  -.51,   .69, 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
Mean Log q,   -3.4040,   -3.4411,   -3.8282,   -3.8282,
S.E(Log q),     .6041,     .4580,     .6177,    1.1116,

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,    1.11,    -.221,      2.76,     .47,     10,     .74,   -3.40,
10,     .84,     .883,      4.19,     .87,     10,     .39,   -3.44,
11,    1.58,   -2.298,      1.97,     .83,      9,     .69,   -3.83,
12,    2.61,   -3.378,      1.43,     .57,      9,    1.31,   -4.38,


Fleet : FLT04: NorBarTrSur r

 Age  ,  1980,  1981,  1982,  1983,  1984,  1985,  1986,  1987,  1988,  1989
    3 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    5 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    6 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    7 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99
    8 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 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
```

Table 3.13 (Continued)

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	-.08	-.25	-.23	.08	.10	.06	.04	.10	-.09	-.11
4	.14	-.47	.00	-.08	.18	.05	.19	.05	-.23	-.06
5	.20	-.06	-.25	.20	-.08	.07	-.06	.16	-.03	-.10
6	-.07	-.28	-.25	-.16	.39	.00	.05	.13	-.04	-.22
7	-.18	-.21	.05	-.16	.12	-.10	-.21	.17	.08	.04
8	-.93	-.83	.27	.31	.28	-.17	.15	-.17	-.23	.09
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									

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	-6.1702	-6.4440	-6.7975
S.E(Log q)	.1981	.1480	.2566

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
3	.64	1.802	8.49	.85	10	.12	-5.67
4	.67	1.618	8.07	.85	10	.19	-5.71
5	.70	2.274	7.83	.93	10	.14	-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	.84	1.400	7.08	.95	10	.15	-6.17
7	1.00	.013	6.45	.93	10	.16	-6.44
8	1.34	-1.196	5.63	.74	10	.33	-6.80

1

Fleet : FLT05: NorBarLofAcSu

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
11	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
12	No data for this fleet at this age									

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
3	-.09	-.14	.09	.44	-.05	-.18	-.05	.25	-.37	.13
4	.18	-.41	.34	.26	.16	-.22	-.04	.14	-.40	.20
5	.32	-.06	.13	.54	.09	-.11	-.35	.20	-.36	.22
6	.30	.29	.43	-.01	.11	-.11	-.11	.05	-.21	.13
7	.03	.40	.75	.29	-.46	-.47	-.10	.06	.22	.11
8	-.69	1.04	1.25	.53	.41	-.80	-.50	-.13	.26	-.01
9	-1.56	.24	1.23	.31	.83	-.64	-.38	.21	-.18	-.20
10	-.54	.19	.23	.40	.34	.03	99.99	-.33	-.37	.17
11	99.99	-1.15	-1.16	-.47	-.03	.20	-.01	99.99	.39	.17
12	No data for this fleet at this age									

Table 3.13 (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,	8,	9,	10,	11
Mean Log q,	-5.4392,	-5.2817,	-5.2488,	-5.4050,	-4.6277,	-3.6571,
S.E(Log q),	.1743,	.3401,	.5623,	.5450,	.3226,	.4457,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
3,	.73,	.598,	7.92,	.53,	10,	.28,	-5.84,
4,	.74,	.828,	7.64,	.70,	10,	.29,	-5.76,
5,	.82,	.585,	6.93,	.71,	10,	.34,	-5.71,

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,	1.13,	-.864,	4.60,	.91,	10,	.20,	-5.44,
7,	1.07,	-.209,	4.88,	.68,	10,	.40,	-5.28,
8,	.64,	1.196,	7.03,	.72,	10,	.35,	-5.25,
9,	.64,	1.815,	6.75,	.85,	10,	.29,	-5.40,
10,	.78,	2.737,	5.37,	.98,	9,	.16,	-4.63,
11,	1.12,	-.645,	3.27,	.90,	8,	.54,	-3.66,

1

Fleet : FLT07: RusSurCatch/h

Age ,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989
3 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
4 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
5 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
6 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
7 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
8 ,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99,	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									

Age ,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999
3 ,	-.53,	.09,	.05,	.07,	-.13,	-.07,	.09,	-.36,	.22,	.15
4 ,	-.19,	-.27,	-.38,	.08,	-.19,	-.23,	-.14,	.05,	.26,	.23
5 ,	-.30,	-.29,	-.88,	.91,	.35,	-.16,	-.45,	-.41,	.30,	.26
6 ,	.10,	.17,	.10,	.67,	1.66,	-.23,	-.54,	-.85,	-.01,	.04
7 ,	-.04,	.86,	.05,	.87,	2.11,	.06,	-.28,	-1.00,	-.68,	-.07
8 ,	.99,	.09,	.26,	.95,	1.87,	.32,	.08,	-.95,	-.84,	-.39
9 ,	No data for this fleet at this age									
10 ,	No data for this fleet at this age									
11 ,	No data for this fleet at this age									
12 ,	No data for this fleet at this age									

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,	-6.8014,	-6.8822,	-6.7777,
S.E(Log q),	.7643,	.9689,	.9352,

Table 3.13 (Continued)

```
 Regression statistics :

 Ages with q dependent on year class strength

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

  3,     .47,    1.407,     10.76,     .62,     10,     .23,   -7.70,
  4,     .58,    1.557,      9.55,     .76,     10,     .25,   -7.10,
  5,    1.00,    -.003,      6.85,     .49,     10,     .54,   -6.85,

 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,    1.88,    -.780,      2.41,     .15,     10,    1.49,   -6.80,
  7,   19.71,   -1.253,    -71.91,     .00,     10,   18.15,   -6.88,
  8,   -3.65,   -1.956,     22.76,     .04,     10,    2.75,   -6.78,
1


 Terminal year survivor and F summaries :

 Age  3   Catchability dependent on age and year class strength

 Year class = 1996

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT02: Norwegian tra,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: Russian trawl,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT04: NorBarTrSur r,    414350.,   .300,       .000,    .00,   1,  .266,     .212
 FLT05: NorBarLofAcSu,    524381.,   .306,       .000,    .00,   1,  .255,     .171
 FLT07: RusSurCatch/h,    535055.,   .300,       .000,    .00,   1,  .266,     .168

   P shrinkage mean  ,    410362.,    .40,,,,                         .183,     .214

   F shrinkage mean  ,    198254.,   1.00,,,,                         .029,     .401

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    460255.,       .16,      .10,    5,    .629,   .193



1
 Age  4   Catchability dependent on age and year class strength

 Year class = 1995

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT02: Norwegian tra,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT03: Russian trawl,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FLT04: NorBarTrSur r,    305400.,   .217,       .013,    .06,   2,  .308,     .221
 FLT05: NorBarLofAcSu,    314232.,   .229,       .281,   1.22,   2,  .272,     .216
 FLT07: RusSurCatch/h,    413150.,   .217,       .007,    .03,   2,  .308,     .168

   P shrinkage mean  ,    246432.,    .48,,,,                         .092,     .268

   F shrinkage mean  ,    208717.,   1.00,,,,                         .021,     .309

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
    328628.,       .12,      .09,    8,    .709,   .207
```

Table 3.13 (Continued)

Age 5 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
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	103148.,	.181,	.086,	.47,	3,	.369,	.596
FLT05: NorBarLofAcSu,	114925.,	.204,	.214,	1.05,	3,	.282,	.549
FLT07: RusSurCatch/h,	119516.,	.207,	.208,	1.01,	3,	.242,	.532
P shrinkage mean ,	132540.,	.58,,,,				.081,	.491
F shrinkage mean ,	152291.,	1.00,,,,				.027,	.439

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
113635.,	.11,	.08,	11,	.680,	.553

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

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	23194.,	.168,	.067,	.40,	4,	.435,	.795
FLT05: NorBarLofAcSu,	26518.,	.195,	.103,	.53,	4,	.345,	.724
FLT07: RusSurCatch/h,	28183.,	.216,	.051,	.24,	4,	.184,	.693
F shrinkage mean ,	30536.,	1.00,,,,				.037,	.654

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
25432.,	.11,	.05,	13,	.409,	.746

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

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	12642.,	.175,	.036,	.20,	5,	.475,	.756
FLT05: NorBarLofAcSu,	11872.,	.193,	.079,	.41,	5,	.367,	.790
FLT07: RusSurCatch/h,	10510.,	.266,	.056,	.21,	5,	.111,	.858
F shrinkage mean ,	10053.,	1.00,,,,				.047,	.884

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
11972.,	.12,	.03,	16,	.282,	.785

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

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: Russian trawl,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT04: NorBarTrSur r,	10599.,	.171,	.019,	.11,	6,	.553,	.856
FLT05: NorBarLofAcSu,	9985.,	.199,	.078,	.39,	6,	.288,	.891
FLT07: RusSurCatch/h,	6704.,	.310,	.097,	.31,	6,	.099,	1.144
F shrinkage mean ,	8035.,	1.00,,,,				.060,	1.024

Table 3.13 (Continued)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
9793.,	.13,	.04,	19,	.338,	.902

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

Year class = 1990

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	3812.,	.435,	.000,	.00,	1,	.194,	1.130
FLT03: Russian trawl,	1784.,	.650,	.000,	.00,	1,	.086,	1.701
FLT04: NorBarTrSur r,	2814.,	.173,	.079,	.46,	6,	.287,	1.345
FLT05: NorBarLofAcSu,	2847.,	.280,	.076,	.27,	7,	.246,	1.337
FLT07: RusSurCatch/h,	1968.,	.318,	.170,	.54,	6,	.052,	1.621
F shrinkage mean ,	4122.,	1.00,,,,				.135,	1.078

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2973.,	.19,	.06,	22,	.339,	1.305

1

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

Year class = 1989

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	541.,	.452,	.014,	.03,	2,	.129,	1.405
FLT03: Russian trawl,	310.,	.430,	.139,	.32,	2,	.199,	1.851
FLT04: NorBarTrSur r,	440.,	.180,	.030,	.17,	6,	.077,	1.563
FLT05: NorBarLofAcSu,	577.,	.293,	.046,	.16,	8,	.407,	1.356
FLT07: RusSurCatch/h,	395.,	.363,	.206,	.57,	6,	.013,	1.651
F shrinkage mean ,	721.,	1.00,,,,				.174,	1.196

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
512.,	.24,	.06,	25,	.270,	1.446

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

Year class = 1988

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FLT02: Norwegian tra,	72.,	.588,	.167,	.28,	3,	.146,	1.236
FLT03: Russian trawl,	39.,	.440,	.139,	.32,	2,	.084,	1.719
FLT04: NorBarTrSur r,	72.,	.207,	.063,	.31,	6,	.032,	1.234
FLT05: NorBarLofAcSu,	64.,	.328,	.092,	.28,	9,	.471,	1.320
FLT07: RusSurCatch/h,	80.,	.498,	.253,	.51,	6,	.004,	1.169
F shrinkage mean ,	71.,	1.00,,,,				.264,	1.247

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
65.,	.32,	.05,	27,	.165,	1.316

1

Table 3.13 (Continued)

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

Year class = 1987

Fleet,                   Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                   Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT02: Norwegian tra,          4.,   .340,       .067,    .20,   4,  .483,    2.319
FLT03: Russian trawl,          9.,   .474,       .226,    .48,   3,  .044,    1.614
FLT04: NorBarTrSur r,          6.,   .241,       .054,    .22,   6,  .007,    1.973
FLT05: NorBarLofAcSu,          8.,   .337,       .125,    .37,   9,  .085,    1.754
FLT07: RusSurCatch/h,         11.,   .706,       .335,    .47,   6,  .001,    1.486

  F shrinkage mean  ,         12.,   1.00,,,,                          .381,    1.399

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
        7.,       .42,      .12,   29,    .293,  1.868


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Table 3.14

Run title : Arctic Cod (run: XSAASA05/X05)

At 24/08/2000 18:52

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.0060,	.0018,	.0003,	.0023,
4,	.0199,	.0247,	.0123,	.0208,
5,	.0529,	.1094,	.0746,	.1477,
6,	.0967,	.2014,	.1987,	.3655,
7,	.1773,	.4156,	.5199,	.5098,
8,	.1923,	.2533,	.3525,	.3856,
9,	.3117,	.4037,	.5280,	.3818,
10,	.2784,	.4400,	.3601,	.3748,
11,	.3419,	.7856,	.5540,	.6252,
12,	.3120,	.6182,	.4604,	.5039,
+gp,	.3120,	.6182,	.4604,	.5039,
0 FBAR 5–10,	.1849,	.3039,	.3390,	.3609,

Table 8 Fishing mortality (F) at age

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.0020,	.0253,	.0224,	.0332,	.0198,	.0158,	.0268,	.0238,	.0713,	.0530,
4,	.0319,	.1605,	.1659,	.1317,	.1448,	.0834,	.1282,	.1120,	.2578,	.2552,
5,	.1160,	.2627,	.3694,	.2289,	.2664,	.2845,	.4562,	.2082,	.3612,	.5088,
6,	.2873,	.2776,	.5503,	.3114,	.3321,	.5290,	.6907,	.4854,	.5510,	.5108,
7,	.4088,	.4114,	.5308,	.3231,	.3956,	.5128,	.6127,	.5488,	.5348,	.5236,
8,	.3466,	.4034,	.4164,	.3454,	.2478,	.5873,	.6883,	.6284,	.4576,	.5094,
9,	.4725,	.5042,	.5783,	.3915,	.4343,	.5791,	.6547,	.5450,	.4516,	.6123,
10,	.5015,	.5125,	.7617,	.5347,	.6430,	.7640,	.7372,	.6322,	.7389,	.6845,
11,	.9071,	.4558,	1.0302,	.6978,	.8038,	.7616,	.8767,	.8590,	.8431,	.6500,
12,	.7111,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,
+gp,	.7111,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,
0 FBAR 5–10,	.3555,	.3953,	.5345,	.3558,	.3865,	.5428,	.6400,	.5080,	.5159,	.5582,

1

Run title : Arctic Cod (run: XSAASA05/X05)

At 24/08/2000 18:52

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.0538,	.0558,	.0659,	.0311,	.0173,	.0224,	.0394,	.0296,	.0249,	.0228,
4,	.2249,	.2698,	.3048,	.2356,	.1440,	.1102,	.1029,	.1515,	.2052,	.2284,
5,	.3462,	.4921,	.6481,	.7433,	.3526,	.3897,	.2105,	.1800,	.4072,	.4783,
6,	.4594,	.5151,	.8272,	1.0105,	.4843,	.4481,	.3801,	.2010,	.4660,	.5366,
7,	.4338,	.5263,	.6071,	.9783,	.5778,	.4013,	.4693,	.4294,	.3990,	.7711,
8,	.4828,	.6904,	.6547,	.8789,	.7401,	.5283,	.5770,	.6827,	.5251,	.9300,
9,	.4023,	.7357,	.8124,	.9431,	1.0699,	.7372,	.7165,	.8762,	.8025,	1.1794,
10,	.7360,	.8353,	.9819,	1.3756,	.8488,	.8071,	.8159,	.8839,	.8051,	1.0793,
11,	.8441,	1.0014,	.9477,	1.4406,	1.3026,	.7625,	.4988,	1.2307,	.6721,	1.5623,
12,	.7981,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,
+gp,	.7981,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,
0 FBAR 5–10,	.4768,	.6325,	.7552,	.9883,	.6789,	.5519,	.5282,	.5422,	.5675,	.8291,

Table 8 Fishing mortality (F) at age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.0406,	.0212,	.0390,	.1948,	.2130,	.0829,	.1648,	.1329,	.1451,	.0485,
4,	.1415,	.1021,	.1662,	.1982,	.4950,	.2092,	.3101,	.5662,	.2220,	.2077,
5,	.3998,	.2275,	.2964,	.3518,	.5358,	.5198,	.4782,	.7537,	.6697,	.3455,
6,	.5672,	.2505,	.3840,	.3901,	.5055,	.7007,	.5698,	.6842,	.8502,	.5455,
7,	.6189,	.5126,	.3411,	.4198,	.4429,	.7025,	.6945,	.6741,	.8578,	.6624,
8,	.8460,	.8312,	.6563,	.7385,	.4847,	.7011,	.8879,	.9089,	.9287,	.7769,
9,	.9684,	.9561,	1.1371,	.9711,	.5181,	.6092,	.7711,	1.2306,	1.3076,	1.0356,
10,	1.0904,	.7847,	1.3451,	.7370,	.8854,	.7154,	.4565,	.7613,	1.0265,	.9809,
11,	.8536,	.8344,	1.2967,	.7203,	.9922,	.9114,	.6125,	.6172,	1.8114,	1.4331,
12,	.9829,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,
+gp,	.9829,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,
0 FBAR 5–10,	.7485,	.5938,	.6933,	.6014,	.5621,	.6581,	.6430,	.8355,	.9401,	.7245,

Table 3.14 (Continued)

Table 8 Fishing mortality (F) at age

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.0315,	.0250,	.0666,	.0206,	.0199,	.0533,	.1454,	.1135,	.0629,	.0327,
4,	.1285,	.0994,	.2106,	.2036,	.1238,	.1701,	.2121,	.2283,	.1268,	.1283,
5,	.3543,	.2282,	.3021,	.3286,	.3075,	.3774,	.4931,	.5094,	.3700,	.2656,
6,	.6204,	.5137,	.5492,	.4996,	.6276,	.6052,	.7089,	.9357,	.5964,	.4010,
7,	.6734,	.8465,	.7973,	.7791,	1.1362,	.9253,	.9482,	1.1555,	1.0425,	.7139,
8,	.7089,	1.0789,	.9850,	1.0285,	1.2112,	1.0190,	1.0924,	1.0146,	1.0231,	.8846,
9,	.9372,	1.2820,	1.1617,	.9709,	1.2625,	.7788,	.8284,	.7809,	1.1603,	.7869,
10,	1.0392,	1.2338,	.7501,	.9209,	.9581,	.5058,	1.1129,	1.3257,	1.7399,	.9886,
11,	1.4842,	.9567,	.9535,	.5822,	1.0878,	.4206,	.8750,	1.0293,	1.5453,	.6036,
12,	1.2775,	1.1082,	.8608,	.7590,	1.0347,	.4667,	1.0052,	1.1919,	1.6651,	.8044,
+gp,	1.2775,	1.1082,	.8608,	.7590,	1.0347,	.4667,	1.0052,	1.1919,	1.6651,	.8044,
0 FBAR 5–10,	.7222,	.8638,	.7576,	.7546,	.9172,	.7019,	.8640,	.9536,	.9887,	.6734,

Table 8 Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97–99
AGE											
3,	.0086,	.0183,	.0405,	.0796,	.2084,	.5459,	.4677,	.3385,	.4303,	.1926,	.3205,
4,	.0622,	.0625,	.1266,	.0963,	.2019,	.2978,	.3483,	.3032,	.3863,	.2072,	.2989,
5,	.1342,	.1875,	.2206,	.3470,	.3400,	.3348,	.4037,	.5627,	.5391,	.5534,	.5517,
6,	.2306,	.3208,	.4430,	.4599,	.6468,	.5763,	.5406,	.7010,	.7744,	.7457,	.7404,
7,	.2499,	.4247,	.5393,	.5668,	1.1694,	.8941,	.7499,	.8366,	.7224,	.7850,	.7813,
8,	.3728,	.3442,	.5966,	.5969,	.9882,	.9464,	.8698,	1.2361,	1.0229,	.9020,	1.0537,
9,	.3030,	.3784,	.4540,	.6609,	1.0512,	.9667,	.7574,	1.3739,	1.1765,	1.3047,	1.2850,
10,	.3802,	.2529,	.4547,	.6585,	1.0190,	1.0113,	.9519,	1.5473,	1.3775,	1.4458,	1.4569,
11,	.5435,	.1643,	.2444,	.6661,	1.1405,	1.1763,	.8492,	1.5108,	1.4838,	1.3160,	1.4369,
12,	.4626,	.1977,	.4662,	.6594,	1.0723,	1.0878,	.7691,	1.3995,	1.5978,	1.8684,	1.6219,
+gp,	.4626,	.1977,	.4662,	.6594,	1.0723,	1.0878,	.7691,	1.3995,	1.5978,	1.8684,	
0 FBAR 5–10,	.2785,	.3181,	.4514,	.5483,	.8691,	.7883,	.7122,	1.0429,	.9355,	.9561,	

Table 3.15

Run title : Arctic Cod (run: XSAASA05/X05)

At 24/08/2000 18:52

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	734497,	428855,	446554,	472677,
4,	582966,	597729,	350475,	365481,
5,	405783,	467894,	477442,	283441,
6,	198974,	315120,	343366,	362798,
7,	94185,	147889,	210932,	230469,
8,	97114,	64587,	79910,	102685,
9,	246943,	65603,	41048,	45987,
10,	102870,	148030,	35870,	19821,
11,	38521,	63758,	78056,	20487,
12,	39479,	22406,	23796,	36724,
+gp,	33328,	42765,	37374,	21336,
0 TOTAL,	2574662,	2364636,	2124822,	1961905,

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	710902,	1092988,	1204159,	1605848,	647779,	275409,	443916,	812552,	501571,	691500,
4,	386098,	580878,	872525,	964076,	1271856,	519975,	221955,	353844,	649589,	382403,
5,	293070,	306199,	405074,	605146,	691905,	900903,	391651,	159849,	259001,	410974,
6,	200199,	213665,	192773,	229216,	394073,	434020,	554970,	203206,	106278,	147762,
7,	206100,	122980,	132527,	91028,	137448,	231477,	209363,	227735,	102397,	50153,
8,	113334,	112117,	66725,	63815,	53950,	75765,	113483,	92886,	107703,	49108,
9,	57173,	65612,	61325,	36024,	36989,	34477,	34478,	46683,	40568,	55799,
10,	25701,	29182,	32445,	28160,	19940,	19615,	15819,	14667,	22162,	21145,
11,	11155,	12743,	14311,	12402,	13507,	8583,	7481,	6197,	6381,	8667,
12,	8976,	3687,	6614,	4182,	5054,	4950,	3281,	2549,	2149,	2249,
+gp,	21134,	13989,	3938,	1880,	2707,	2738,	3722,	1687,	857,	1142,
0 TOTAL,	2033843,	2554041,	2992417,	3641779,	3275208,	2507911,	2000118,	1921855,	1798656,	1820903,

Run title : Arctic Cod (run: XSAASA05/X05)

At 24/08/2000 18:52

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,	1969,
AGE										
3,	799052,	926695,	734810,	476587,	342140,	785390,	1598553,	1308149,	166364,	112970,
4,	536919,	619931,	717564,	563232,	378256,	275327,	628794,	1258171,	1039834,	132851,
5,	242561,	351040,	387525,	433157,	364332,	268147,	201894,	464464,	885286,	693373,
6,	202303,	140481,	175698,	165953,	168651,	209661,	148693,	133920,	317625,	482350,
7,	72587,	104623,	68719,	62903,	49461,	85079,	109665,	83248,	89683,	163185,
8,	24324,	38512,	50605,	30658,	19362,	22722,	46634,	56154,	44365,	49266,
9,	24159,	12288,	15808,	21529,	10423,	7562,	10968,	21441,	23228,	21485,
10,	24766,	13229,	4821,	5744,	6864,	2927,	2962,	4386,	7309,	8524,
11,	8732,	9713,	4698,	1478,	1188,	2405,	1069,	1073,	1484,	2675,
12,	3705,	3073,	2921,	1491,	287,	264,	919,	532,	256,	620,
+gp,	1351,	2332,	1351,	1113,	1278,	670,	351,	461,	498,	278,
0 TOTAL,	1940458,	2221918,	2164519,	1763844,	1342243,	1660155,	2750501,	3331998,	2575933,	1667579,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	198940,	409015,	1026675,	1837462,	529207,	628980,	620797,	351567,	644843,	200699,
4,	90405,	156396,	327857,	808416,	1238128,	350164,	473992,	431049,	252013,	456632,
5,	86560,	64252,	115615,	227319,	542896,	617938,	232583,	284612,	200350,	165251,
6,	351872,	47513,	41900,	70379,	130918,	260105,	300847,	118042,	109660,	83959,
7,	230923,	163376,	30280,	23366,	39010,	64654,	105672,	139328,	48756,	38366,
8,	61794,	101819,	80113,	17627,	12572,	20510,	26221,	43200,	58134,	16929,
9,	15915,	21710,	36308,	34026,	6896,	6339,	8330,	8835,	14252,	18804,
10,	5408,	4947,	6833,	9535,	10548,	3363,	2822,	3154,	2113,	3156,
11,	2372,	1488,	1848,	1457,	3736,	3563,	1346,	1464,	1206,	620,
12,	459,	827,	529,	414,	581,	1134,	1173,	597,	646,	161,
+gp,	312,	421,	697,	408,	525,	550,	572,	583,	1198,	218,
0 TOTAL,	1044961,	971765,	1668655,	3030409,	2515016,	1957300,	1774355,	1382433,	1333172,	984794,

Table 3.15 (Continued)

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	139415,	152554,	153472,	168488,	402907,	528944,	1048482,	289144,	206651,	174578,
4,	156537,	110604,	121818,	117556,	135134,	323386,	410604,	742245,	211329,	158877,
5,	303748,	112701,	81990,	80795,	78517,	97754,	223353,	271937,	483640,	152415,
6,	95775,	174504,	73449,	49624,	47625,	47267,	54874,	111680,	133779,	273504,
7,	39836,	42166,	85475,	34723,	24653,	20817,	21129,	22112,	35873,	60325,
8,	16197,	16632,	14808,	31529,	13043,	6480,	6757,	6703,	5701,	10355,
9,	6374,	6527,	4630,	4527,	9229,	3180,	1915,	1855,	1989,	1678,
10,	5465,	2044,	1483,	1186,	1404,	2138,	1195,	685,	696,	510,
11,	969,	1583,	487,	573,	387,	441,	1056,	322,	149,	100,
12,	121,	180,	498,	154,	262,	107,	237,	360,	94,	26,
+gp,	87,	66,	70,	170,	116,	208,	130,	155,	82,	55,
0 TOTAL,	764524,	619561,	538179,	489326,	713277,	1030723,	1769732,	1447199,	1079984,	832424,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 46–97	AMST 46–97
AGE													
3,	245864,	416341,	729553,	907559,	826267,	664386,	442204,	743324,	927407,	681568,	0,	495459,	615543,
4,	138332,	199567,	334694,	573582,	686209,	549243,	315138,	226794,	433815,	493789,	460255,	377548,	468220,
5,	114412,	106424,	153499,	241437,	426492,	459112,	333865,	182127,	137113,	241377,	328628,	264065,	322917,
6,	95682,	81910,	72233,	100797,	139719,	248532,	268929,	182559,	84946,	65476,	113635,	154451,	188642,
7,	149950,	62208,	48656,	37973,	52102,	59906,	114349,	128232,	74149,	32061,	25432,	76844,	96309,
8,	24187,	95618,	33306,	23232,	17638,	13247,	20060,	44226,	45478,	29479,	11972,	34241,	46431,
9,	3500,	13640,	55489,	15016,	10471,	5376,	4210,	6882,	10519,	13388,	9793,	14832,	26260,
10,	625,	2117,	7650,	28853,	6349,	2996,	1674,	1616,	1426,	2656,	2973,	6048,	14183,
11,	156,	350,	1346,	3975,	12229,	1876,	892,	529,	282,	294,	512,	2391,	7371,
12,	45,	74,	243,	863,	1672,	3200,	474,	313,	96,	52,	65,	901,	3762,
+gp,	38,	25,	38,	194,	237,	432,	1815,	549,	158,	91,	18,		
0 TOTAL,	772791,	978273,	1436708,	1933481,	2179384,	2008307,	1503611,	1517149,	1715388,	1560232,	953284,		

Table 3.16

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Table 4 Natural Mortality (M) at age

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
4,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
5,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
7,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
8,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
9,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
10,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
11,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
12,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

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Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Table 4 Natural Mortality (M) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 3.16 (Continued)

Table 4 Natural Mortality (M) at age

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.2000,	.2000,	.2000,	.2000,	.2006,	.2004,	.3122,	.2583,	.2087,	.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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 4 Natural Mortality (M) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	.2000,	.2050,	.2068,	.2666,	.3980,	.7281,	.6387,	.5114,	.5585,	.3771,
4,	.2000,	.2000,	.2000,	.2030,	.2959,	.3977,	.4240,	.2955,	.3109,	.2133,
5,	.2000,	.2000,	.2000,	.2026,	.2265,	.2081,	.2784,	.2098,	.2278,	.2000,
6,	.2000,	.2000,	.2000,	.2000,	.2048,	.2001,	.2059,	.2018,	.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,
+gp,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,

Table 3.17

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	.0061,	.0018,	.0003,	.0023,
4,	.0200,	.0249,	.0124,	.0209,
5,	.0532,	.1101,	.0751,	.1484,
6,	.0973,	.2024,	.1997,	.3662,
7,	.1781,	.4160,	.5201,	.5101,
8,	.1932,	.2545,	.3536,	.3869,
9,	.3125,	.4047,	.5286,	.3832,
10,	.2798,	.4405,	.3617,	.3766,
11,	.3432,	.7827,	.5536,	.6259,
12,	.3120,	.6182,	.4604,	.5039,
+gp,	.3120,	.6182,	.4604,	.5039,
0 FBAR 5–10,	.1857,	.3047,	.3398,	.3619,

Table 8 Fishing mortality (F) at age

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	.0020,	.0254,	.0225,	.0334,	.0199,	.0159,	.0270,	.0240,	.0718,	.0535,
4,	.0321,	.1612,	.1667,	.1325,	.1457,	.0840,	.1291,	.1128,	.2589,	.2564,
5,	.1167,	.2637,	.3700,	.2299,	.2676,	.2859,	.4568,	.2094,	.3626,	.5093,
6,	.2882,	.2787,	.5501,	.3125,	.3333,	.5297,	.6900,	.4862,	.5517,	.5121,
7,	.4096,	.4122,	.5311,	.3243,	.3969,	.5139,	.6129,	.5494,	.5357,	.5251,
8,	.3480,	.4046,	.4175,	.3469,	.2494,	.5880,	.6880,	.6287,	.4593,	.5111,
9,	.4741,	.5057,	.5790,	.3932,	.4364,	.5805,	.6551,	.5463,	.4535,	.6141,
10,	.5031,	.5149,	.7613,	.5364,	.6441,	.7645,	.7380,	.6333,	.7388,	.6860,
11,	.9031,	.4585,	1.0260,	.6980,	.8035,	.7621,	.8756,	.8584,	.8415,	.6511,
12,	.7111,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,
+gp,	.7111,	.4879,	.9056,	.6217,	.7304,	.7704,	.8152,	.7529,	.7990,	.6734,
0 FBAR 5–10,	.3566,	.3966,	.5348,	.3572,	.3879,	.5437,	.6401,	.5089,	.5169,	.5596,

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Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	.0543,	.0562,	.0663,	.0313,	.0174,	.0226,	.0398,	.0298,	.0251,	.0230,
4,	.2266,	.2717,	.3063,	.2366,	.1449,	.1110,	.1037,	.1525,	.2064,	.2292,
5,	.3477,	.4944,	.6498,	.7420,	.3537,	.3909,	.2119,	.1814,	.4087,	.4792,
6,	.4607,	.5168,	.8279,	1.0069,	.4854,	.4494,	.3818,	.2026,	.4683,	.5382,
7,	.4363,	.5279,	.6094,	.9764,	.5787,	.4033,	.4713,	.4320,	.4019,	.7725,
8,	.4855,	.6931,	.6564,	.8798,	.7409,	.5303,	.5797,	.6844,	.5291,	.9302,
9,	.4053,	.7389,	.8167,	.9416,	1.0674,	.7389,	.7183,	.8781,	.8041,	1.1783,
10,	.7381,	.8379,	.9855,	1.3731,	.8476,	.8074,	.8182,	.8850,	.8105,	1.0769,
11,	.8449,	1.0011,	.9522,	1.4366,	1.2968,	.7617,	.5024,	1.2253,	.6772,	1.5554,
12,	.7981,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,
+gp,	.7981,	.9284,	.9756,	1.4264,	1.0883,	.7927,	.6634,	1.0696,	.7458,	1.3377,
0 FBAR 5–10,	.4789,	.6348,	.7576,	.9866,	.6789,	.5533,	.5302,	.5439,	.5704,	.8292,

Table 8 Fishing mortality (F) at age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	.0409,	.0214,	.0394,	.1959,	.2141,	.0837,	.1660,	.1338,	.1460,	.0489,
4,	.1422,	.1028,	.1673,	.1996,	.4959,	.2106,	.3121,	.5671,	.2234,	.2090,
5,	.4004,	.2285,	.2976,	.3536,	.5375,	.5211,	.4800,	.7544,	.6703,	.3475,
6,	.5680,	.2517,	.3849,	.3917,	.5078,	.7021,	.5715,	.6857,	.8497,	.5478,
7,	.6211,	.5144,	.3427,	.4210,	.4451,	.7050,	.6973,	.6763,	.8581,	.6643,
8,	.8479,	.8330,	.6583,	.7375,	.4863,	.7032,	.8908,	.9121,	.9296,	.7789,
9,	.9682,	.9584,	1.1338,	.9698,	.5192,	.6109,	.7746,	1.2298,	1.3057,	1.0352,
10,	1.0900,	.7876,	1.3393,	.7386,	.8842,	.7149,	.4600,	.7689,	1.0301,	.9848,
11,	.8533,	.8388,	1.2904,	.7222,	.9905,	.9079,	.6132,	.6231,	1.8042,	1.4314,
12,	.9829,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,
+gp,	.9829,	.8179,	1.3377,	.7358,	.9492,	.8218,	.5389,	.6958,	1.4375,	1.2219,
0 FBAR 5–10,	.7493,	.5956,	.6928,	.6020,	.5633,	.6595,	.6457,	.8379,	.9406,	.7264,

Table 3.17 (Continued)

Table 8 Fishing mortality (F) at age

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	.0318,	.0252,	.0672,	.0208,	.0194,	.0532,	.0330,	.0555,	.0546,	.0330,
4,	.1296,	.1003,	.2121,	.2050,	.1250,	.1716,	.2132,	.2291,	.1275,	.1292,
5,	.3562,	.2300,	.3045,	.3308,	.3097,	.3800,	.4958,	.5101,	.3706,	.2666,
6,	.6225,	.5163,	.5518,	.5034,	.6303,	.6078,	.7118,	.9355,	.5967,	.4017,
7,	.6766,	.8476,	.7996,	.7821,	1.1350,	.9269,	.9488,	1.1525,	1.0390,	.7125,
8,	.7123,	1.0789,	.9846,	1.0295,	1.2085,	1.0193,	1.0925,	1.0147,	1.0189,	.8805,
9,	.9390,	1.2765,	1.1589,	.9702,	1.2574,	.7820,	.8329,	.7869,	1.1558,	.7836,
10,	1.0380,	1.2299,	.7508,	.9204,	.9566,	.5090,	1.1143,	1.3263,	1.7247,	.9821,
11,	1.4798,	.9558,	.9516,	.5854,	1.0813,	.4239,	.8779,	1.0354,	1.5364,	.6026,
12,	1.2775,	1.1082,	.8608,	.7590,	1.0347,	.4667,	1.0052,	1.1919,	1.6651,	.8044,
+gp,	1.2775,	1.1082,	.8608,	.7590,	1.0347,	.4667,	1.0052,	1.1919,	1.6651,	.8044,
0 FBAR 5–10,	.7241,	.8632,	.7584,	.7561,	.9162,	.7042,	.8660,	.9543,	.9843,	.6712,

Table 8 Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97–99
AGE											
3,	.0087,	.0134,	.0341,	.0129,	.0098,	.0106,	.0241,	.0226,	.0475,	.0155,	.0286,
4,	.0628,	.0631,	.1277,	.0942,	.1065,	.0997,	.1205,	.2075,	.2739,	.1939,	.2251,
5,	.1352,	.1889,	.2227,	.3467,	.3155,	.3287,	.3264,	.5544,	.5120,	.5534,	.5399,
6,	.2319,	.3226,	.4452,	.4638,	.6445,	.5790,	.5375,	.7000,	.7573,	.7454,	.7342,
7,	.2513,	.4265,	.5413,	.5699,	1.1678,	.8958,	.7540,	.8392,	.7238,	.7850,	.7827,
8,	.3740,	.3460,	.5984,	.6001,	.9888,	.9481,	.8743,	1.2364,	1.0256,	.9020,	1.0547,
9,	.3039,	.3801,	.4566,	.6637,	1.0511,	.9687,	.7639,	1.3738,	1.1792,	1.3047,	1.2859,
10,	.3805,	.2541,	.4572,	.6620,	1.0193,	1.0120,	.9573,	1.5476,	1.3768,	1.4458,	1.4567,
11,	.5412,	.1651,	.2459,	.6693,	1.1400,	1.1719,	.8540,	1.5118,	1.4880,	1.3160,	1.4386,
12,	.4626,	.1977,	.4663,	.6594,	1.0724,	1.0878,	.7691,	1.3995,	1.5978,	1.8684,	1.6219,
+gp,	.4626,	.1977,	.4663,	.6594,	1.0724,	1.0878,	.7691,	1.3995,	1.5978,	1.8684,	
0 FBAR 5–10,	.2794,	.3197,	.4536,	.5510,	.8645,	.7887,	.7022,	1.0419,	.9291,	.9561,	

Table 3.18

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

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

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	728139,	425311,	442592,	468348,
4,	577860,	592530,	347574,	362238,
5,	402060,	463732,	473210,	281072,
6,	197212,	312115,	340097,	359415,
7,	93323,	146496,	208708,	228044,
8,	96213,	63939,	79121,	101579,
9,	244722,	64933,	40588,	45487,
10,	101777,	146581,	35470,	19586,
11,	38117,	62991,	77255,	20227,
12,	39205,	22142,	23578,	36361,
+gp,	33324,	42765,	37377,	21337,
0 TOTAL,	2551952,	2343535,	2105569,	1943694,

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	704908,	1083753,	1193111,	1590377,	641584,	272778,	439602,	804781,	496824,	683690,
4,	382556,	575973,	865011,	955076,	1259285,	514924,	219807,	350332,	643259,	378598,
5,	290427,	303320,	401364,	599477,	684912,	891184,	387619,	158175,	256234,	406511,
6,	198391,	211595,	190765,	226975,	389987,	429102,	548181,	200984,	105033,	145989,
7,	204032,	121764,	131099,	90099,	135956,	228785,	206850,	225110,	101196,	49529,
8,	112107,	110900,	66016,	63110,	53333,	74845,	112048,	91748,	106395,	48488,
9,	56484,	64808,	60583,	35603,	36525,	34028,	34036,	46105,	40060,	55027,
10,	25387,	28785,	32000,	27799,	19673,	19329,	15591,	14474,	21860,	20840,
11,	11003,	12568,	14083,	12237,	13311,	8459,	7368,	6103,	6291,	8550,
12,	8856,	3651,	6506,	4133,	4985,	4880,	3232,	2513,	2118,	2220,
+gp,	21133,	13989,	3938,	1880,	2707,	2738,	3722,	1687,	857,	1142,
0 TOTAL,	2015284,	2531108,	2964476,	3606766,	3242259,	2481052,	1978057,	1902013,	1780129,	1800584,

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Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	789653,	916842,	728338,	472064,	338678,	776941,	1582560,	1295416,	164955,	112039,
4,	530599,	612324,	709603,	558039,	374580,	272501,	621906,	1245195,	1029477,	131705,
5,	239862,	346346,	382037,	427678,	360621,	265306,	199663,	458995,	875269,	685697,
6,	199996,	138702,	172949,	163321,	166726,	207288,	146941,	132256,	313440,	476187,
7,	71623,	103298,	67732,	61876,	48854,	84015,	108284,	82121,	88421,	160667,
8,	23986,	37908,	49883,	30149,	19083,	22424,	45954,	55340,	43651,	48433,
9,	23813,	12084,	15518,	21185,	10240,	7448,	10803,	21072,	22854,	21054,
10,	24380,	13000,	4726,	5614,	6764,	2883,	2913,	4313,	7170,	8373,
11,	8592,	9541,	4605,	1444,	1164,	2373,	1053,	1052,	1457,	2610,
12,	3650,	3022,	2871,	1455,	281,	261,	907,	522,	253,	606,
+gp,	1351,	2332,	1351,	1113,	1278,	670,	351,	461,	498,	278,
0 TOTAL,	1917505,	2195401,	2139612,	1743938,	1328269,	1642109,	2721334,	3296742,	2547445,	1647648,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	197105,	404774,	1015319,	1818949,	523916,	621616,	613942,	348054,	638488,	198487,
4,	89647,	154909,	324399,	799193,	1224278,	346265,	468089,	425778,	249275,	451721,
5,	85743,	63671,	114439,	224670,	535936,	610486,	229669,	280485,	197708,	163230,
6,	347649,	47037,	41482,	69576,	129164,	256342,	296843,	116349,	108003,	82807,
7,	227600,	161288,	29940,	23112,	38504,	63643,	104000,	137232,	47987,	37806,
8,	60756,	100131,	78947,	17401,	12421,	20199,	25746,	42398,	57130,	16658,
9,	15642,	21306,	35642,	33463,	6815,	6253,	8186,	8650,	13943,	18463,
10,	5306,	4863,	6690,	9391,	10388,	3320,	2779,	3089,	2070,	3093,
11,	2335,	1461,	1811,	1435,	3673,	3513,	1330,	1436,	1172,	605,
12,	451,	815,	517,	408,	571,	1117,	1160,	590,	631,	158,
+gp,	312,	421,	697,	408,	525,	550,	572,	583,	1198,	218,
0 TOTAL,	1032545,	960676,	1649883,	2998007,	2486189,	1933303,	1752317,	1364642,	1317605,	973245,

Table 3.18 (Continued)

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	137733,	150853,	151826,	166447,	397926,	523892,	1039401,	286652,	204704,	172720,
4,	154745,	109235,	120432,	116231,	133469,	319332,	406526,	736010,	209453,	157316,
5,	300087,	111294,	80898,	79759,	77522,	96438,	220220,	268932,	479213,	150957,
6,	94413,	172066,	72399,	48847,	46908,	46568,	53997,	109815,	132212,	270832,
7,	39202,	41481,	84062,	34137,	24175,	20448,	20761,	21696,	35280,	59605,
8,	15928,	16316,	14551,	30937,	12785,	6362,	6626,	6581,	5611,	10219,
9,	6259,	6397,	4542,	4451,	9047,	3126,	1879,	1819,	1953,	1658,
10,	5368,	2004,	1461,	1167,	1381,	2106,	1171,	669,	678,	503,
11,	946,	1557,	480,	565,	381,	434,	1037,	315,	145,	99,
12,	118,	176,	490,	152,	257,	106,	233,	353,	91,	26,
+gp,	87,	66,	70,	170,	116,	208,	130,	155,	82,	55,
0 TOTAL,	754887,	611445,	531211,	482860,	703967,	1019021,	1751981,	1432998,	1069422,	823991,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	GMST 46–97	AMST 46–97
AGE													
3,	242669,	411539,	721099,	896602,	814793,	648244,	434253,	730946,	894430,	585132,	0,	490135,	608966,
4,	136820,	196954,	330789,	566742,	677973,	541950,	309674,	223814,	428500,	487919,	395139,	373528,	463307,
5,	113194,	105205,	151387,	238363,	421032,	453370,	329552,	179646,	135348,	238759,	324715,	261061,	319305,
6,	94666,	80959,	71306,	99201,	137626,	244865,	265035,	179997,	83662,	64588,	112399,	152513,	186358,
7,	148376,	61464,	48006,	37405,	51078,	58867,	112345,	126024,	73048,	31598,	25094,	75784,	95065,
8,	23933,	94487,	32850,	22875,	17322,	13008,	19678,	43275,	44581,	28999,	11800,	33734,	45804,
9,	3469,	13481,	54732,	14784,	10277,	5276,	4127,	6721,	10290,	13088,	9634,	14599,	25912,
10,	620,	2096,	7547,	28385,	6233,	2941,	1640,	1574,	1393,	2591,	2907,	5950,	13997,
11,	154,	347,	1331,	3912,	11988,	1841,	875,	515,	274,	288,	500,	2352,	7272,
12,	44,	74,	241,	852,	1640,	3139,	467,	305,	93,	51,	63,	887,	3719,
+gp,	38,	25,	38,	194,	237,	432,	1815,	549,	158,	91,	18,		
0 TOTAL,	763983,	966630,	1419326,	1909314,	2150199,	1973932,	1479462,	1493366,	1671778,	1453103,	882268,		

Table 3.19

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

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

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	318775,	157785,	176979,	206968,
4,	389206,	338187,	213821,	246272,
5,	419739,	410248,	451221,	296190,
6,	312146,	418630,	491671,	574229,
7,	216853,	288465,	442957,	534884,
8,	304571,	171518,	228766,	324580,
9,	1016986,	228664,	154057,	190806,
10,	527833,	644194,	168017,	102531,
11,	237473,	332558,	439612,	127202,
12,	286501,	137117,	157374,	268216,
+gp,	293172,	327730,	316575,	196503,
0 TOTALBIO,	4323254,	3455095,	3241050,	3068382,

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	356511,	620840,	581592,	867924,	324849,	144863,	241405,	436578,	285188,	380496,
4,	297661,	507619,	648703,	801874,	980930,	420706,	185701,	292382,	568068,	324157,
5,	350265,	414352,	466546,	780140,	826953,	1128586,	507586,	204616,	350739,	539487,
6,	362758,	438238,	336195,	447831,	713892,	823880,	1088338,	394185,	217977,	293742,
7,	547701,	370231,	339189,	260979,	365369,	644886,	602902,	648162,	308318,	146304,
8,	409975,	459373,	232686,	249037,	195259,	287407,	444912,	359887,	441605,	195125,
9,	271168,	352412,	280322,	184433,	175543,	171538,	177420,	237413,	218280,	290697,
10,	152098,	195340,	184784,	179715,	117998,	121603,	101422,	93013,	148649,	137394,
11,	79192,	102459,	97691,	95036,	95911,	63926,	57579,	47112,	51387,	67712,
12,	74768,	34914,	52937,	37647,	42132,	43257,	29627,	22758,	20291,	20624,
+gp,	215471,	169552,	41383,	20982,	27476,	29316,	41030,	19064,	10174,	13122,
0 TOTALBIO,	3117568,	3665331,	3262029,	3925600,	3866313,	3879969,	3477921,	2755169,	2620675,	2408859,

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Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	452677,	540463,	434384,	240233,	180161,	452749,	968495,	739897,	102512,	63674,
4,	467957,	555316,	651094,	436901,	306552,	244301,	585529,	1094173,	984262,	115155,
5,	327893,	486855,	543332,	518999,	457450,	368668,	291375,	625156,	1297082,	929280,
6,	414503,	295604,	372918,	300488,	320651,	436715,	325113,	273107,	704232,	978426,
7,	217927,	323200,	214409,	167133,	137936,	259854,	351727,	248955,	291654,	484650,
8,	99423,	161580,	215117,	110939,	73401,	94484,	203351,	228553,	196150,	199033,
9,	129582,	67619,	87854,	102335,	51708,	41196,	62756,	114243,	134818,	113579,
10,	165562,	90783,	33389,	33845,	42626,	19904,	21115,	29179,	52781,	56371,
11,	70096,	80041,	39080,	10459,	8815,	19677,	9170,	8552,	12887,	21110,
12,	34929,	29738,	28578,	12358,	2496,	2535,	9265,	4973,	2624,	5750,
+gp,	16128,	27517,	16531,	11527,	14007,	8539,	4530,	5191,	6370,	3229,
0 TOTALBIO,	2396677,	2658716,	2636686,	1945217,	1595803,	1948624,	2832426,	3371979,	3785372,	2970258,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	124707,	294193,	711941,	1351398,	349761,	363926,	408469,	224614,	416570,	138221,
4,	87260,	173213,	349951,	913484,	1257408,	311879,	479122,	422728,	250208,	483948,
5,	129363,	110351,	191352,	398040,	853180,	852285,	364379,	431636,	307594,	271057,
6,	795223,	123598,	105162,	186886,	311748,	542581,	714025,	271461,	254758,	208480,
7,	764313,	622196,	111430,	91139,	136432,	197765,	367259,	470058,	166173,	139735,
8,	277951,	526228,	400276,	93481,	59957,	85507,	123860,	197842,	269515,	83876,
9,	93940,	146995,	237234,	235996,	43183,	34751,	51697,	52985,	86348,	122041,
10,	39766,	41874,	55570,	82650,	82153,	23023,	21906,	23613,	16001,	25519,
11,	21027,	15106,	18075,	15174,	34899,	29268,	12589,	13192,	10883,	5996,
12,	4764,	9882,	6049,	5061,	6360,	10916,	12885,	6352,	6869,	1836,
+gp,	4040,	6148,	9823,	6357,	7229,	6388,	7775,	7806,	15305,	3189,
0 TOTALBIO,	2342353,	2069785,	2196865,	3379665,	3142310,	2458289,	2563965,	2122288,	1800223,	1483900,

Table 3.19 (Continued)

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
3,	87122,	108348,	106257,	55139,	158493,	218712,	327362,	55684,	42993,	51189,
4,	150590,	120702,	129670,	95740,	146823,	286137,	363458,	383777,	83790,	80814,
5,	452644,	190614,	135009,	114256,	133065,	157115,	328896,	351948,	378620,	129742,
6,	215914,	446802,	183189,	106710,	124111,	133242,	135502,	217815,	251231,	395978,
7,	131614,	158130,	312259,	116753,	86660,	84534,	82682,	72759,	105145,	158397,
8,	72854,	84735,	73636,	131844,	55406,	37764,	39113,	34788,	24634,	46743,
9,	37581,	43612,	30171,	24587,	52935,	24478,	12564,	12128,	15257,	11549,
10,	40227,	17049,	12115,	8045,	10085,	21706,	8125,	6361,	8213,	4963,
11,	8515,	15910,	4776,	4677,	3339,	6322,	11586,	4229,	1907,	904,
12,	1250,	2114,	5725,	1473,	2649,	1168,	2566,	3914,	992,	275,
+gp,	1139,	928,	978,	1977,	1435,	2847,	1796,	2197,	1070,	789,
0 TOTALBIO,	1199450,	1188944,	993786,	661202,	775002,	974025,	1313651,	1145602,	913851,	881341,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
3,	98114,	203754,	325857,	308718,	189092,	130043,	88125,	146245,	198184,	116637,
4,	98189,	213778,	315946,	671513,	513064,	266363,	153967,	116428,	228732,	252873,
5,	135008,	174292,	281414,	439332,	603256,	518413,	324356,	194092,	158128,	278418,
6,	164580,	187311,	199193,	283301,	334670,	520692,	551295,	338525,	163466,	130677,
7,	368939,	187852,	192283,	152658,	197394,	204890,	402398,	424862,	217036,	95422,
8,	86361,	408430,	174762,	127410,	94729,	64453,	109820,	227714,	205194,	128907,
9,	16514,	88307,	380546,	101358,	68750,	37891,	32534,	60043,	76901,	84527,
10,	4889,	21392,	74409,	246353,	47984,	26905,	16904,	19130,	14549,	26519,
11,	1398,	3123,	16991,	36643,	98097,	18654,	9476,	5620,	3242,	3121,
12,	486,	760,	2684,	9364,	17955,	34161,	5141,	3311,	1017,	548,
+gp,	521,	329,	536,	2537,	3054,	5510,	23270,	7341,	2208,	1246,
0 TOTALBIO,	974999,	1489328,	1964622,	2379187,	2168043,	1827975,	1717286,	1543310,	1268658,	1118896,

Table 3.20

Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

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

YEAR,	1946,	1947,	1948,	1949,
AGE				
3,	0,	0,	0,	0,
4,	0,	0,	0,	0,
5,	0,	0,	0,	0,
6,	0,	0,	0,	0,
7,	0,	0,	0,	0,
8,	304571,	171518,	228766,	324580,
9,	1016986,	228664,	154057,	190806,
10,	527833,	644194,	168017,	102531,
11,	237473,	332558,	439612,	127202,
12,	286501,	137117,	157374,	268216,
+gp,	293172,	327730,	316575,	196503,
0 TOTSPBIO,	2666535,	1841781,	1464402,	1209839,

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

YEAR,	1950,	1951,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	409975,	459373,	232686,	249037,	195259,	287407,	444912,	359887,	441605,	195125,
9,	271168,	352412,	280322,	184433,	175543,	171538,	177420,	237413,	218280,	290697,
10,	152098,	195340,	184784,	179715,	117998,	121603,	101422,	93013,	148649,	137394,
11,	79192,	102459,	97691,	95036,	95911,	63926,	57579,	47112,	51387,	67712,
12,	74768,	34914,	52937,	37647,	42132,	43257,	29627,	22758,	20291,	20624,
+gp,	215471,	169552,	41383,	20982,	27476,	29316,	41030,	19064,	10174,	13122,
0 TOTSPBIO,	1202672,	1314051,	889803,	766851,	654320,	717047,	851990,	779247,	890385,	724674,

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Run title : Arctic Cod (run: SVPASA04/V04)

At 28/08/2000 14:42

Traditional vpa using file input for terminal F

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	99423,	161580,	215117,	110939,	73401,	94484,	203351,	228553,	196150,	199033,
9,	129582,	67619,	87854,	102335,	51708,	41196,	62756,	114243,	134818,	113579,
10,	165562,	90783,	33389,	33845,	42626,	19904,	21115,	29179,	52781,	56371,
11,	70096,	80041,	39080,	10459,	8815,	19677,	9170,	8552,	12887,	21110,
12,	34929,	29738,	28578,	12358,	2496,	2535,	9265,	4973,	2624,	5750,
+gp,	16128,	27517,	16531,	11527,	14007,	8539,	4530,	5191,	6370,	3229,
0 TOTSPBIO,	515719,	457278,	420549,	281462,	193053,	186336,	310186,	390691,	405629,	399072,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
3,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
4,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
5,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
6,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
7,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
8,	277951,	526228,	400276,	93481,	59957,	85507,	123860,	197842,	269515,	83876,
9,	93940,	146995,	237234,	235996,	43183,	34751,	51697,	52985,	86348,	122041,
10,	39766,	41874,	55570,	82650,	82153,	23023,	21906,	23613,	16001,	25519,
11,	21027,	15106,	18075,	15174,	34899,	29268,	12589,	13192,	10883,	5996,
12,	4764,	9882,	6049,	5061,	6360,	10916,	12885,	6352,	6869,	1836,
+gp,	4040,	6148,	9823,	6357,	7229,	6388,	7775,	7806,	15305,	3189,
0 TOTSPBIO,	441488,	746233,	727028,	438718,	233781,	189852,	230712,	301791,	404920,	242458,

Table 3.20 (Continued)

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

	YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
	AGE										
	3,	0,	0,	0,	551,	0,	0,	0,	0,	0,	0,
	4,	0,	0,	6483,	7659,	7341,	2861,	18173,	3838,	1676,	0,
	5,	0,	0,	13501,	11426,	23952,	14140,	26312,	24636,	18931,	6487,
	6,	0,	0,	62284,	32013,	38474,	47967,	25745,	39207,	82906,	71276,
	7,	0,	0,	202968,	85229,	48530,	46494,	43822,	16007,	55727,	64943,
	8,	72854,	84735,	60382,	116023,	49866,	32100,	27770,	16002,	15273,	32253,
	9,	37581,	43612,	27758,	23850,	52406,	23499,	7790,	6064,	15257,	9817,
	10,	40227,	17049,	12115,	8045,	10085,	19536,	7312,	4771,	8213,	4963,
	11,	8515,	15910,	4776,	4677,	3339,	6322,	11586,	4229,	1907,	904,
	12,	1250,	2114,	5725,	1473,	2649,	1168,	2566,	3914,	992,	275,
	+gp,	1139,	928,	978,	1977,	1435,	2847,	1796,	2197,	1070,	789,
0	TOTSPBIO,	161566,	164348,	396971,	292924,	238077,	196933,	172872,	120865,	201951,	191706,

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

	YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
	AGE										
	3,	0,	0,	3259,	0,	0,	0,	0,	0,	0,	0,
	4,	982,	8551,	3159,	20145,	5131,	0,	0,	0,	2287,	0,
	5,	6750,	10458,	33770,	39540,	66358,	36289,	6487,	3882,	6325,	2784,
	6,	34562,	52447,	85653,	84990,	110441,	171828,	143337,	47393,	31059,	13068,
	7,	213984,	122104,	144212,	93121,	118436,	127032,	253510,	237923,	95496,	42940,
	8,	66498,	338997,	162529,	115943,	76731,	47695,	91150,	186725,	168259,	101836,
	9,	14202,	85658,	369130,	98317,	66687,	35996,	31883,	57041,	71517,	74384,
	10,	4791,	21392,	74409,	243890,	47504,	26367,	16904,	18174,	14258,	26519,
	11,	1398,	3123,	16991,	36643,	97116,	18654,	9476,	5339,	3242,	3121,
	12,	486,	760,	2684,	9364,	17955,	34161,	5141,	3311,	1017,	548,
	+gp,	521,	329,	536,	2537,	3054,	5510,	23270,	7341,	2208,	1246,
0	TOTSPBIO,	344176,	643818,	896332,	744490,	609413,	503533,	581159,	567129,	395669,	266446,

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Table 3.21

Run title : Arctic Cod (run: SVPASA04/V04) ,

At 28/08/2000 14:42

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,	728139,	4323254,	2666535,	706000,	.2648,	.6735,	.1857,
1947,	425311,	3455095,	1841781,	882017,	.4789,	.5708,	.3047,
1948,	442592,	3241050,	1464402,	774295,	.5287,	.6152,	.3398,
1949,	468348,	3068382,	1209839,	800122,	.6613,	.6799,	.3619,
1950,	704908,	3117568,	1202672,	731982,	.6086,	.7781,	.3566,
1951,	1083753,	3665331,	1314051,	827180,	.6295,	.8813,	.3966,
1952,	1193111,	3262029,	889803,	876795,	.9854,	.7499,	.5348,
1953,	1590377,	3925600,	766851,	695546,	.9070,	.8396,	.3572,
1954,	641584,	3866313,	654320,	826021,	1.2624,	.7790,	.3879,
1955,	272778,	3879969,	717047,	1147841,	1.6008,	.8170,	.5437,
1956,	439602,	3477921,	851990,	1343068,	1.5764,	.8448,	.6401,
1957,	804781,	2755169,	779247,	792557,	1.0171,	.8346,	.5089,
1958,	496824,	2620675,	890385,	769313,	.8640,	.8831,	.5169,
1959,	683690,	2408859,	724674,	744607,	1.0275,	.8562,	.5596,
1960,	789653,	2396677,	515719,	622042,	1.2062,	.8819,	.4789,
1961,	916842,	2658716,	457278,	783221,	1.7128,	.9069,	.6348,
1962,	728338,	2636686,	420549,	909266,	2.1621,	.9175,	.7576,
1963,	472064,	1945217,	281462,	776337,	2.7582,	.7829,	.9866,
1964,	338678,	1595803,	193053,	437695,	2.2672,	.8184,	.6789,
1965,	776941,	1948624,	186336,	444930,	2.3878,	.8965,	.5533,
1966,	1582560,	2832426,	310186,	483711,	1.5594,	.9415,	.5302,
1967,	1295416,	3371979,	390691,	572605,	1.4656,	.8787,	.5439,
1968,	164955,	3785372,	405629,	1074084,	2.6479,	.9561,	.5704,
1969,	112039,	2970258,	399072,	1197226,	3.0000,	.8743,	.8292,
1970,	197105,	2342353,	441488,	933246,	2.1139,	.9734,	.7493,
1971,	404774,	2069785,	746233,	689048,	.9234,	1.1182,	.5956,
1972,	1015319,	2196865,	727028,	565254,	.7775,	1.0788,	.6928,
1973,	1818949,	3379665,	438718,	792685,	1.8068,	1.1430,	.6020,
1974,	523916,	3142310,	233781,	1102433,	4.7157,	1.0271,	.5633,
1975,	621616,	2458289,	189852,	829377,	4.3685,	.9007,	.6595,
1976,	613942,	2563965,	230712,	867463,	3.7599,	1.0236,	.6457,
1977,	348054,	2122288,	301791,	905301,	2.9998,	.9928,	.8379,
1978,	638488,	1800223,	404920,	698715,	1.7256,	1.0037,	.9406,
1979,	198487,	1483900,	242458,	440538,	1.8170,	1.0713,	.7264,
1980,	137733,	1199450,	161566,	380434,	2.3547,	.9731,	.7241,
1981,	150853,	1188944,	164348,	399038,	2.4280,	1.1050,	.8632,
1982,	151826,	993786,	396971,	363730,	.9163,	1.0767,	.7584,
1983,	166447,	661202,	292924,	289992,	.9900,	.8953,	.7561,
1984,	397926,	775002,	238077,	277651,	1.1662,	.9483,	.9162,
1985,	523892,	974025,	196933,	307920,	1.5636,	1.0182,	.7042,
1986,	1039401,	1313651,	172872,	430113,	2.4880,	1.0160,	.8660,
1987,	286652,	1145602,	120865,	523071,	4.3277,	1.0224,	.9543,
1988,	204704,	913851,	201951,	434939,	2.1537,	1.0001,	.9843,
1989,	172720,	881341,	191706,	332481,	1.7343,	.9879,	.6712,
1990,	242669,	974999,	344176,	212000,	.6160,	1.0108,	.2794,
1991,	411539,	1489328,	643818,	319158,	.4957,	.9521,	.3197,
1992,	721099,	1964622,	896332,	513234,	.5726,	1.0270,	.4536,
1993,	896602,	2379187,	744490,	581611,	.7812,	1.0127,	.5510,
1994,	814793,	2168043,	609413,	771086,	1.2653,	1.0090,	.8645,
1995,	648244,	1827975,	503533,	739999,	1.4696,	1.0030,	.7887,
1996,	434253,	1717286,	581159,	732228,	1.2599,	1.0147,	.7022,
1997,	730946,	1543310,	567129,	762403,	1.3443,	1.0004,	1.0419,
1998,	894430,	1268658,	395669,	592624,	1.4978,	1.0072,	.9291,
1999,	585132,	1118896,	266446,	484910,	1.8199,	.9967,	.9561,
Arith. Mean ,	613811,	2282736,	577425,	675762,	1.6636		.6418,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

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Table 3.22

The SAS System 11:31 Wednesday, September 6, 2000
North-East Arctic cod (Sub-areas I and II)

Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	711470.00	0.3328	0.0000	0.0000	0.0000	0.194	0.0280	0.660
4	395139.00	0.2000	0.0000	0.0000	0.0000	0.465	0.2206	1.033
5	324715.00	0.2000	0.0640	0.0000	0.0000	1.205	0.5291	1.563
6	112399.00	0.2000	0.2290	0.0000	0.0000	1.980	0.7195	2.287
7	25094.000	0.2000	0.6480	0.0000	0.0000	3.123	0.7670	3.310
8	11800.000	0.2000	0.8370	0.0000	0.0000	4.163	1.0335	4.783
9	9634.000	0.2000	0.9720	0.0000	0.0000	5.474	1.2601	6.687
10	2907.000	0.2000	1.0000	0.0000	0.0000	8.342	1.4275	7.920
11	500.000	0.2000	1.0000	0.0000	0.0000	9.812	1.4097	9.663
12	63.000	0.2000	1.0000	0.0000	0.0000	10.850	1.5893	13.333
13+	18.000	0.2000	1.0000	0.0000	0.0000	13.700	1.5893	13.233
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	473913.00	0.3328	0.0000	0.0000	0.0000	0.206	0.0280	0.660
4	.	0.2000	0.0033	0.0000	0.0000	0.505	0.2206	1.033
5	.	0.2000	0.0400	0.0000	0.0000	1.178	0.5291	1.563
6	.	0.2000	0.1733	0.0000	0.0000	1.983	0.7195	2.287
7	.	0.2000	0.5133	0.0000	0.0000	3.034	0.7670	3.310
8	.	0.2000	0.8167	0.0000	0.0000	4.398	1.0335	4.783
9	.	0.2000	0.9267	0.0000	0.0000	6.458	1.2601	6.687
10	.	0.2000	0.9933	0.0000	0.0000	9.661	1.4275	7.920
11	.	0.2000	1.0000	0.0000	0.0000	10.811	1.4097	9.663
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.5893	13.333
13+	.	0.2000	1.0000	0.0000	0.0000	13.700	1.5893	13.233
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	165000.00	0.3328	0.0000	0.0000	0.0000	0.206	0.0280	0.660
4	.	0.2000	0.0033	0.0000	0.0000	0.505	0.2206	1.033
5	.	0.2000	0.0400	0.0000	0.0000	1.178	0.5291	1.563
6	.	0.2000	0.1733	0.0000	0.0000	1.983	0.7195	2.287
7	.	0.2000	0.5133	0.0000	0.0000	3.034	0.7670	3.310
8	.	0.2000	0.8167	0.0000	0.0000	4.398	1.0335	4.783
9	.	0.2000	0.9267	0.0000	0.0000	6.458	1.2601	6.687
10	.	0.2000	0.9933	0.0000	0.0000	9.661	1.4275	7.920
11	.	0.2000	1.0000	0.0000	0.0000	10.811	1.4097	9.663
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.5893	13.333
13+	.	0.2000	1.0000	0.0000	0.0000	13.700	1.5893	13.233
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANASA05
Date and time: 28AUG00:11:47

Table 3.23

The SAS System 11:31 Wednesday, September 6, 2000

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

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
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
0.6639	0.6347	1145911	249251	390000	0.0000	0.0000	1354625	285520	0	1956884	644205
.	.	.	.	.	0.0250	0.0239	.	285520	21645	1931673	631471
.	.	.	.	.	0.0500	0.0478	.	285520	42928	1906906	619013
.	.	.	.	.	0.0750	0.0717	.	285520	63857	1882574	606826
.	.	.	.	.	0.1000	0.0956	.	285520	84438	1858669	594903
.	.	.	.	.	0.1250	0.1195	.	285520	104679	1835182	583237
.	.	.	.	.	0.1500	0.1434	.	285520	124587	1812104	571823
.	.	.	.	.	0.1750	0.1673	.	285520	144167	1789426	560654
.	.	.	.	.	0.2000	0.1912	.	285520	163427	1767142	549725
.	.	.	.	.	0.2250	0.2151	.	285520	182372	1745242	539029
.	.	.	.	.	0.2500	0.2390	.	285520	201009	1723719	528563
.	.	.	.	.	0.2750	0.2629	.	285520	219345	1702565	518320
.	.	.	.	.	0.3000	0.2868	.	285520	237384	1681773	508294
.	.	.	.	.	0.3250	0.3107	.	285520	255133	1661337	498482
.	.	.	.	.	0.3500	0.3346	.	285520	272597	1641247	488877
.	.	.	.	.	0.3750	0.3585	.	285520	289782	1621499	479476
.	.	.	.	.	0.4000	0.3824	.	285520	306693	1602084	470273
.	.	.	.	.	0.4250	0.4063	.	285520	323335	1582997	461265
.	.	.	.	.	0.4500	0.4303	.	285520	339714	1564231	452445
.	.	.	.	.	0.4750	0.4542	.	285520	355835	1545779	443811
.	.	.	.	.	0.5000	0.4781	.	285520	371703	1527636	435357
.	.	.	.	.	0.5250	0.5020	.	285520	387321	1509795	427080
.	.	.	.	.	0.5500	0.5259	.	285520	402697	1492250	418976
.	.	.	.	.	0.5750	0.5498	.	285520	417832	1474996	411040
.	.	.	.	.	0.6000	0.5737	.	285520	432733	1458027	403270
.	.	.	.	.	0.6250	0.5976	.	285520	447404	1441337	395660
.	.	.	.	.	0.6500	0.6215	.	285520	461849	1424922	388208
.	.	.	.	.	0.6750	0.6454	.	285520	476072	1408775	380910
.	.	.	.	.	0.7000	0.6693	.	285520	490078	1392892	373762
.	.	.	.	.	0.7250	0.6932	.	285520	503869	1377268	366762
.	.	.	.	.	0.7500	0.7171	.	285520	517452	1361897	359905
.	.	.	.	.	0.7750	0.7410	.	285520	530828	1346775	353189
.	.	.	.	.	0.8000	0.7649	.	285520	544003	1331896	346610
.	.	.	.	.	0.8250	0.7888	.	285520	556980	1317258	340166
.	.	.	.	.	0.8500	0.8127	.	285520	569762	1302854	333852
.	.	.	.	.	0.8750	0.8366	.	285520	582353	1288680	327668
.	.	.	.	.	0.9000	0.8605	.	285520	594756	1274733	321609
.	.	.	.	.	0.9250	0.8844	.	285520	606975	1261007	315672
.	.	.	.	.	0.9500	0.9083	.	285520	619014	1247499	309856
.	.	.	.	.	0.9750	0.9322	.	285520	630875	1234205	304157
.	.	.	.	.	1.0000	0.9561	.	285520	642562	1221120	298574
.	.	.	.	.	1.0250	0.9800	.	285520	654078	1208241	293102
.	.	.	.	.	1.0500	1.0039	.	285520	665426	1195564	287740
.	.	.	.	.	1.0750	1.0278	.	285520	676608	1183085	282486
.	.	.	.	.	1.1000	1.0517	.	285520	687629	1170800	277337
.	.	.	.	.	1.1250	1.0756	.	285520	698490	1158707	272291
.	.	.	.	.	1.1500	1.0995	.	285520	709195	1146801	267346
.	.	.	.	.	1.1750	1.1234	.	285520	719746	1135078	262499
.	.	.	.	.	1.2000	1.1473	.	285520	730147	1123537	257748
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANASA05
Date and time : 28AUG00:11:47
Computation of ref. F: Simple mean, age 5 - 10
Basis for 2000 : TAC constraints

Table 3.24

The SAS System 11:31 Wednesday, September 6, 2000

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

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	1.000	0.3328	0.0000	0.0000	0.0000	0.206	0.0280	0.660
4	.	0.2000	0.0033	0.0000	0.0000	0.505	0.2206	1.033
5	.	0.2000	0.0400	0.0000	0.0000	1.178	0.5291	1.563
6	.	0.2000	0.1733	0.0000	0.0000	1.983	0.7195	2.287
7	.	0.2000	0.5133	0.0000	0.0000	3.034	0.7670	3.310
8	.	0.2000	0.8167	0.0000	0.0000	4.398	1.0335	4.783
9	.	0.2000	0.9267	0.0000	0.0000	6.458	1.2601	6.687
10	.	0.2000	0.9933	0.0000	0.0000	9.661	1.4275	7.920
11	.	0.2000	1.0000	0.0000	0.0000	10.811	1.4097	9.663
12	.	0.2000	1.0000	0.0000	0.0000	10.850	1.5893	13.333
13+	.	0.2000	1.0000	0.0000	0.0000	13.700	1.5893	13.233
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : YLDASA04
Date and time: 28AUG00:11:53

Table 3.25

The SAS System 11:31 Wednesday, September 6, 2000
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 Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
0.0000	0.0000	0.000	0.000	4.955	21050.236	2.008	18052.324	2.008	18052.324
0.0500	0.0478	0.122	790.738	4.347	14396.202	1.447	11528.572	1.447	11528.572
0.1000	0.0956	0.196	1092.063	3.980	10820.074	1.124	8072.017	1.124	8072.017
0.1500	0.1434	0.247	1206.870	3.727	8619.925	0.912	5981.869	0.912	5981.869
0.2000	0.1912	0.286	1241.745	3.537	7145.534	0.761	4608.902	0.761	4608.902
0.2500	0.2390	0.316	1240.595	3.388	6096.867	0.647	3653.957	0.647	3653.957
0.3000	0.2868	0.341	1223.219	3.265	5317.343	0.559	2961.219	0.559	2961.219
0.3500	0.3346	0.362	1199.029	3.162	4717.768	0.489	2442.173	0.489	2442.173
0.4000	0.3824	0.380	1172.616	3.074	4243.877	0.431	2043.150	0.431	2043.150
0.4500	0.4303	0.396	1146.221	2.996	3860.901	0.384	1729.913	0.384	1729.913
0.5000	0.4781	0.410	1120.906	2.928	3545.615	0.343	1479.704	0.343	1479.704
0.5500	0.5259	0.422	1097.127	2.868	3281.959	0.309	1276.882	0.309	1276.882
0.6000	0.5737	0.433	1075.034	2.813	3058.499	0.280	1110.387	0.280	1110.387
0.6500	0.6215	0.444	1054.620	2.763	2866.892	0.254	972.208	0.254	972.208
0.7000	0.6693	0.453	1035.802	2.718	2700.918	0.232	856.423	0.232	856.423
0.7500	0.7171	0.462	1018.468	2.676	2555.852	0.213	758.574	0.213	758.574
0.8000	0.7649	0.470	1002.493	2.638	2428.043	0.195	675.251	0.195	675.251
0.8500	0.8127	0.477	987.755	2.602	2314.634	0.180	603.813	0.180	603.813
0.9000	0.8605	0.484	974.138	2.569	2213.352	0.166	542.183	0.166	542.183
0.9500	0.9083	0.490	961.537	2.539	2122.375	0.154	488.717	0.154	488.717
1.0000	0.9561	0.496	949.853	2.510	2040.222	0.143	442.092	0.143	442.092
1.0500	1.0039	0.502	939.002	2.483	1965.680	0.133	401.241	0.133	401.241
1.1000	1.0517	0.508	928.903	2.457	1897.745	0.125	365.293	0.125	365.293
1.1500	1.0995	0.513	919.489	2.433	1835.580	0.116	333.531	0.116	333.531
1.2000	1.1473	0.517	910.695	2.410	1778.483	0.109	305.362	0.109	305.362
1.2500	1.1951	0.522	902.466	2.389	1725.859	0.102	280.293	0.102	280.293
1.3000	1.2430	0.526	894.753	2.368	1677.203	0.096	257.909	0.096	257.909
1.3500	1.2908	0.531	887.510	2.349	1632.081	0.091	237.861	0.091	237.861
1.4000	1.3386	0.534	880.697	2.330	1590.120	0.086	219.854	0.086	219.854
1.4500	1.3864	0.538	874.277	2.313	1550.998	0.081	203.636	0.081	203.636
1.5000	1.4342	0.542	868.219	2.296	1514.434	0.077	188.992	0.077	188.992
1.5500	1.4820	0.545	862.493	2.280	1480.182	0.073	175.737	0.073	175.737
1.6000	1.5298	0.549	857.073	2.264	1448.028	0.069	163.711	0.069	163.711
1.6500	1.5776	0.552	851.934	2.249	1417.782	0.065	152.777	0.065	152.777
1.7000	1.6254	0.555	847.055	2.235	1389.277	0.062	142.815	0.062	142.815
1.7500	1.6732	0.558	842.416	2.221	1362.364	0.059	133.720	0.059	133.720
1.8000	1.7210	0.561	838.000	2.208	1336.911	0.057	125.401	0.057	125.401
1.8500	1.7688	0.564	833.791	2.195	1312.800	0.054	117.777	0.054	117.777
1.9000	1.8166	0.566	829.773	2.183	1289.924	0.052	110.779	0.052	110.779
1.9500	1.8644	0.569	825.934	2.171	1268.190	0.050	104.344	0.050	104.344
2.0000	1.9122	0.571	822.261	2.160	1247.510	0.047	98.417	0.047	98.417
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDASA04
Date and time : 28AUG00:11:53
Computation of ref. F: Simple mean, age 5 - 10
F-0.1 factor : 0.1184
F-max factor : 0.2210
F-0.1 reference F : 0.1132
F-max reference F : 0.2113
Recruitment : Single recruit

Table 3.26

```
Fleksibest/Bormicon logfile
--------- Run status & identity ---------
Run started: Tue Aug 29 18:17:54 MET DST 2000
Host:        skrei
System:      SunOS skrei 5.7 Generic_106541–08 sun4u sparc SUNW,Ultra-4
Executable:  ./borm.exper1: ELF 32-bit MSB executable SPARC Version 1, dynamically
linked, not stripped
Arguments:   ./borm.exper1 -l -i optfile.retro -o lik.out.ct -print1 20
Username:    kristinf
Directory:   /home/kristinf/FLEKSITEST/AFWG2000/Data-age3–12/2.5cm/Pearson

Run ended:   Tue Aug 29 20:02:17 MET DST 2000
Lik val:     14238250.5557622
Runid:       runid skrei Tue Aug 29 18:17:54 2000
Timing:
Rounds:      9154
--------- Input data ---------
Start time:  1983.1
End time:    2000.1

Fleet                             File

  danish_seine                    ../../Common/Fleets/danish_seine
  gillnet                         ../../Common/Fleets/gillnet
  handline                        ../../Common/Fleets/handline
  longline                        ../../Common/Fleets/longline
  nortrawl                        ../../Common/Fleets/nortrawl
  rustrawltotal                   ../../Common/Fleets/rustrawl
  overfish                        ../../Common/Fleets/overfish
  thirdcountries                  ../../Common/Fleets/thirdcountries

Catch                     Weight  File

  danish_seineD.cod          10.0 ../../Common/Catch/Pearson/danish_seineD.cod
  gillnetD.cod               10.0 ../../Common/Catch/Pearson/gillnetD.cod
  handlineD.cod              10.0 ../../Common/Catch/Pearson/handlineD.cod
  longlineD.cod              10.0 ../../Common/Catch/Pearson/longlineD.cod
  nortrawlD.cod              10.0 ../../Common/Catch/Pearson/nortrawlD.cod
  rustrawltotalD.cod         10.0 ../../Common/Catch/Pearson/rustrawltotal.cod

Survey                    Weight  File

  bartrawlwin8393.cod         0.1 ../../Common/Surveys/Pearson/bartrawlny.dat.8393
  bartrawlwin9400.cod         1.0 ../../Common/Surveys/Pearson/bartrawlny.dat.9400
  lofoten.cod                 1.0 ../../Common/Surveys/Pearson/lofoten.dat.8500
  baracwin8393.cod            0.1 ../../Common/Surveys/Pearson/baracwin.dat.8393
  baracwin9400.cod            1.0 ../../Common/Surveys/Pearson/baracwin.dat.9400
  rustrawl8299.cod       0.000001 ../../Common/Surveys/Pearson/rustrawl.dat.8299

Other                     Weight  File

  stomach.cod                10.0 ../../Common/Stomach/stomach.8499.cod-20–60
  bounds                      1.0 boundsfile.retro

Likelihood component     Weight  Value
     danish_seine          10.0     110578.7
     gillnet               10.0     121321.1
     handline              10.0      56679.9
     longline              10.0      83657.6
     nortrawl              10.0     225377.4
     rustrawltotal         10.0     508276.3
     bartrawlwin8393.cod    0.1    1986083.0
     bartrawlwin9400.cod    1.0     849509.8
     lofoten.cod            1.0     820411.1
     baracwin8393.cod       0.1    1667619.0
     baracwin9400.cod       1.0    1137095.2
     rustrawl8299.cod     0.000001 5926716.0
     stomach.cod           10.0       691.8
     bounds                 1.0        30.2
```

Table 3.26 (cont.)

```
Parameters estimated in key run.

Parameter number  Final value    Estimated  Original value
                                  0 or 1

If a parameter is estimated, 1 is set in third column and the original
value is printed in fourth column.  Else nothing is printed in fourth column.

Quarterly mortality (in 3 length intervals)
   Immature                                 Mature
   50     0.05 0                            60     0.05 0
   51     0.05 0                            61     0.07 0
   52     0.05 0                            62     0.05 0

Maturation parameters
  101   0.0296 0                           102    78.44 0

Number of xx-age fish in startyear
  Immature                                 Mature
  202                                      304     1e-05 0
  203   25.3274 1     27.5321              305   3.16267 1     2.90195
  204   14.9575 1     13.5664              306  0.217632 1     0.79308
  205   6.18268 1     8.53243              307     0.201 1      0.4002
  206   4.73303 1     4.88571              308  0.342747 1    0.311699
  207   3.04172 1     3.04469              309  0.167663 1    0.185407
  208   2.56311 1     2.67002              310 0.0795119 1   0.0723092
  209   0.29148 1    0.248109              311 0.0261852 1   0.00929738
  210         0 0                          312      0.03 0


Length in start year

 Immature fish
 age    meanlength  (old)        standard deviation (old)
   2
   3        34.8  0                        4.2  0
   4        45.9  0                        4.7  0
   5        54.5  0                        4.3  0
   6        62.7  0                        5.2  0
   7        73.1  0                        4.2  0
   8        78.6  0                        6.8  0
   9          85  0                       13.7  0
  10          90  0                       13.5  0

 Mature fish
 age    meanlength  (old)        standard deviation (old)
   4     51.0036  0                    1.06835  0
   5        59.6  0                    1.05602  0
   6        71.1  0                    1.01149  0
   7          79  0                    1.82767  0
   8        88.2  0                    2.56627  0
   9        97.3  0                    4.00303  0
  10         100  0                    7.15294  0
  11         105  0                    7.33135  0
  12         110  0                    9.03202  0

Cannibalism (alpha, beta, gamma, and delta)
  401        7e-06 0                       402   0.00103295 0
  403       0.0001 0                       404     0.309428 0

Growth distribution parameters (k1, k2)
  501    -0.072783 0                       502          0.8 1            0.8
```

Table 3.26 (cont.)

```
Selection and catchability parameters for surveys
  Slope                                    b (linear or power)
  l50                                      catchability

Survey 1,   Lofoten acoustic (1985–2000)
  10101          1 0                       10102         0.05 0
  10103          5 0                       10104     0.625572 1       0.654327

Survey 2,   Barents Sea trawl (1983–1993)
  10201          1 0                       10202       0.4375 1            0.5
  10203     22.0702 1        13.6144       10204     0.357571 1       0.353088

Survey 3,   Barents Sea acoustic (1983–1993)
  10301          1 0                       10302         0.01 1           0.01
  10303     32.7873 1        38.3705       10304       0.4676 1       0.594072

Survey 4,   Svalbard bottom trawl survey (1987–1999) not in use at present
  10401                                    10402
  10403                                    10404

Survey 5,   Barents Sea acoustic (1994–2000)
  10501          1 0                       10502         0.05 0
  10503          5 0                       10504     0.444921 1       0.376528

Survey 6,   Barents Sea trawl (1994–2000)
  10601          1 0                       10602         0.05 0
  10603          5 0                       10604     0.466394 1       0.433776

Survey 7,   Russian autumn bottom trawl survey - 1982–1999
  10701          1 0                       10702     0.151427 1      0.0248695
  10703     12.2634 1        31.7916       10704     0.211347 1       0.133345

Survey 8,   Norwegian summer (autumn) survey - bottom trawl (1995–1999)
  10801                                    10802
  10803                                    10804
```

Table 3.26 (cont.)

Growth parameter in year				Number of age 2 in year			
51983	0.126068	1	0.09375				
51984	0.141406	1	0.1	81984	54.5818	1	40.181
51985	0.0920898	1	0.071875	81985	61.0069	1	52.852
51986	0.0656519	1	0.100041	81986	131.969	1	105.164
51987	0.0656267	1	0.0442117	81987	45.8513	1	28.929
51988	0.0842974	1	0.126942	81988	36.5858	1	20.664
51989	0.167152	1	0.102616	81989	24.8615	1	17.485
51990	0.10682	1	0.118125	81990	39.8435	1	24.593
51991	0.117188	1	0.09375	81991	56.7738	1	41.645
51992	0.0514282	1	0.06875	81992	90.9312	1	72.973
51993	0.0966437	1	0.0999628	81993	113.923	1	90.925
51994	0.0938329	1	0.0705469	81994	100.567	1	82.915
51995	0.096411	1	0.110184	81995	59.6459	1	67.118
51996	0.0994057	1	0.0889785	81996	43.1394	1	44.621
51997	0.120715	1	0.0996875	81997	67.7589	1	75.255
51998	0.0999573	1	0.099375	81998	82.6284	1	97.93
51999	0.115532	1	0.0893539	81999	43.0077	1	68.92
52000	0.096	1	0.096	82000	55.7226	1	71.147

Mean length of age2 fish in year			SD of mean length of age2 fish in year			
71984	35.8	0	91984	3.70371	1	4.3
71985	40.3	0	91985	6.61904	1	5.1
71986	34.4	0	91986	3.97031	1	4.4
71987	31.8	0	91987	3.35303	1	3.5
71988	29.7	0	91988	5.36143	1	3.1
71989	34.7	0	91989	5.5582	1	3.4
71990	39.4	0	91990	7.97852	1	4.3
71991	41.6	0	91991	7.36895	1	5.8
71992	41.3	0	91992	8	1	4.8
71993	35.9	0	91993	4.09922	1	4.4
71994	30.5	0	91994	5.41504	1	5
71995	29.9	0	91995	5.30078	1	5.9
71996	28.1	0	91996	7.98828	1	5
71997	28	0	91997	4.96641	1	3.9
71998	28.7	0	91998	5.56875	1	4.4
71999	29	0	91999	4.16309	1	4.2
72000	28.7	0	92000	4.36426	1	4.1

Selection for fleets

slope				l50			
Fleet 1, danish seine							
110005	0.0535938	1	0.04	110006	49.0092	1	49.3951
Fleet 2, gillnet							
120005	0.0366699	1	0.05	120006	79.732	1	79.4218
Fleet 3, handline							
130005	0.0362109	1	0.04	130006	58.7195	1	58.3208
Fleet 4, longline							
140005	0.0376953	1	0.04	140006	61.344	1	60.5166
Fleet 5, nortrawl							
150005	0.0374219	1	0.04	150006	55.7671	1	55.6042
Fleet 6, rustrawl							
160005	0.05625	1	0.04	160006	48.9062	1	48.5271
Fleet 8, overfishing							
180005	0.04	0		180006	52	0	

Table 3.26 (cont.)

Partial F (sw# 1fyyyy: f=fleetnr, yyyy=year)

	Fleet 1	Fleet 2	Fleet 3	Fleet 4	Fleet 5	Fleet 6	Fleet 8
1983	0.050724	0.628754	0.066128	0.110736	0.132342	0.037435	0.000000
1985	0.018666	0.405198	0.067570	0.045157	0.077831	0.093197	0.000000
1986	0.018708	0.250674	0.055632	0.095618	0.124217	0.182764	0.000000
1987	0.009939	0.221723	0.016016	0.116396	0.350292	0.278445	0.000000
1988	0.016382	0.287888	0.010442	0.147813	0.257852	0.223710	0.000000
1989	0.014912	0.459230	0.018961	0.073564	0.113071	0.166019	0.000000
1990	0.008042	0.074660	0.013242	0.014687	0.041651	0.060653	0.030000
1991	0.005906	0.079617	0.013148	0.013038	0.024917	0.084999	0.070000
1992	0.005531	0.060095	0.012761	0.012429	0.030401	0.087636	0.080000
1993	0.008454	0.096930	0.018177	0.018453	0.048357	0.140608	0.030000
1994	0.012575	0.109828	0.020678	0.033096	0.100598	0.181665	0.015000
1995	0.020027	0.211743	0.011134	0.053155	0.115887	0.194441	0.000000
1996	0.044495	0.227044	0.011621	0.059949	0.103353	0.258714	0.000000
1997	0.054639	0.339836	0.021004	0.083107	0.159643	0.426688	0.000000
1998	0.060941	0.328690	0.027837	0.086693	0.161785	0.446674	0.000000
1999	0.042353	0.331146	0.043335	0.086171	0.157944	0.388781	0.000000

Original values

1983	0.050576	0.497177	0.059451	0.094102	0.114555	0.036404	--
1985	0.020686	0.456461	0.079167	0.051208	0.046690	0.084380	--
1986	0.021969	0.385420	0.064883	0.099911	0.161010	0.201021	--
1987	0.009805	0.210226	0.017048	0.114495	0.401229	0.278717	--
1988	0.018077	0.333104	0.011411	0.144428	0.284220	0.243701	--
1989	0.014152	0.323419	0.018906	0.064827	0.125038	0.173296	--
1990	0.013748	0.125331	0.023339	0.023721	0.059987	0.095114	--
1991	0.012679	0.176468	0.029015	0.027757	0.051030	0.167382	--
1992	0.006686	0.079301	0.015763	0.014236	0.038056	0.101058	--
1993	0.008597	0.092849	0.018231	0.017529	0.048357	0.135322	--
1994	0.012612	0.094826	0.021829	0.032967	0.101992	0.175165	--
1995	0.023225	0.220350	0.012796	0.057176	0.129550	0.192934	--
1996	0.035707	0.207213	0.011599	0.054278	0.099468	0.239100	--
1997	0.044582	0.268512	0.019017	0.072488	0.145569	0.369652	--
1998	0.057888	0.297331	0.024982	0.071247	0.143187	0.386966	--
1999	0.035346	0.250809	0.037353	0.068456	0.131278	0.313968	--

Table 3.27

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Total fishing mortality at age

Year	1983	1984	1985
Age			
3	0.0418	0.0539	0.0756
4	0.1451	0.1850	0.1730
5	0.3160	0.3407	0.2991
6	0.4474	0.5083	0.4018
7	0.6584	0.6268	0.5094
8	0.7977	0.8426	0.5827
9	0.9246	0.9289	0.6914
10	1.0775	0.9671	0.7105
11	1.0892	1.0855	0.7238
12+	1.0920	1.0903	0.7522
F 5–10	0.7036	0.7024	0.5325

Total fishing mortality at age

Year	1986	1987	1988	1989	1990	1991	1992
Age							
3	0.0394	0.0431	0.0354	0.0648	0.0499	0.0760	0.0629
4	0.2381	0.1814	0.1171	0.1107	0.1228	0.1372	0.1534
5	0.3939	0.5383	0.2902	0.2115	0.1479	0.2054	0.2053
6	0.5266	0.7588	0.5583	0.3271	0.1850	0.2213	0.2500
7	0.6118	0.9030	0.7219	0.4724	0.2110	0.2443	0.2596
8	0.6852	0.9831	0.8407	0.5902	0.2371	0.2625	0.2741
9	0.7234	1.0436	0.9201	0.7138	0.2554	0.2835	0.2856
10	0.7686	1.0706	0.9815	0.8062	0.2691	0.2974	0.2966
11	0.7758	1.0988	1.0084	0.8726	0.2767	0.3063	0.3028
12+	0.7800	1.1023	1.0316	0.9014	0.2806	0.3104	0.3058
F 5–10	0.6183	0.8829	0.7188	0.5202	0.2176	0.2524	0.2619

Total fishing mortality at age

Year	1993	1994	1995	1996	1997	1998	1999	1997–1999
Age								
3	0.0400	0.0314	0.0321	0.0392	0.0484	0.0501	0.0426	0.0470
4	0.1377	0.1846	0.1421	0.1617	0.2554	0.2588	0.2000	0.2381
5	0.2372	0.3243	0.3490	0.3450	0.5344	0.5403	0.4679	0.5142
6	0.2850	0.4295	0.4551	0.5240	0.7376	0.7813	0.6644	0.7278
7	0.3306	0.4755	0.5437	0.5989	0.9065	0.9124	0.8324	0.8838
8	0.3424	0.5206	0.5937	0.6715	0.9911	1.0384	0.9315	0.9870
9	0.3614	0.5319	0.6520	0.7140	1.0781	1.1026	1.0376	1.0728
10	0.3764	0.5481	0.6658	0.7580	1.1232	1.1607	1.0829	1.1223
11	0.3905	0.5609	0.6889	0.7713	1.1660	1.1890	1.1223	1.1591
12+	0.3972	0.5695	0.7016	0.7875	1.1812	1.2106	1.1404	1.1774
F 5–10	0.3222	0.4717	0.5432	0.6019	0.8952	0.9226	0.8361	

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Residual natural mortality (M1)

Year	1983	1984	1985
Age			
3	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2001
8	0.2002	0.2006	0.2007
9	0.2042	0.2030	0.2040
10	0.2171	0.2113	0.2081
11	0.2244	0.2249	0.2178
12+	0.2325	0.2360	0.2361

Table 3.27 (Cont).

Residual natural mortality (M1)

Year Age	1986	1987	1988	1989	1990	1991	1992
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	0.2001	0.2000	0.2000	0.2000	0.2000	0.2001	0.2001
8	0.2007	0.2004	0.2003	0.2002	0.2004	0.2004	0.2005
9	0.2023	0.2019	0.2012	0.2014	0.2017	0.2020	0.2015
10	0.2079	0.2044	0.2042	0.2041	0.2053	0.2051	0.2049
11	0.2128	0.2118	0.2078	0.2096	0.2108	0.2109	0.2098
12+	0.2252	0.2181	0.2188	0.2185	0.2210	0.2205	0.2193

Residual natural mortality (M1)

Year Age	1993	1994	1995	1996	1997	1998	1999	1997–1999
3	0.2000	0.1999	0.1999	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	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000	0.1999	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2002	0.2001	0.2001	0.2001	0.2001	0.2000	0.2000	0.2000
8	0.2004	0.2009	0.2006	0.2006	0.2005	0.2005	0.2003	0.2004
9	0.2013	0.2016	0.2027	0.2020	0.2023	0.2021	0.2020	0.2021
10	0.2032	0.2034	0.2040	0.2059	0.2052	0.2059	0.2051	0.2054
11	0.2082	0.2070	0.2074	0.2084	0.2114	0.2105	0.2111	0.2110
12+	0.2154	0.2154	0.2134	0.2166	0.2198	0.2239	0.2233	0.2223

Predation mortality (M2)

Year Age	1983	1984	1985
3	0.0382	0.0279	0.0384
4	0.0058	0.0033	0.0043

Predation mortality (M2)

Year Age	1986	1987	1988	1989	1990	1991	1992
3	0.1385	0.1817	0.1442	0.0524	0.0612	0.0523	0.1076
4	0.0133	0.0353	0.0227	0.0219	0.0035	0.0124	0.0154

Predation mortality (M2)

Year Age	1993	1994	1995	1996	1997	1998	1999	1997–1999
3	0.2029	0.5098	0.5228	0.3916	0.2285	0.1218	0.0676	0.1393
4	0.0575	0.0724	0.1326	0.0882	0.0699	0.0296	0.0190	0.0395

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Stock numbers (thousands) at age by Jan. 1

Year Age	1983	1984	1985	1986
3	253274	545818	610069	1319690
4	149575	191409	411785	445680
5	93453	105305	129793	282246
6	49507	55745	61302	78755
7	32427	25906	27443	33578
8	29059	13741	11326	13495
9	4586	10701	4839	5173
10	795	1477	3484	2007
11	262	218	416	1360
12+	300	150	99	199
Total	613238	950471	1260558	2182183

Table 3.27 (Cont).

Stock numbers (thousands) at age by Jan. 1

Year	1987	1988	1989	1990	1991	1992	1993
Age							
3	458513	365858	248615	398435	567738	909312	1139230
4	904365	299825	250151	181031	291894	408829	627615
5	283473	593922	212532	179190	130605	205711	282498
6	155665	134984	362242	140487	126366	87029	136698
7	38074	59643	63162	213750	95573	82895	55480
8	14907	12631	23706	32225	141684	61276	52329
9	5564	4564	4457	10749	20800	89171	38106
10	2057	1611	1495	1796	6829	12888	54955
11	748	564	484	532	1092	4041	7587
12+	579	356	269	252	479	933	2972
Total	1863944	1473958	1167115	1158447	1383061	1862085	2397470

Stock numbers (thousands) at age by Jan. 1

Year	1994	1995	1996	1997	1998	1999	2000
Age							
3	1005670	596459	431394	677589	826284	430077	557226
4	731557	479158	280323	227774	420472	569085	315382
5	422298	462870	297453	178365	134337	257312	373313
6	181145	245450	263986	169357	84677	63566	131483
7	84022	96328	127052	127799	66179	31702	26744
8	32626	42726	45762	57103	42251	21744	11285
9	30400	15856	19299	19123	17334	12237	7007
10	22653	15001	6961	7780	5370	4733	3579
11	29806	10271	6065	2591	2003	1335	1268
12+	5780	16465	10785	6228	2188	1015	612
Total	2545957	1980584	1489079	1473711	1601096	1392808	1427899

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Spawning stock biomass (tons) at Jan. 1

Year	1983	1984
Age		
4	0	0
5	65927	20650
6	7677	74353
7	9726	36979
8	23101	44426
9	15210	50224
10	7910	11072
11	3014	2572
12+	3981	2196
SSB total	136546	242471

Spawning stock biomass (tons) at Jan. 1

Year	1985	1986	1987	1988	1989	1990	1991	1992
Age								
4	0	0	0	0	0	0	0	0
5	42708	58632	37763	20793	7864	31005	48466	80058
6	66289	74562	88404	50089	66210	63662	93249	123779
7	78773	70566	64945	66760	59098	227275	136637	169880
8	41733	51420	46832	33091	52115	84116	353494	195443
9	29419	24398	27021	19143	18295	46730	89580	401534
10	25050	13031	12026	9360	8663	11250	40174	80174
11	4070	10254	5847	3937	3701	4338	8364	31694
12+	1355	1917	5241	3308	2600	2646	4604	9074
SSB total	289396	304780	288078	206479	218547	471021	774568	1091635

Table 3.27 (Cont).

Spawning stock biomass (tons) at Jan. 1

Year / Age	1993	1994	1995	1996	1997	1998	1999	2000
4	0	0	0	0	0	0	0	0
5	68705	81336	62528	25233	14470	13790	18634	27879
6	126661	155234	160116	143828	63948	36118	23880	47532
7	134804	159152	172983	193798	180654	79329	35240	27740
8	164434	120518	130901	142533	158303	126978	49770	26324
9	167524	132837	79270	85795	87510	78948	52146	26581
10	310641	119450	82613	42340	45520	34113	26133	20462
11	56984	201456	71480	42710	20254	15875	9685	9068
12+	27142	48387	136996	94347	60134	23994	9750	5811
SSB total	1056894	1018369	896886	770584	630793	409144	225237	191398

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Total stock biomass (tons) at Jan. 1

Year / Age	1983	1984
3	99912	253308
4	143155	196182
5	166329	183667
6	125220	149257
7	127271	90514
8	147792	70107
9	34110	66653
10	7910	12496
11	3014	2572
12+	3981	2196
Total	858693	1026950

Total stock biomass (tons) at Jan. 1

Year / Age	1985	1986	1987	1988	1989	1990	1991	1992
3	369958	519575	143222	93644	110752	267566	459082	676878
4	474555	459321	511596	156350	152091	240143	373856	583582
5	262859	461899	376110	554299	214746	289852	276453	433784
6	181342	198998	312934	234210	560284	306094	310511	278549
7	112842	115325	113932	150234	160028	613415	297528	300942
8	56706	60530	59657	45654	83980	130757	550868	271754
9	32525	27149	28914	21536	21622	56298	106367	474011
10	26757	13464	12495	9666	9163	11975	42776	85160
11	4070	10254	5847	3937	3701	4338	8364	31694
12+	1355	1917	5241	3308	2600	2646	4604	9074
Total	1522969	1868432	1569948	1272837	1318967	1923084	2430408	3145428

Total stock biomass (tons) at Jan. 1

Year / Age	1993	1994	1995	1996	1997	1998	1999	2000
3	509379	287332	162259	110778	148133	200005	100239	126779
4	621133	685738	349259	197081	154825	283478	342930	211088
5	507977	692540	694850	372455	221170	168990	299690	437234
6	346964	461561	545805	560239	316930	166809	114569	242911
7	208000	279870	308066	379151	373655	185315	83982	68766
8	220790	148544	173429	189195	222078	176240	76845	40519
9	194202	152104	86295	97657	98911	91286	59776	32148
10	332318	131096	88923	44740	48189	35951	27810	21616
11	56984	201456	71480	42710	20254	15875	9685	9068
12+	27142	48387	136996	94347	60134	23994	9750	5811
Total	3024890	3088628	2617361	2088353	1664278	1347942	1125273	1195941

Table 3.27 (Cont).

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Weight (kg) in catch (Observed)

Year	1983	1985	1986	1987	1988	1989	1990
Age							
1	0.02	0.12	0.09	0.09	0.07	0.05	0.16
2	0.45	0.33	0.31	0.24	0.32	0.51	0.44
3	0.84	0.94	0.64	0.51	0.54	0.74	0.83
4	1.37	1.37	1.27	0.88	0.86	0.96	1.22
5	2.08	2.01	1.87	1.55	1.31	1.32	1.65
6	2.86	3.21	2.79	2.32	2.23	1.91	2.23
7	3.99	4.63	4.49	3.43	3.52	2.93	3.23
8	5.58	6.04	5.84	5.92	5.34	4.63	4.67
9	7.76	7.65	6.83	8.59	8.04	7.51	7.30
10	9.30	9.81	7.68	9.60	9.28	9.12	9.84
11	11.55	11.80	9.81	12.20	11.46	11.08	13.25
12+	16.46	14.08	11.17	13.61	15.42	14.95	14.21

Weight (kg) in catch (Observed)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	1997–1999
Age										
1	0.12	0.06	0.14	0.04	0.11	0.08	0.10	0.12	0.06	0.09
2	0.48	0.54	0.49	0.41	0.40	0.31	0.33	0.35	0.33	0.34
3	1.05	1.17	0.80	0.84	0.81	0.82	0.71	0.69	0.64	0.68
4	1.45	1.57	1.50	1.30	1.25	1.13	1.06	1.06	1.03	1.05
5	2.16	2.22	2.16	2.00	1.79	1.63	1.54	1.61	1.49	1.55
6	2.89	3.11	2.80	2.86	2.57	2.45	2.22	2.28	2.26	2.25
7	3.74	4.26	4.16	3.21	3.78	3.83	3.41	3.28	3.18	3.29
8	4.71	5.18	5.55	5.27	4.94	5.81	5.29	4.85	4.30	4.82
9	6.07	6.13	6.48	6.86	6.14	6.85	7.32	6.89	6.01	6.74
10	8.80	7.77	7.19	7.60	8.02	8.10	7.83	9.44	6.80	8.03
11	11.80	10.11	7.99	8.05	8.82	9.51	8.62	10.63	10.83	10.03
12+	16.61	11.81	11.36	10.02	9.61	11.12	11.42	15.19	14.46	13.69

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stocks cod.imm cod.mat
areas 0

Weight (kg) in catch (Model)

Year	1983	1985	1986	1987	1988	1989	1990
Age							
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	0.83	1.11	0.61	0.48	0.62	1.02	1.28
4	1.37	1.57	1.43	0.90	0.95	1.22	1.86
5	2.05	2.41	1.95	1.64	1.35	1.54	2.13
6	2.81	3.28	2.83	2.23	2.13	2.02	2.64
7	4.11	4.35	3.73	3.19	2.87	2.97	3.33
8	5.48	5.20	4.78	4.22	3.97	3.89	4.48
9	8.41	6.73	5.53	5.46	5.10	5.08	5.53
10	10.87	7.65	6.96	6.38	6.40	6.18	6.76
11	12.74	9.47	7.74	8.19	7.42	7.45	7.95
12+	14.91	12.55	9.17	9.44	9.79	8.99	9.64

Table 3.27 (Cont).

Weight (kg) in catch (Model)

Year Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	1997–1999
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	1.40	1.19	0.84	0.68	0.68	0.80	0.69	0.70	0.62	0.67
4	1.91	1.83	1.55	1.30	1.18	1.16	1.27	1.19	1.09	1.18
5	2.70	2.46	2.25	1.95	1.84	1.66	1.71	1.73	1.58	1.67
6	3.06	3.49	2.95	2.76	2.65	2.53	2.34	2.36	2.24	2.31
7	3.74	3.92	4.11	3.56	3.70	3.47	3.43	3.18	3.13	3.25
8	4.55	4.72	4.57	4.85	4.61	4.69	4.44	4.54	4.14	4.37
9	5.77	5.59	5.40	5.33	5.99	5.69	5.71	5.61	5.63	5.65
10	6.81	6.84	6.28	6.17	6.46	7.14	6.71	6.97	6.71	6.80
11	7.96	7.98	7.61	7.20	7.45	7.77	8.27	8.13	8.17	8.19
12+	9.23	9.45	9.06	8.92	8.75	9.39	9.87	10.93	10.26	10.35

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stocks cod.imm cod.mat
areas 0

Weight (kg) in stock at Jan. 1

Year Age	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.39	0.46	0.61	0.39	0.31	0.26	0.45	0.67	0.81
4	0.96	1.02	1.15	1.03	0.57	0.52	0.61	1.33	1.28
5	1.78	1.74	2.03	1.64	1.33	0.93	1.01	1.62	2.12
6	2.53	2.68	2.96	2.53	2.01	1.74	1.55	2.18	2.46
7	3.92	3.49	4.11	3.43	2.99	2.52	2.53	2.87	3.11
8	5.09	5.10	5.01	4.49	4.00	3.61	3.54	4.06	3.89
9	7.44	6.23	6.72	5.25	5.20	4.72	4.85	5.24	5.11
10	9.95	8.46	7.68	6.71	6.07	6.00	6.13	6.67	6.26
11	11.50	11.80	9.78	7.54	7.82	6.98	7.65	8.15	7.66
12+	13.27	14.64	13.69	9.64	9.05	9.29	9.67	10.50	9.61

Weight (kg) in stock at Jan. 1

Year Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	1997–1999
3	0.74	0.45	0.29	0.27	0.26	0.22	0.24	0.23	0.23	0.23
4	1.43	0.99	0.94	0.73	0.70	0.68	0.67	0.60	0.67	0.65
5	2.11	1.80	1.64	1.50	1.25	1.24	1.26	1.16	1.17	1.22
6	3.20	2.54	2.55	2.22	2.12	1.87	1.97	1.80	1.85	1.88
7	3.63	3.75	3.33	3.20	2.98	2.92	2.80	2.65	2.57	2.79
8	4.43	4.22	4.55	4.06	4.13	3.89	4.17	3.53	3.59	3.86
9	5.32	5.10	5.00	5.44	5.06	5.17	5.27	4.88	4.59	5.11
10	6.61	6.05	5.79	5.93	6.43	6.19	6.69	5.88	6.04	6.25
11	7.84	7.51	6.76	6.96	7.04	7.82	7.93	7.25	7.15	7.67
12+	9.73	9.13	8.37	8.32	8.75	9.66	10.97	9.61	9.50	10.08

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Proportion mature at age

Year Age	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.396	0.112	0.162	0.127	0.100	0.038	0.037	0.107	0.175
6	0.061	0.498	0.366	0.375	0.282	0.214	0.118	0.208	0.300
7	0.076	0.409	0.698	0.612	0.570	0.444	0.369	0.371	0.459
8	0.156	0.634	0.736	0.849	0.785	0.725	0.621	0.643	0.642
9	0.446	0.754	0.905	0.899	0.935	0.889	0.846	0.830	0.842
10	1.000	0.886	0.936	0.968	0.962	0.968	0.945	0.939	0.939
11	1.000	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	1.000

Table 3.27 (Cont).

Proportion mature at age

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	1998–2000
Age										
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	0.185	0.135	0.117	0.090	0.068	0.065	0.082	0.062	0.064	0.0693
6	0.444	0.365	0.336	0.293	0.257	0.202	0.217	0.208	0.196	0.2070
7	0.564	0.648	0.569	0.562	0.511	0.483	0.428	0.420	0.403	0.4170
8	0.719	0.745	0.811	0.755	0.753	0.713	0.720	0.648	0.650	0.6727
9	0.847	0.863	0.873	0.919	0.879	0.885	0.865	0.872	0.827	0.8547
10	0.941	0.935	0.911	0.929	0.946	0.945	0.949	0.940	0.947	0.9453
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

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stocks cod.imm cod.mat
areas 0
fleets danish_seineD.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	1991
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	7818	34989	37941	13256	9032	11691	11366	22574
4	15872	52655	77238	117803	26194	20371	12996	21096
5	20193	27178	75418	95521	121537	32276	15354	13944
6	14539	16733	26601	67146	47232	81000	14905	14590
7	13279	9293	12833	18507	25255	19401	26009	12357
8	13938	4317	5670	7705	6001	8819	4508	20153
9	2462	2125	2273	3007	2324	1945	1651	3291
10	471	1562	924	1132	861	718	294	1153
11	156	189	630	419	307	247	90	192
12+	179	46	92	324	197	140	43	85
Total	88906	149087	239621	324821	238939	176608	87217	109435

Model catch in numbers (thousands) at age

Year	1992	1993	1994	1995	1996	1997	1998	1999
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	29098	27974	15854	9600	10001	21458	29408	13561
4	32482	57107	86647	44451	31834	40348	77259	83985
5	21503	43082	83414	101955	68988	60434	45995	79584
6	11095	24587	45153	67164	85582	72323	37694	25496
7	11065	11499	22858	30641	45848	62686	32641	14837
8	8782	11255	9674	14733	18186	29898	22816	11025
9	13543	8684	9215	5966	8086	10638	9773	6709
10	2064	13090	7080	5754	3067	4454	3136	2674
11	665	1878	9537	4063	2711	1520	1188	772
12+	155	748	1874	6613	4894	3677	1308	592
Total	130451	199904	291307	290941	279198	307435	261217	239234

Table 3.27 (Cont).

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stocks cod.imm cod.mat
areas 0
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	1991
Age								
1	382	92	33	14	3	2	5	16
2	475	1504	816	310	171	232	111	369
3	5275	19827	24601	10451	9320	4905	1318	3498
4	14129	41156	59095	117702	19556	15829	5815	8518
5	18164	24947	71522	84258	117466	28910	9871	12313
6	14398	16756	23485	57247	48956	66518	13789	15180
7	12598	10562	10443	13079	19909	24998	23675	14196
8	13092	3509	3796	3576	3153	5194	5160	18101
9	2148	1437	890	872	1163	795	607	2706
10	580	713	696	450	384	275	127	270
11	227	132	517	184	105	41	49	36
12+	91	97	206	308	128	40	20	14
Total	81559	120732	196100	288451	220314	147739	60547	75217

Observed catch in numbers (thousands) at age

Year	1992	1993	1994	1995	1996	1997	1998	1999
Age								
1	91	9	22	8	175	78	92	21
2	771	306	167	208	728	664	1453	296
3	14281	7684	5560	4744	7029	10454	28163	8086
4	22808	37104	49637	35103	25578	32825	78276	72596
5	18690	54335	79313	95626	70977	63737	42661	81445
6	17119	28253	50250	79442	87255	75833	35607	27626
7	12909	11530	28783	28300	46093	60404	29470	13875
8	9545	7452	7686	6796	8735	22662	23807	14380
9	12829	5190	4522	2499	1797	3198	6147	7971
10	1766	9814	2497	1441	817	817	886	1815
11	194	1302	5466	811	362	355	172	203
12+	49	299	853	1871	844	413	136	91
Total	111052	163278	234756	256849	250390	271440	246870	228405

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Model catch in biomass (tons) at age

Year	1983	1985	1986	1987	1988	1989	1990	1991
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	6497	38837	23110	6299	5619	11893	14531	31628
4	21791	82511	110753	106252	24806	24873	24133	40365
5	41404	65375	147173	156912	164438	49863	32738	37621
6	40880	54857	75169	149548	100819	163575	39418	44624
7	54577	40437	47900	59010	72430	57580	86576	46192
8	76399	22440	27084	32522	23835	34318	20197	91673
9	20698	14314	12576	16414	11839	9878	9136	18978
10	5119	11955	6433	7218	5513	4436	1989	7850
11	1987	1789	4882	3432	2279	1838	717	1524
12+	2665	576	846	3062	1927	1262	417	787
Total	272016	333090	455926	540668	413505	359515	229852	321242
Total+	303702	368538	505053	611542	463465	412890	328179	488290

(++ Also includes: overfish thirdcountries)

Table 3.27 (Cont).

Model catch in biomass (tons) at age

Year	1992	1993	1994	1995	1996	1997	1998	1999
Age								
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	34635	23510	10843	6494	7984	14847	20456	8451
4	59567	88798	113038	52352	36938	51377	91590	91351
5	52936	96782	162922	187796	114805	103154	79733	126020
6	38735	72465	124695	177712	216146	168962	88816	57200
7	43423	47230	81281	113401	158983	215192	103837	46491
8	41449	51398	46879	67943	85368	132630	103475	45592
9	75749	46864	49156	35726	46044	60772	54793	37756
10	14119	82212	43701	37193	21893	29899	21849	17940
11	5308	14293	68716	30282	21054	12563	9660	6306
12+	1467	6778	16716	57875	45950	36278	14294	6072
Total	367387	530329	717948	766773	755165	825672	588502	443178
Total+	573929	658647	913589	926324	867432	916632	649126	489565

(++ Also includes: overfish thirdcountries)

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stocks cod.imm cod.mat
areas 0
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	1991
Age								
1	8	11	3	1	0	0	1	2
2	214	498	250	75	54	118	49	178
3	4457	18541	15729	5303	5068	3654	1094	3663
4	19398	56430	74809	103615	16787	15245	7117	12312
5	37870	50216	134094	130619	154429	38035	16335	26586
6	41142	53841	65500	132881	109296	127317	30725	43831
7	50245	48881	46853	44903	70054	73174	76473	53104
8	72992	21189	22168	21173	16824	24028	24108	85331
9	16675	10999	6080	7493	9352	5968	4431	16431
10	5395	6991	5346	4320	3565	2507	1249	2377
11	2621	1557	5071	2245	1203	454	649	425
12+	1498	1366	2301	4193	1974	598	284	232
Total	252514	270521	378203	456821	388606	291097	162514	244473
Total+	285531	304887	425679	509575	430768	330301	211168	317978

(++ Also includes: overfish thirdcountries)

Observed catch in biomass (tons) at age

Year	1992	1993	1994	1995	1996	1997	1998	1999
Age								
1	5	1	1	1	14	8	11	1
2	420	151	68	83	229	219	508	99
3	16698	6169	4687	3828	5735	7437	19474	5211
4	35829	55751	64423	43838	28884	34792	82714	74652
5	41519	117097	158367	171270	115499	98445	68716	121180
6	53169	79208	143844	204440	213474	168154	81289	62357
7	54966	47910	92517	106962	176528	205811	96598	44146
8	49414	41384	40470	33573	50792	119901	115574	61880
9	78612	33656	31016	15353	12315	23400	42378	47875
10	13728	70541	18989	11563	6620	6401	8364	12342
11	1961	10407	44007	7156	3441	3062	1828	2199
12+	579	3397	8550	17989	9383	4717	2065	1316
Total	346898	465673	606939	616056	622914	672345	519519	433258
Total+	509357	581373	767705	739910	730667	763579	583381	483107

(++ Also includes: overfish thirdcountries)

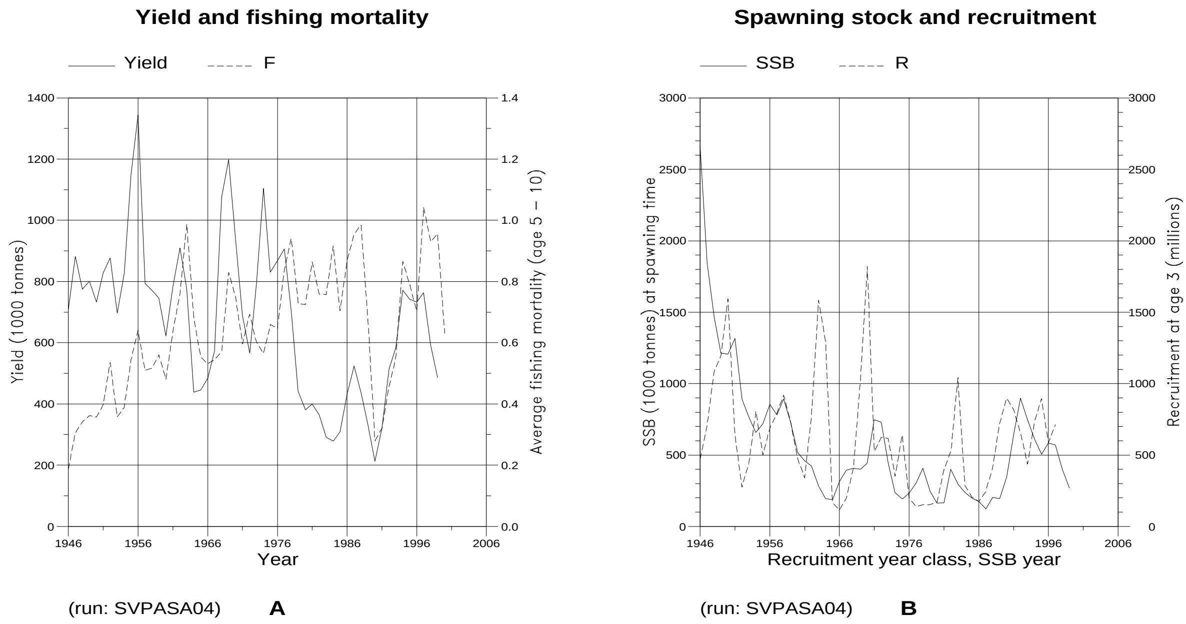


Figure 3.1 a,b Yield and fishing mortality (full time series)

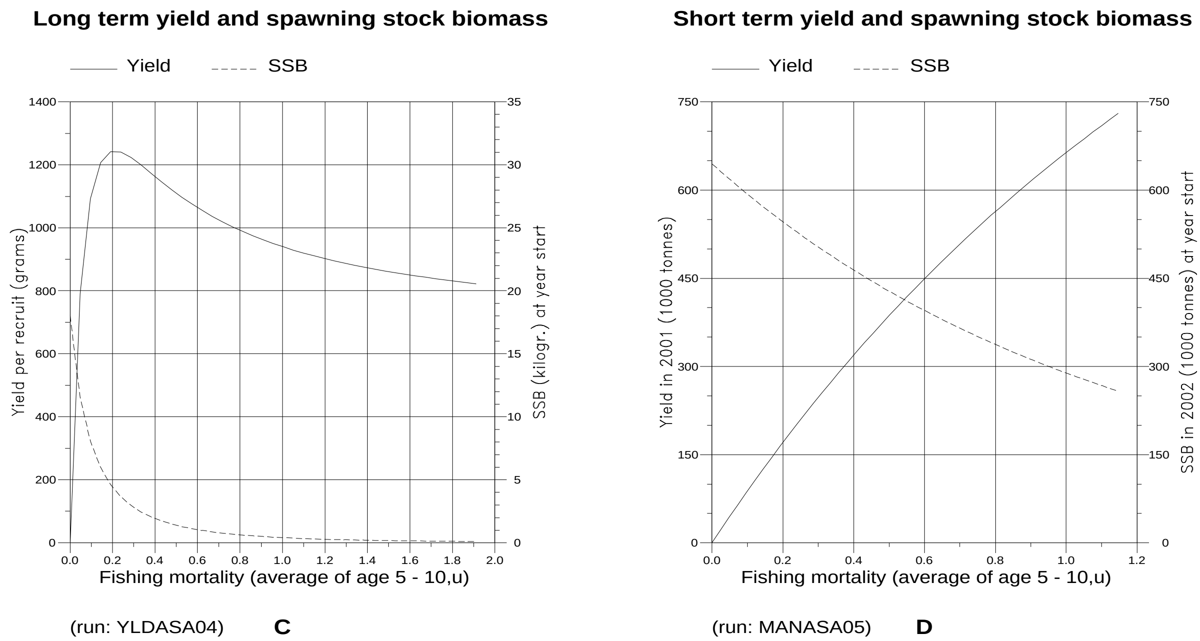


Figure 3.1 c,d Spawning stock and recruitment (full time series)

Figure 3.2: Time series of the liver condition index for five 10-cm length classes of cod sampled in the southern Barents Sea. Values shown are the annual means estimated by average monthly values for January through December.

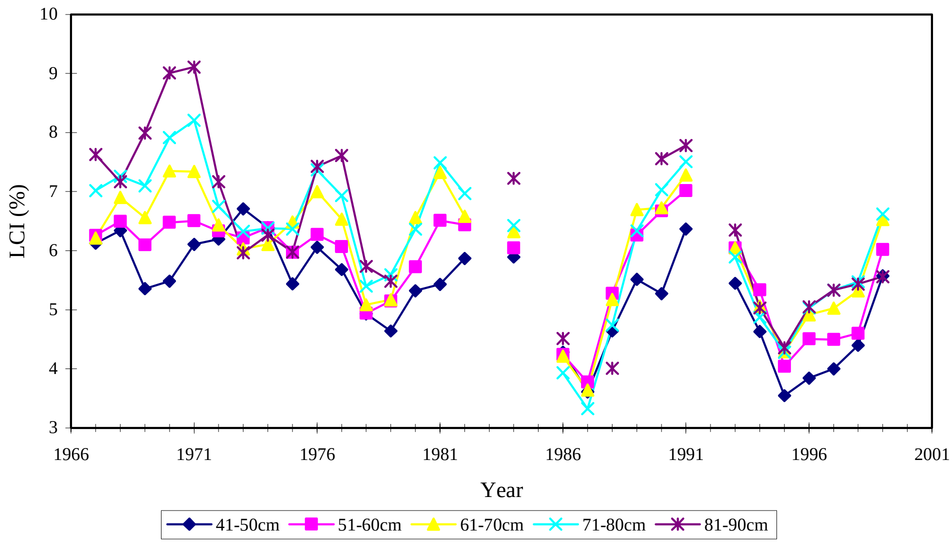
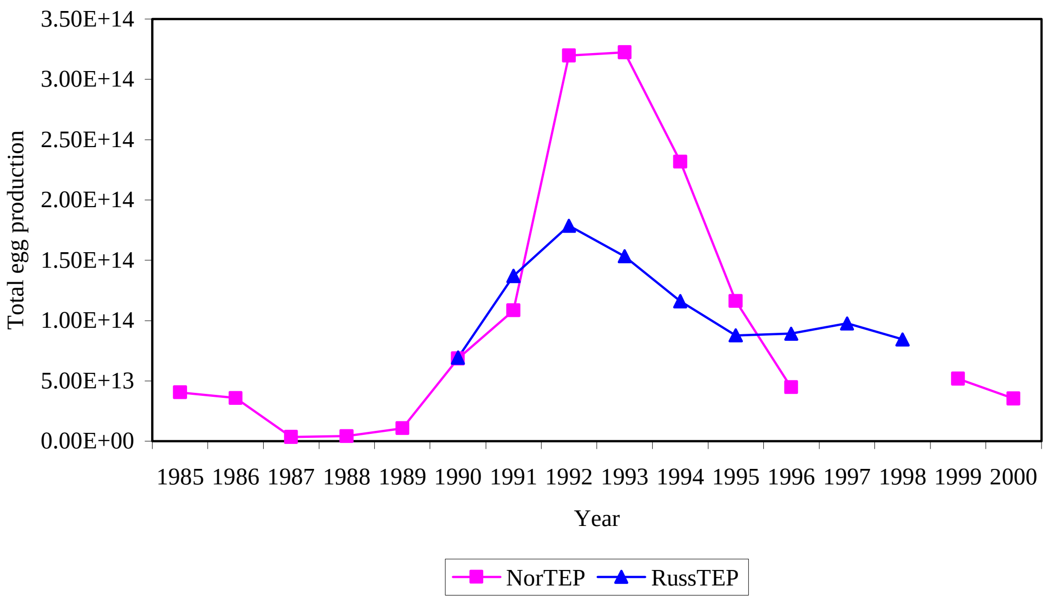
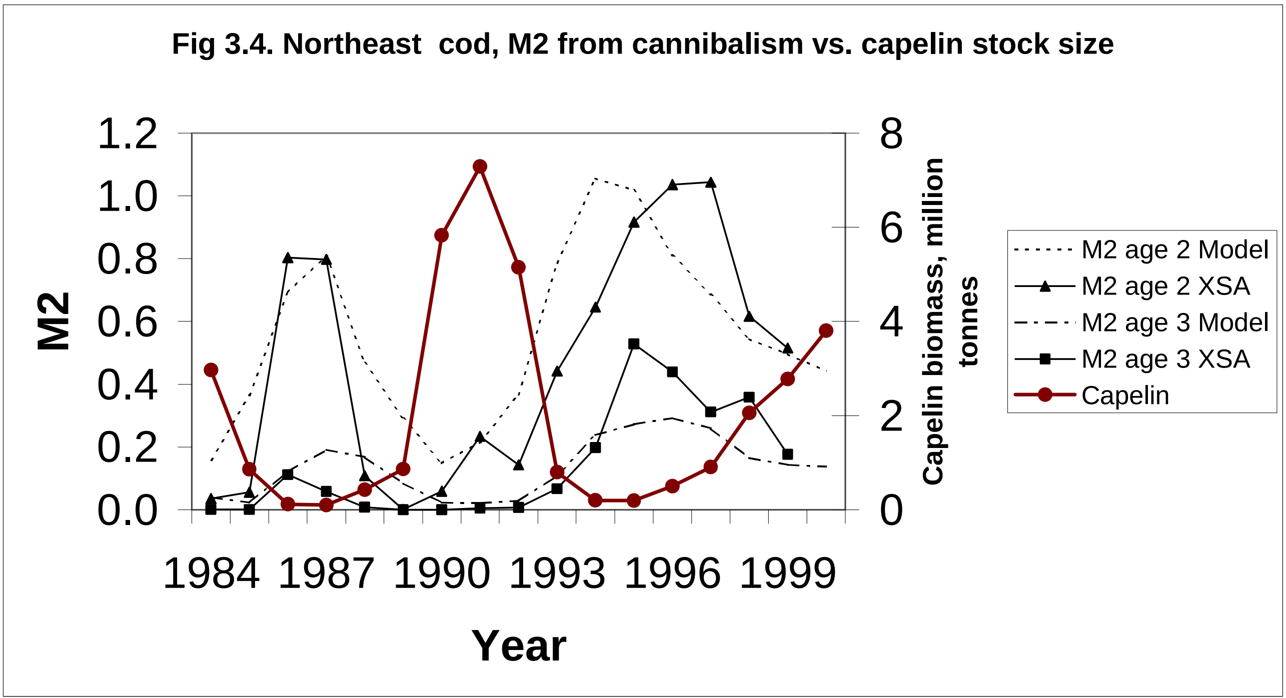


Figure 3.3: Survey-based estimates of total egg production from Norwegian sources (squares). For comparison, the values presented at the May meeting in Bergen (Kiseleva WD May 2000), which were calculated from VPA estimates of abundance at age and used constant values for fecundity at age, are also shown (triangles)





Stock - Recruitment

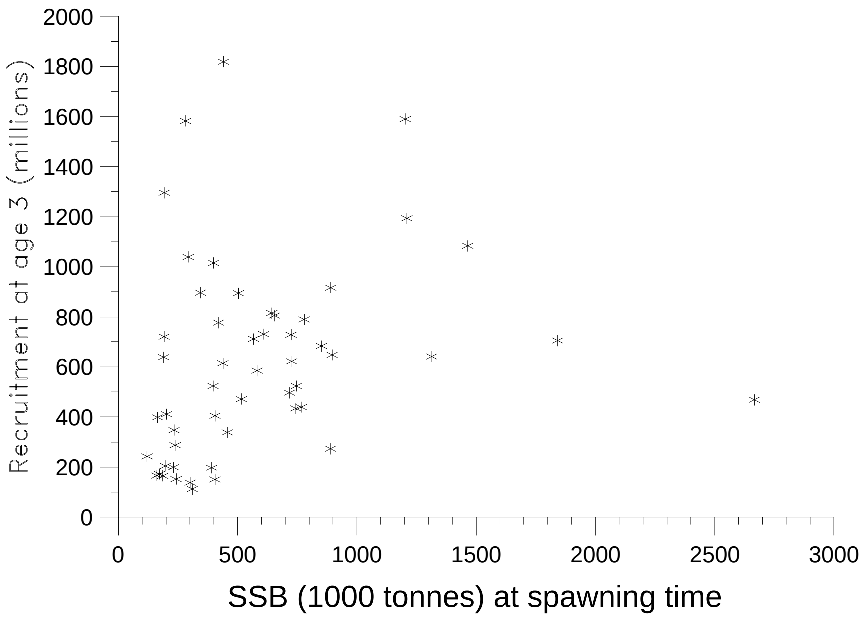


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Figure 3.5 Stock Recruitment Plot

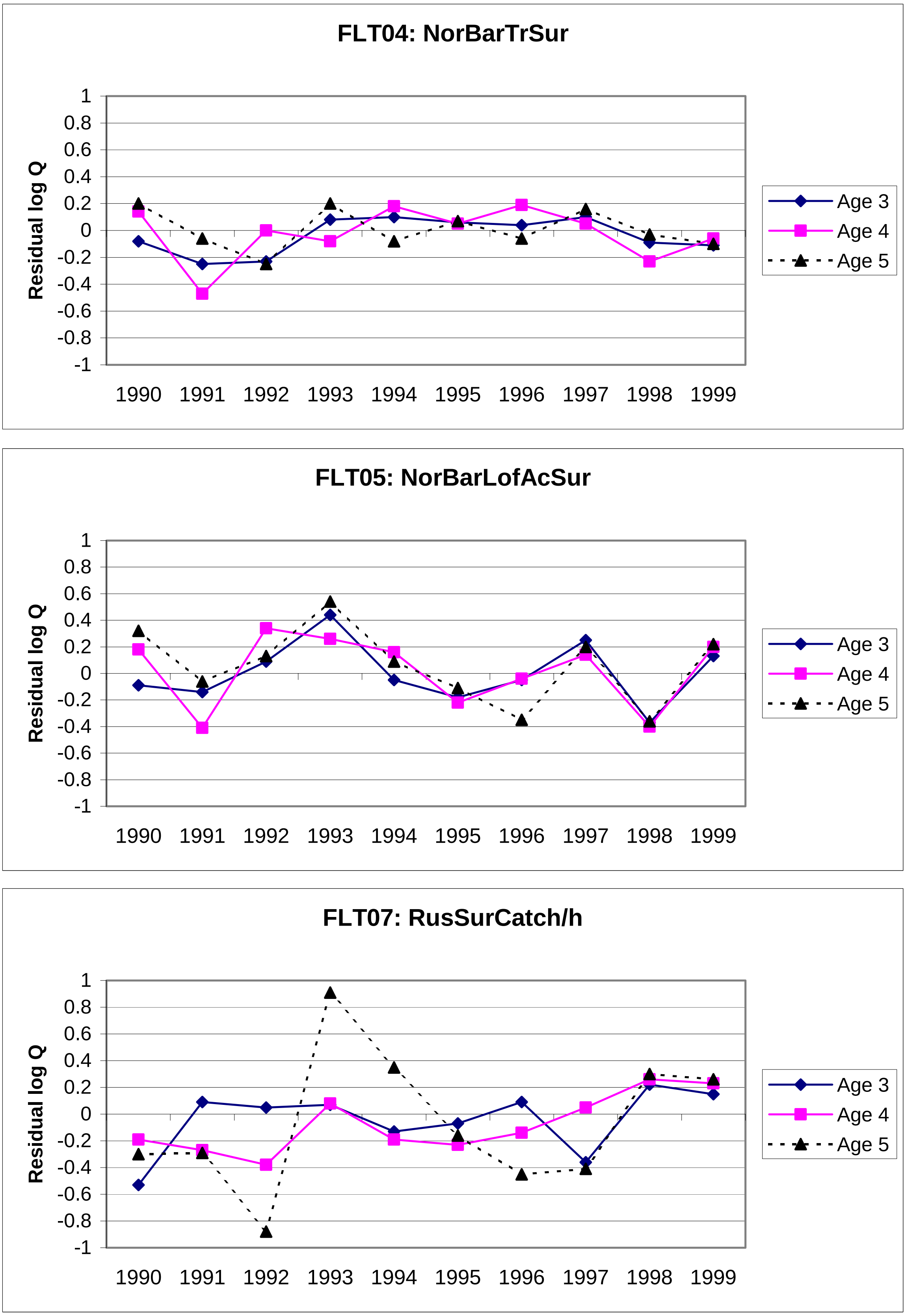
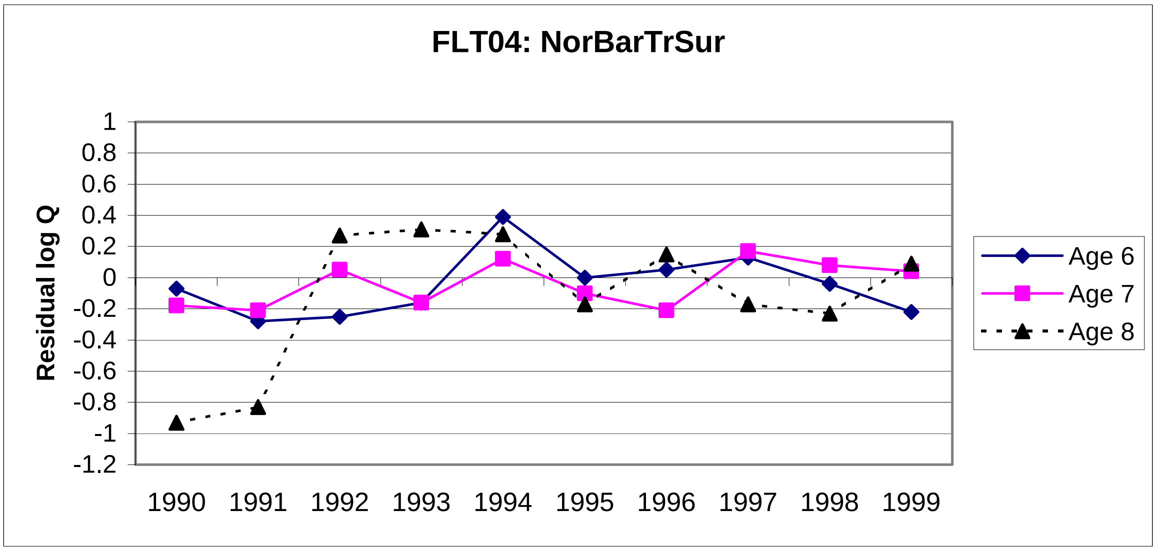
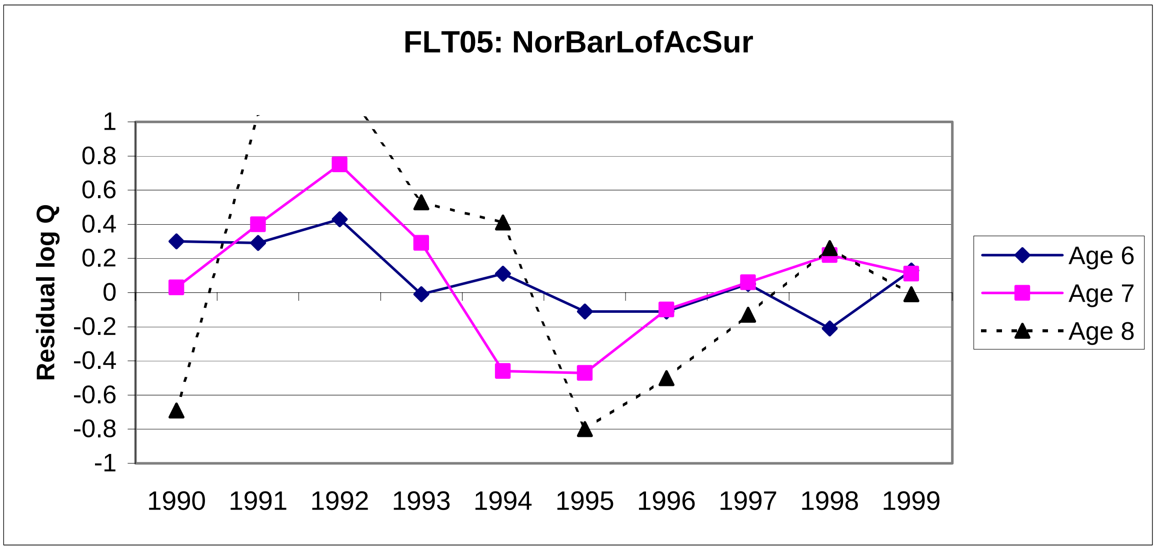


Figure 3.6a Nort-East Arctic cod. Residual log catchability by fleet and age from the XSA output in the 2000 assessment.





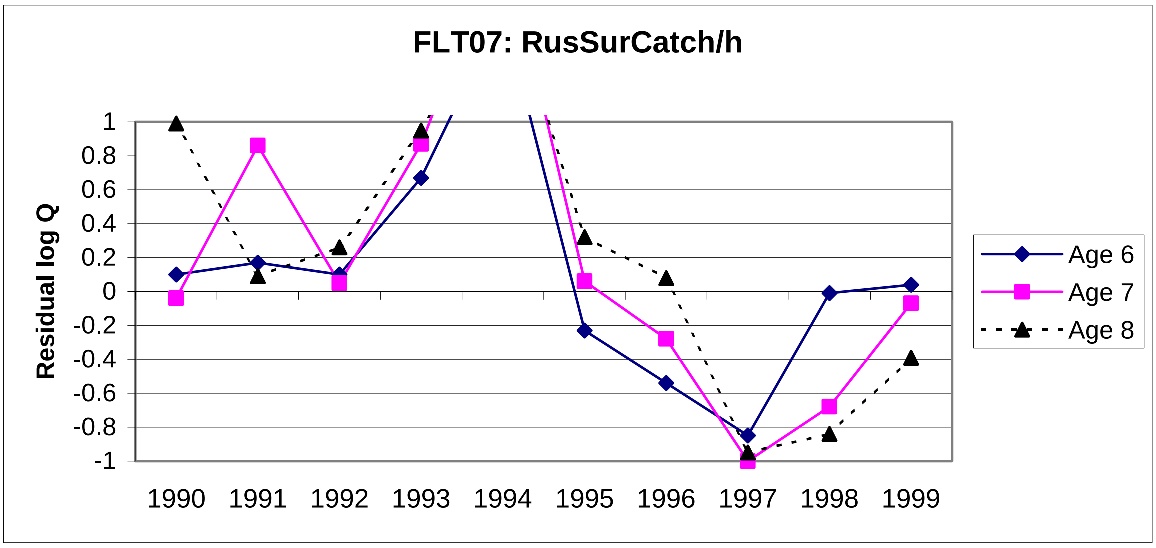


Figure 3.6b Nort-East Arctic cod. Residual log catchability by fleet and age from the XSA output in the 2000 assessment.

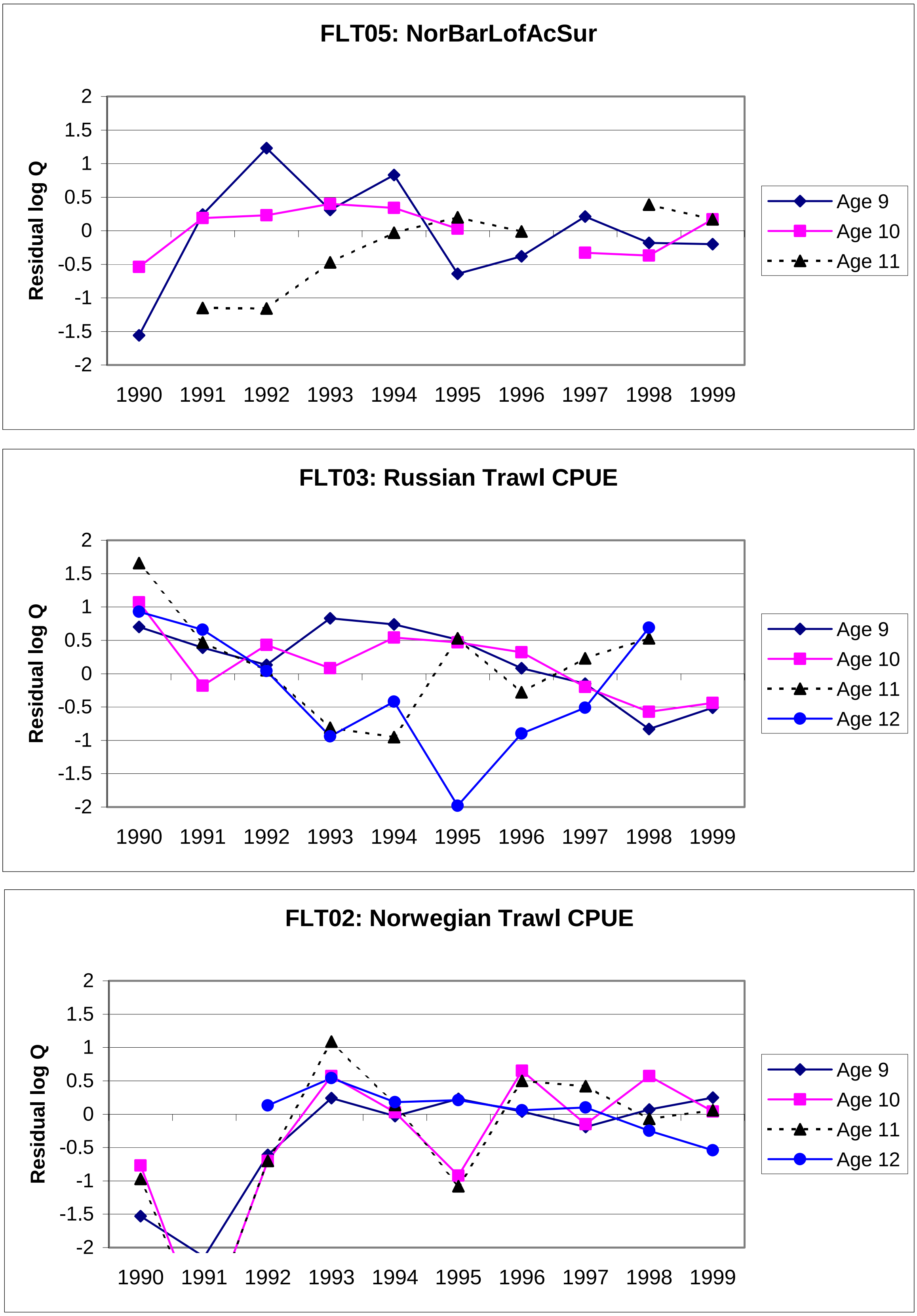


Figure 3.6c Nort-East Arctic cod. Residual log catchability by fleet and age from the XSA output in the 2000 assessment.

Figure 3.7. NEA Cod, retrospective F

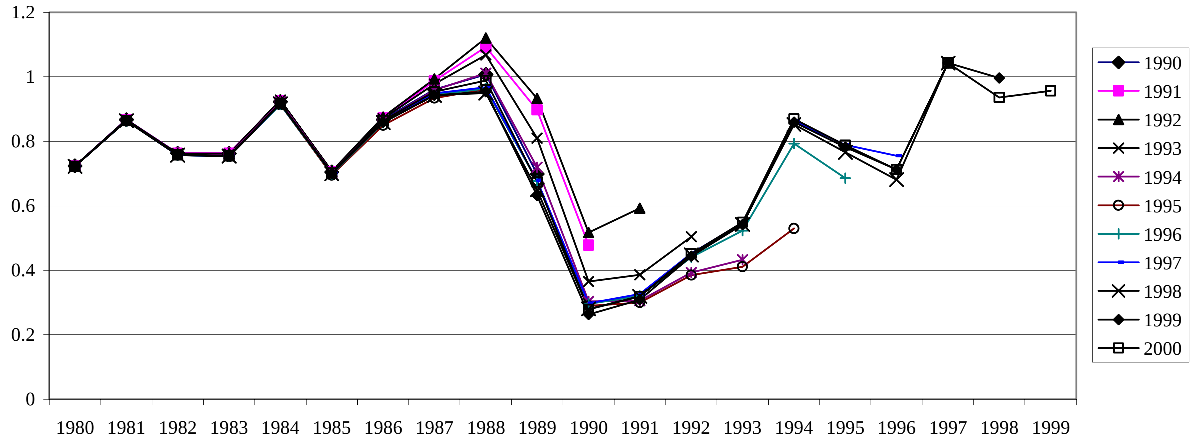


Figure 3.8. NEA Cod, retrospective SSB

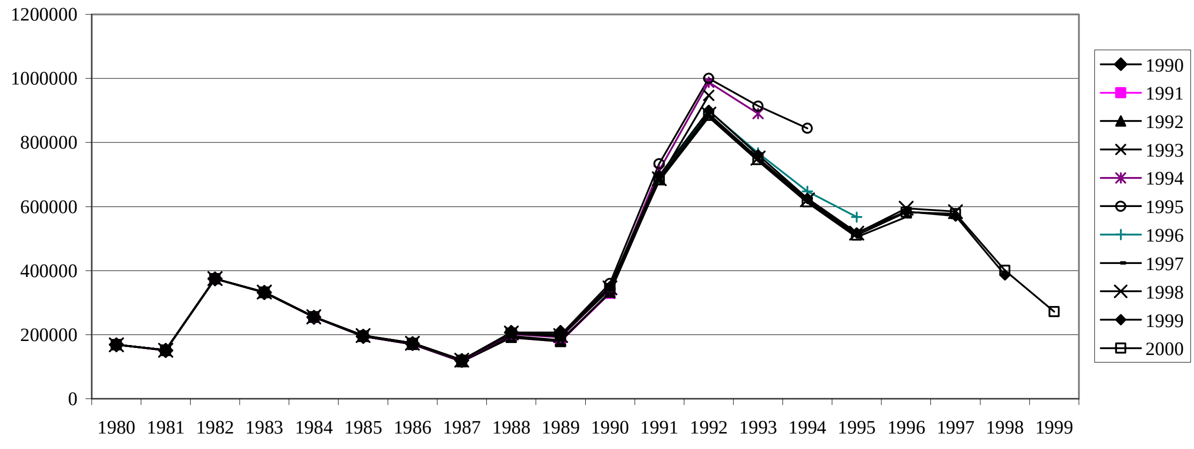


Figure 3.9. NEA Cod, retrospective recruitement age 3

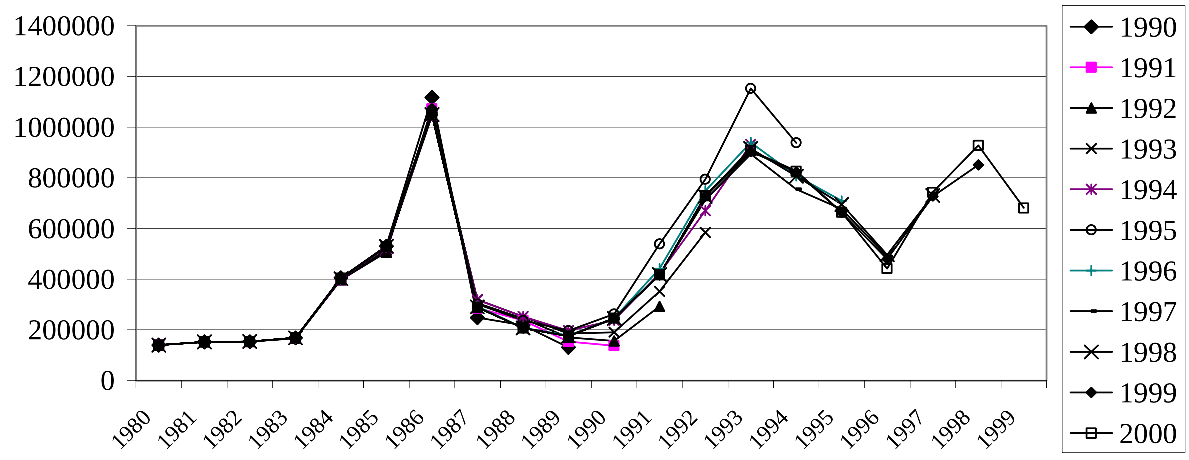
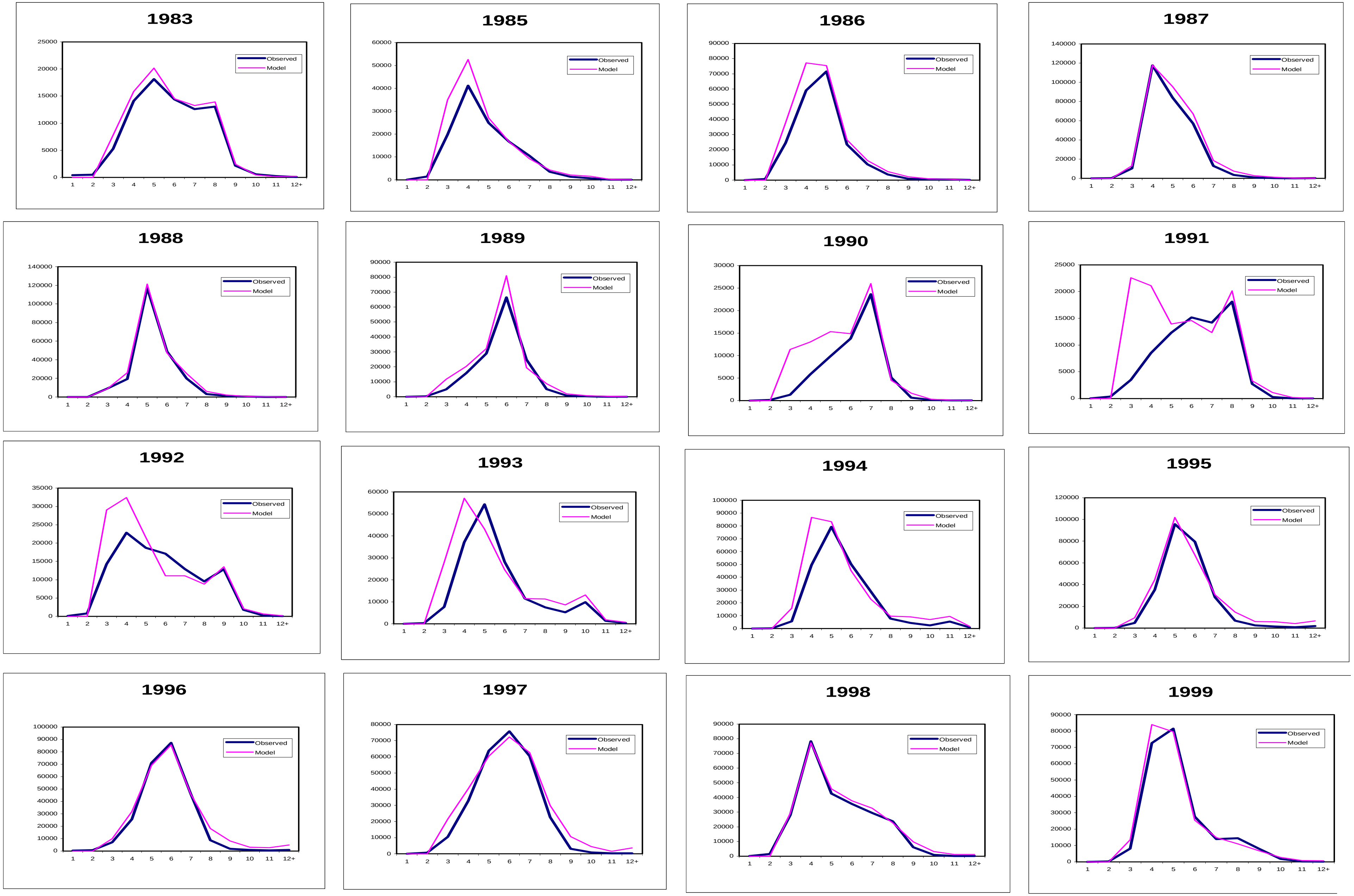


Figure 3.10 Observed catch at age vs. results from Fleksibest key run



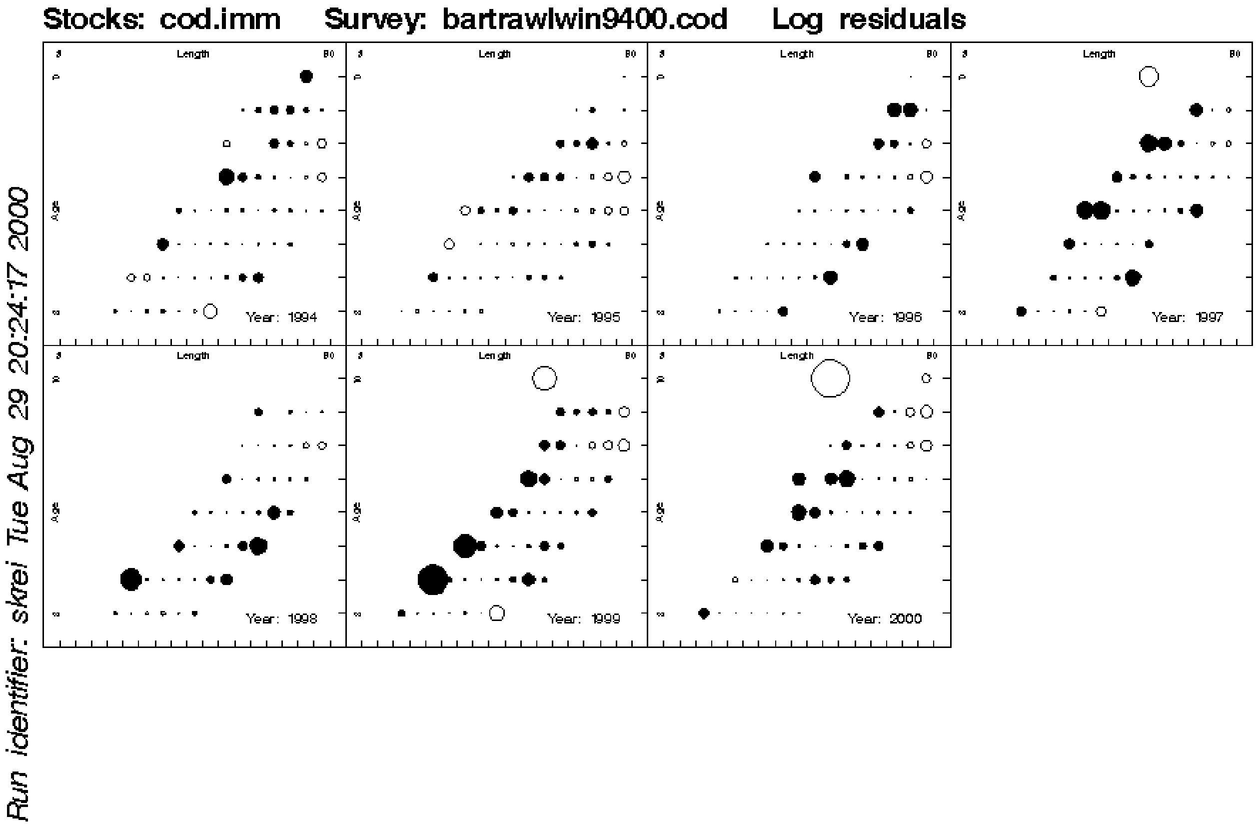


Figure 3.11 Sample residual plot from fleksibest.

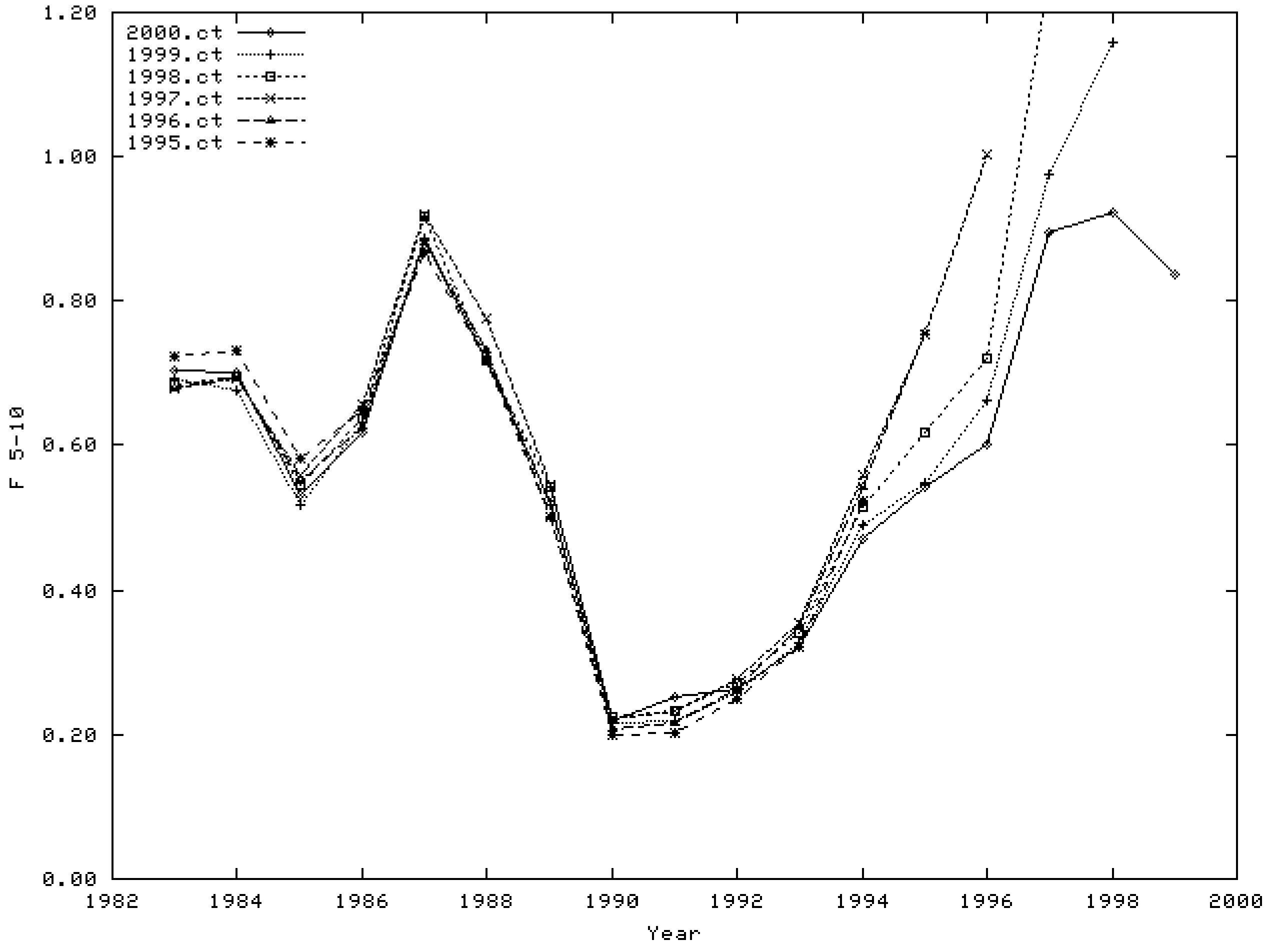


Figure 3.12.a F values – retrospective analysis with fleksibest.

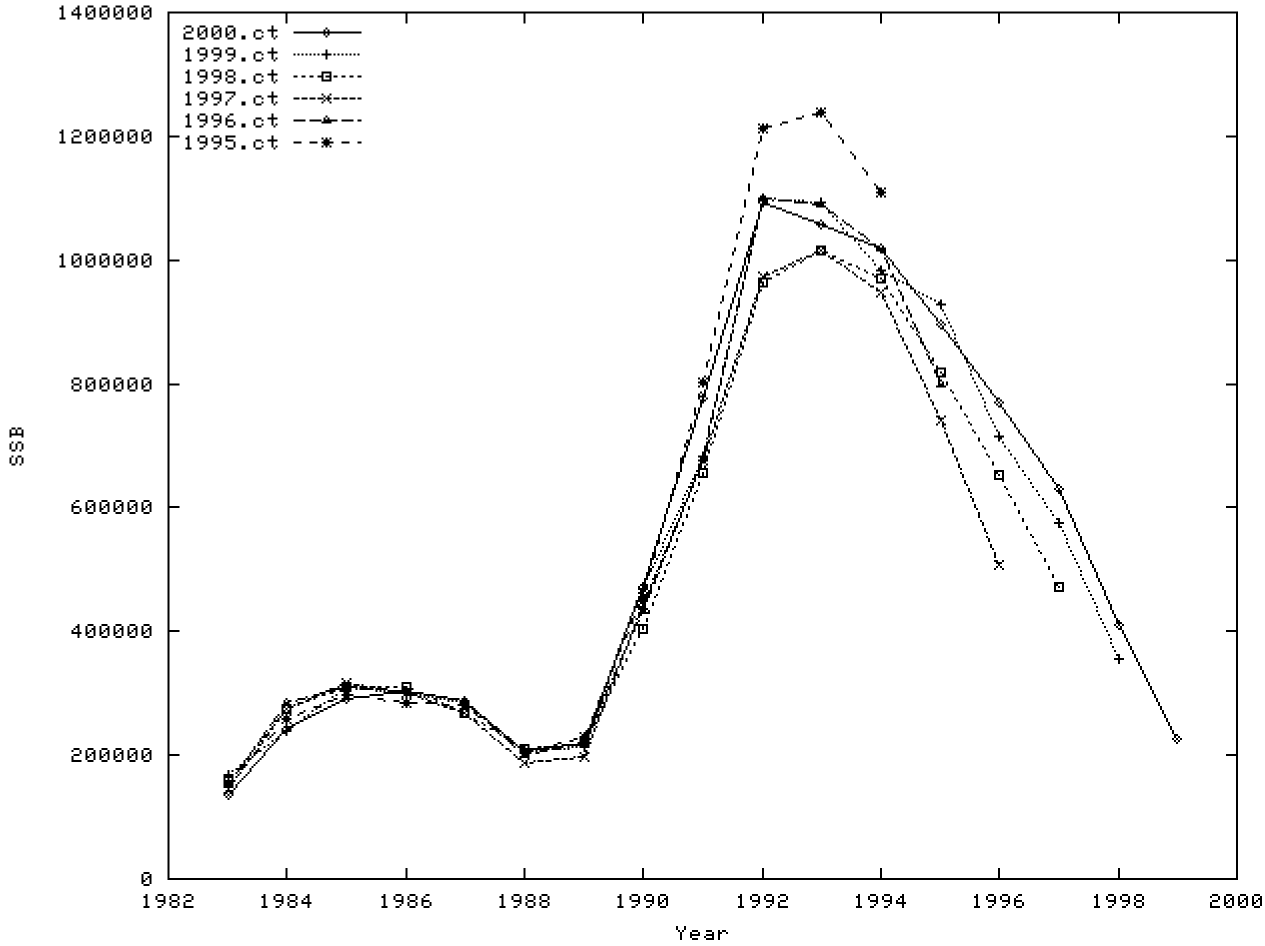


Figure 3.12b SSB values – retrospective analysis using fleksibest.

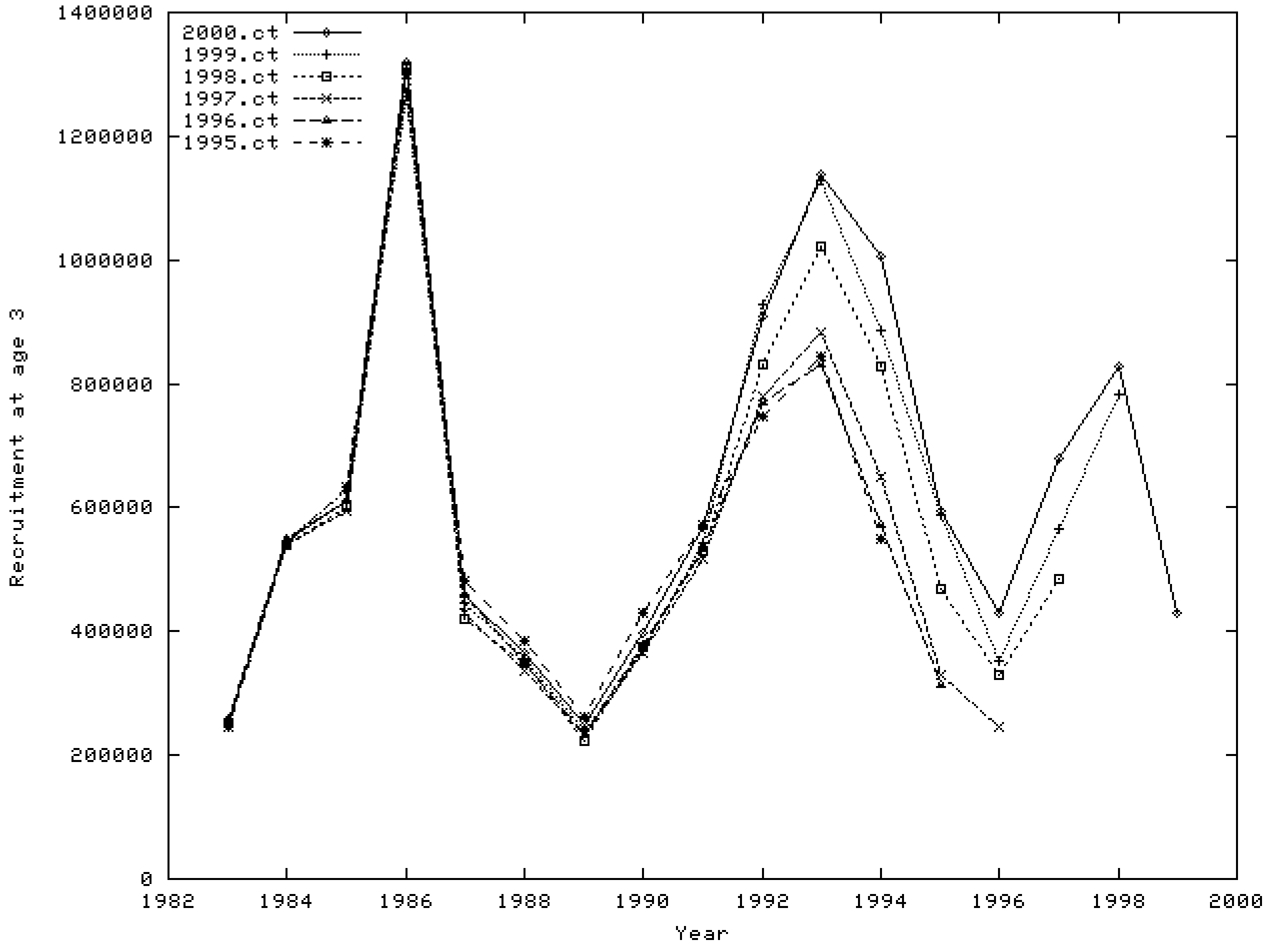


Figure 3.12c Recruitment – retrospective analysis using Fleksibest.

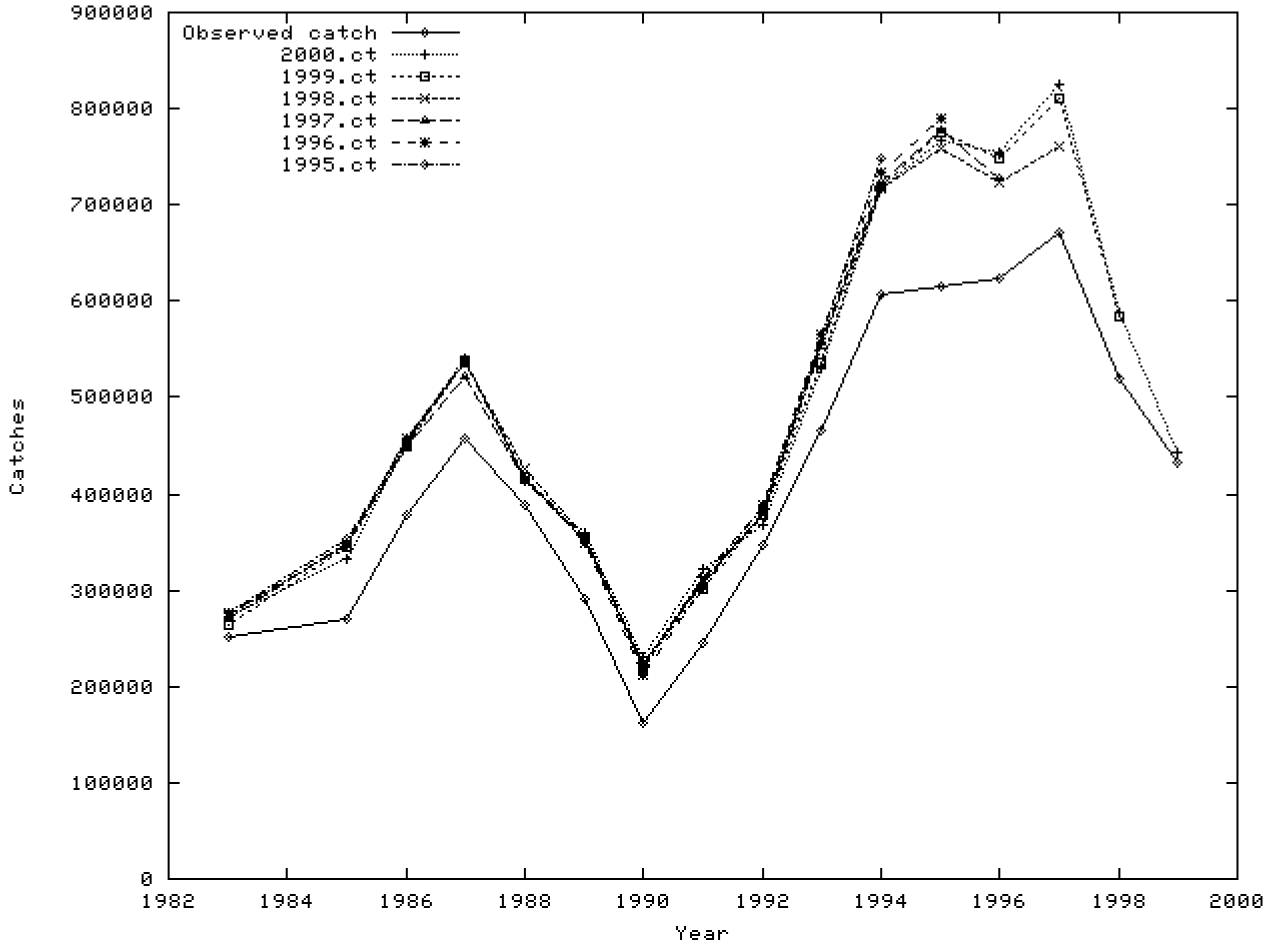


Figure 3.12d Catch values – retrospective analysis using fleksibest.

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

	Sub-area I			Division IIb			Division IIa		
Year	Norway[2]	UK[3]	Russia[4]	Norway[2]	UK[3]	Russia[4]	Norway[2]	UK[3]	Norway[5]
1960	-	0.075	0.42	-	0.105	0.31	-	0.067	3.0
1961	-	0.079	0.38	-	0.129	0.44	-	0.058	3.7
1962	-	0.092	0.59	-	0.133	0.74	-	0.066	4.0
1963	-	0.085	0.60	-	0.098	0.55	-	0.066	3.1
1964	-	0.056	0.37	-	0.092	0.39	-	0.070	4.8
1965	-	0.066	0.39	-	0.109	0.49	-	0.066	2.9
1966	-	0.074	0.42	-	0.078	0.19	-	0.067	4.0
1967	-	0.081	0.53	-	0.106	0.87	-	0.052	3.5
1968	-	0.110	1.09	-	0.173	1.21	-	0.056	5.1
1969	-	0.113	1.00	-	0.135	1.17	-	0.094	5.9
1970	-	0.100	0.80	-	0.100	0.80	-	0.066	6.4
1971	-	0.056	0.43	-	0.071	0.16	-	0.062	10.6
1972	0.90	0.047	0.34	0.59	0.051	0.18	1.08	0.055	11.5
1973	1.05	0.057	0.56	0.43	0.054	0.57	0.71	0.043	6.8
1974	1.75	0.079	0.86	1.94	0.106	0.77	0.19	0.028	3.4
1975	1.82	0.077	0.94	1.67	0.100	0.43	1.36	0.033	3.4
1976	1.69	0.060	0.84	1.20	0.081	0.30	1.69	0.035	3.8
1977	1.54	0.052	0.63	0.91	0.056	0.25	1.16	0.044	5.0
1978	1.37	0.062	0.52	0.56	0.044	0.08	1.12	0.037	7.1
1979	0.85	0.046	0.43	0.62	-	0.06	1.06	0.042	6.4
1980	1.47	-	0.49	0.41	-	0.16	1.27	-	5.0
					Spain[6]			**Russia[4]**	
1981	1.42	-	0.41	(0.96)	-	0.07	1.02	0.35	6.2
1982	1.30	-	0.35	-	0.86	0.26	1.01	0.34	6.4
1983	1.58	-	0.31	(1.31)	0.92	0.36	1.05	0.38	7.6
1984	1.40	-	0.45	1.20	0.78	0.35	0.73	0.27	7.0
1985	1.86	-	1.04	1.51	1.37	0.50	0.90	0.39	5.1
1986	1.97	-	1.00	2.39	1.73	0.84	1.36	1.14	4.1
1987	1.77	-	0.97	2.00	1.82	1.05	1.73	0.67	3.3
1988	1.58	-	0.66	1.61	(1.36)	0.54	0.97	0.55	2.2
1989	1.49	-	0.71	0.41	2.70	0.45	0.78	0.43	3.6
1990	1.35	-	0.70	0.39	2.69	0.80	0.38	0.60	4.8
1991	1.38	-	0.67	0.29	4.96	0.76	0.50	0.90	-
1992	2.19	-	0.79	3.06	2.47	0.23	0.98	0.65	-
1993	2.33	-	0.85	2.98	3.38	1.00	1.74	1.03	-
1994	2.50	-	1.01	2.82	1.44	1.14	1.27	0.86	-
1995	1.57	-	0.59	2.73	1.65	1.10	1.00	1.01	-
1996			0.74		1.11	0.85		0.99	
1997			0.61			0.57		0.74	
1998			0.37			0.29		0.40	
1999[1]			0.29			0.34		0.39	

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

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

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

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

Year	Age									
	1	2	3	4	5	6	7	8	9	10+	Total
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
2000 [1]	154.1	221.4	245.1	158.8	142.0	45.3	9.5	4.6	2.9	1.0	984.7

[1] Survey covered a larger area
[2] Adjusted indices

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

	Age										
Year	1	2	3	4	5	6	7	8	9	10+	Total
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
2000 [1]	128.8	248.3	235.2	132.1	108.3	26.9	4.3	2.0	1.2	0.4	887.5

[1] Survey covered a larger area
[2] Adjusted indices

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

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

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

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

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

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

[1] Adjusted lengths

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

Year	Age							
	1	2	3	4	5	6	7	8
1983		190	372	923	1597	2442	3821	4758
1984	23	219	421	1155	1806	2793	3777	4566
1985		171	576	1003	2019	3353	5015	6154
1986		119	377	997	1623	2926	3838	7385
1987 [2]	21	65	230	490	1380	2300	3970	
1988	24	114	241	492	892	1635	3040	4373
1989	16	158	374	604	947	1535	2582	4906
1990	26	217	580	1009	1435	1977	2829	4435
1991	18	196	805	1364	2067	2806	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
2000	17	77	210	559	1189	1978	2989	3797

[1] Adjusted weights
[2] Estimated weights

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

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

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

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

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

Year	Age 1	2	3	4	5	6	7	8	9	10+	Total
1985 [1]	77	569	400	568	244	51	20	8	1	3	1941
1986 [1]	25	129	899	612	238	69	20	3	2	1	1998
1987 [2]	2	58	103	855	198	82	19	4	1	1	1323
1988 [2]	3	23	96	100	305	54	16	3	1	1	602
1989 [1]	1	3	17	45	57	91	75	25	13	5	332
1990 [1]	36	27	8	27	62	74	91	39	10	3	377
1991 [1]	63	65	96	45	50	54	66	49	5	1	494
1992 [1]	133	399	380	121	56	58	33	29	11	2	1222
1993 [1]	20	44	220	234	164	51	19	13	8	10	783
1994 [1]	105	38	147	275	303	314	100	35	10	8	1335
1995 [1]	242	42	111	219	229	97	21	6	2	2	971
1996 [1,3,5]	424	275	189	316	449	314	126	27	3	4	2127
1997 [4,5]	72	160	263	198	112	57	27	9	1	1	900
1998 [1]	26	86	279	186	57	23	10	4	1	0	672
1999 [1]	19	79	166	260	98	20	8	5	2	1	658

[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 1	2	3	4	5	6	7	8	9	10+	Total
			Total (Sub-area I and Division IIa and IIb)								
1982	2.1	2.5	14.1	7.6	9.4	5.8	3.2	1.1	0.4	0.3	46.3
1983	11.7	5.1	6.0	7.3	4.8	2.0	0.7	1.1	0.2	0.2	39.2
1984	11.1	11.3	15.6	9.3	4.9	3.0	1.2	0.5	0.3	0.2	57.2
1985	6.2	39.6	28.3	39.7	18.1	4.5	1.7	0.6	0.1	0.2	139.0
1986	1.5	8.0	49.5	28.6	14.0	5.0	1.4	0.2	0.1	0.1	108.4
1987	0.1	2.5	6.1	40.2	7.8	3.4	0.8	0.2	0.1	0.1	61.2
1988	0.2	1.5	6.6	7.3	19.3	3.3	1.0	0.2	0.1	0.1	39.5
1989	0.3	0.6	3.4	9.1	10.9	16.1	13.1	5.5	2.9	0.8	62.7
1990	3.8	2.9	0.9	2.9	6.5	7.8	9.6	4.3	1.1	0.3	40.1
1991	6.9	7.1	10.2	4.8	5.8	6.6	8.3	7.1	0.7	0.1	57.6
1992	10.8	30.6	30.9	9.0	4.5	4.8	2.6	2.3	0.9	0.1	96.4
1993	4.5	10.3	49.1	52.6	37.7	11.7	4.5	3.2	1.9	2.5	178.0
1994	11.4	5.8	23.0	40.4	38.3	36.6	12.0	4.2	1.3	1.4	174.3
1995	26.0	4.5	11.9	23.5	24.7	10.5	2.3	0.7	0.2	0.2	104.5
1996 [1]	17.8	11.6	7.7	10.1	12.6	8.6	3.6	0.9	0.1	0.1	73.1
1997 [1]	7.3	17.3	9.9	8.3	6.2	3.7	1.8	0.5	0.1	0.0	55.1
1998	4.9	15.9	50.8	33.4	9.7	3.7	1.6	0.7	0.1	0.1	120.9
1999	3.6	14.3	28.4	47.5	16.2	3.1	1.2	0.8	0.2	0.1	115.4

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

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

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

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

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

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

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

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

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

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

Table A16. The North-east arctic COD stock's consumption of various prey species in 1984-1999 (1000 tonnes)

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

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

Year	Age								
	1	2	3	4	5	6	7	8	9+	Total
1990	197.9	27.4	32.1	25.3	38.1	31.3	58.1	5.5	0.9	416.6
1991	391.4	213.6	105.6	31.0	20.2	22.3	20.7	31.3	3.8	839.9
1992	450.1	449.5	240.2	169.7	33.0	17.8	10.0	6.7	12.2	1389.2
1993	453.7	542.1	448.9	123.2	64.6	13.2	7.2	2.4	9.8	1665.1
1994										
1995	1045.7	257.4	233.4	281.0	180.3	66.9	22.1	4.6	2.3	2093.7
1996	2061.4	710.9	161.2	159.4	142.6	80.5	38.3	6.3	1.8	3362.3
1997*	1168.5	889.5	251.7	69.5	52.5	52.1	30.8	11.1	2.4	2528.1
1998**	1425.2	710.2	468.5	137.8	34.6	19.5	12.0	5.7	2.1	2815.5
1999	339.2	418.2	299.4	191.3	44.9	9.0	5.8	3.6	1.3	1312.8
ratio95	1.40	2.21	1.32	1.58	1.70	1.41	1.22	1.22	1.23	
ratio96	1.57	1.61	1.54	1.81	1.94	1.77	1.53	1.48	1.10	
ratio99	1.69	1.52	1.57	1.31	1.27	1.34	1.13	1.08	1.33	

*raised by the 1996 ratio
**raised by the 1999 ratio

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 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 peaked in 1996 at 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.

1.1.2 Landings prior to 2000 (Tables 4.1–4.3, Figure 4.1A)

Final reported landings in 1998 are 94,269 t (Table 4.1), e.g. the figure used in last year's assessment. The provisional landings for 1999 are 81,707 t which is nearly 7,000 t higher than the 75,000 t landings expected by the Working Group last year. The agreed TAC was 78,000 t. Catches decreased in Sub-area I and Division IIb and increased in Sub-area IIb. The catch by area, broken down by trawl and other gears, is given in Table 4.2. The nominal catch by country is given in Table 4.3.

1.1.3 Expected landings in 2000

The 78,000 t TAC agreed in 1999 was exceeded by almost 5%. The agreed TAC for 2000 was 62,000 t. The Norwegian quota of 33,400 t is expected to be taken. Russia has transferred 2,348 t of their quota to Norway and expects to take all the remaining 22,350 t. On this basis the landings in 2000 are estimated to be equal to the TAC of 62,000 t.

1.2 Status of Research

1.2.1 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.

1.2.2 Survey results (Tables B1-B6)

The overall picture seen in the surveys is summarized as follows: the year-class 1997 seems to be poor, and the 1998 and 1999 year classes appear above average. Regarding the fishable stock, numbers of 5+ age groups are much reduced after the fading of the strong 89–91 year classes from the surveys.

Norwegian bottom trawl and acoustic survey

Norway provided indices from the 2000 Barents Sea bottom trawl and acoustic survey in January-March (Table B1 and B3). There was full area coverage both in 1998 and in 1999. Due to the restriction of the survey, 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. Recruitment of the 1992–1997 year classes are all well below those of the 1989–1991 year classes which has supported the fishery in the recent period. The 1998 (at ages 1 and 2) and 1999 year classes (at age 1) appear relatively strong in both surveys.

Russian bottom trawl and acoustic survey

Russia provided indices from the 1999 Barents Sea trawl and acoustic survey (Tables B2 and B4) which was carried out in October-December. The Russian survey shows the same main trends as the Norwegian survey. From 1995 onwards there has been a substantial change in the method for calculating acoustic indices. The acoustic survey (Table B4) will therefore be excluded from the VPA tuning until a longer time series with the new method can be established.

International 0-group survey

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, good in 1998 and average in 1999.

Norwegian coastal bottom trawl and acoustic survey

Data were presented to the Working Group on a Norwegian standard trawl-acoustic survey conducted along the Norwegian coast in October-November. The series covers the period from 1995 to 1999. Having 5 years of data permits the use of this survey in the tuning assessment of this stock. However, several problems were detected related to these data. The data were presented as numbers at length and transformed to numbers at age at the WG using age length keys from another survey (Norwegian saithe survey carried out in November over similar areas) provided by Norway. These ALK were only available for the 1996–1999 period. For 1995, the 1996 ALK was used.

Results from trial tuning assessments did not support the including this data series, because of the poor fit of catchability regressions for most ages and consequent very low contribution to terminal year's survivor estimation in any age observed in the survey (< 10%). These results, in addition to inconsistencies observed when transforming numbers at length to numbers at age, suggest that the Working Group should not include this series in the assessment at present. The WG recommends the data to be prepared as numbers at age in advance of the Working Group including reading of otoliths from the survey.

1.2.3 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 continues to show an increase from the previous year for age classes up to 7 years old, no improvement for 8 years old, and slight reduction of 9 and 10 years old.

1.3 Data Used in the Assessment

1.3.1 Catch at age (Table 4.7)

Age compositions of the landings for 1999 were available from Norway and Russia in Sub-area I, from Norway, Russia and Germany in Division IIa, and from Norway in Division IIb. The catches of the other countries were distributed among ages using the combined Norwegian/Russian age composition in Sub-area I and in Division IIb, and the Russian trawl age composition in Division IIa. The SOP check gave a deviation of 0.6% from the nominal catch of 1999. The numbers at age were adjusted to make the SOP fit to the nominal catch for these years.

1.3.2 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 and Russia. The weights at age in the catch in 1999 continues to show an increase for most age groups, but are still below the level of the early 1990s.

Stock weights (Table 4.9) used from 1985 to 2000 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 continue to show an increasing trend for the age groups 3–7 observed since 1997.

1.3.3 Natural mortality (Table 4.10)

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 (see Section 4.4.1). The proportion of F and M before spawning was set to zero.

1.3.4 Maturity at age (Table 4.4 and 4.11)

A maturity ogive was available from Russia for the period 1981–2000 (Table 4.4). Like in 1998, the ogive showed a further change towards earlier maturation. The maturity at age series for the whole period 1950–1999 is shown in Table 4.11.

1.3.5 Data for tuning (Table 4.12)

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 first two 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	1983–1999
Norwegian bottom trawl	Barents Sea	Winter	1–8	1982–1999
Norwegian acoustic	Barents Sea	Winter	1–7	1980–1999
Norwegian trawl fleet	Total area	All year	8–13	1985–1999

1.3.6 Recruitment indices (Table 4.5)

Four time series of recruitment indices were updated with data from 1999. 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). Data from the International 0-group survey collected before 1985 has been excluded due to substantial changes in both sampling and processing procedures used in this survey from that year on.

1.3.7 Prediction data (Table 4.19)

The data used for 2000–2002 in the short-term prediction were also used for these years in the medium-term prediction (2000–2004), with the 2002 data extended forward to 2003 and 2004.

The stock numbers at age are taken from the VPA (Table 4.15) and the recruitment of the 1999 year class from the RCT3 analysis (Table 4.6). The recruitment at age 3 of the 2000 and subsequent classes is set as the long-term geometric mean of 96 million.

The fishing pattern in 1999 continues to shift towards younger fish, as happened from 1997 to 1998. The mean fishing pattern from 1998 and 1999 is used in the predictions to account for this shift.

The Russian maturity ogive for 2000 continues to show earlier maturation than in the preceding years (Table 4.4). The mean values for the 1999 and 2000 maturity ogives were used for prediction, because maturity in 1994–1997 was unusually low.

The most recent surveys show evidence of improved growth for age groups up to 7 years old, no improvement for 8 years old, and a slight reduction for ages 9 and 10 (weight for older ages are not well estimated), both for the stock and the catches. The mean weight-at-age of the last two years was used for the prediction.

The natural mortality, as estimated from cod predation plus an assumed value of 0.2, shows declining trends for all the ages 3–5 and almost no predation in 1999. In view of the development of the capelin (Gjøsæter, WD 34) stock and the expected predation rates of cod, the 1999 values were used in the prediction.

1.4 Methods Used in the Assessment

1.4.1 VPA and tuning

The Extended Survivors Analysis (XSA) was used to tune the VPA to the available index series (Table 4.12). The same settings used last year were employed the current year. An age span of ages 1 to 14 was used.

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 (1984–1999) (Table A16). The consumption of haddock by cod is given below:

Consumption of haddock by cod (millions individuals)						
	AGE					
Year	1	2	3	4	5	6
1984	996.46	14.90	0.08	0.00	0.00	0.00
1985	1,218.13	5.26	0.00	0.00	0.00	0.00
1986	572.39	245.30	167.68	0.00	0.00	0.00
1987	760.11	0.00	0.00	0.00	0.00	0.00
1988	16.64	0.49	8.87	0.00	0.22	0.00
1989	242.92	0.00	0.00	0.00	0.00	0.00
1990	143.15	37.21	3.60	0.00	0.00	0.00
1991	457.71	14.39	0.00	0.00	0.00	0.00
1992	2,113.04	150.23	1.07	0.00	0.00	0.00
1993	1,395.03	167.36	37.43	3.44	2.92	0.00
1994	1,437.71	80.61	25.03	7.84	0.94	0.01
1995	2,924.60	162.30	11.80	30.05	30.51	0.35
1996	1,637.64	160.02	39.62	5.38	2.60	3.41
1997	941.88	36.96	26.37	1.71	0.76	0.51
1998	1,665.00	36.56	2.88	4.38	0.75	0.00
1999	992.67	7.47	0.02	0.00	0.00	0.00

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 4.10) was used in the final XSA. Based on this last run, a conventional VPA was made, which includes age group 3 and older in order to get a summary table needed for the report.

The retrospective analysis shows that changes from one year to the next in the assessment can be considerable (Figure 4.2). The current assessment indicates that there has been a tendency towards overestimation of fishing mortality in the early 90's, and towards underestimation in the four most recent years. However, the underestimation observed last year is slight with relation to the current assessment.

A trial run was attempted with the same settings but with age group 1 and 2 excluded. No improvements were observed in the XSA diagnostics derived from this run. The WG decided not to change the age span used in the previous assessment because there were no improvements in the assessment fits and the use of ages 1 and 2 allows for having recruitment estimates at age 3 for the next two years after the assessment year span. No attempts were made to truncate the older ages in the assessment (e.g., 1–11+).

1.4.2 Recruitment (Tables 4.6, 4.15)

The XSA estimate of the strength of the 1997 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 1999 value was used to project the 1998 year class to age 3. The only year class estimated by the RCT3 program was thus the 1999 year class at age 3. The age 0 and 1 survey indices for this year class were used in the estimation, together with estimates of year class strength at age 3 from the final VPA.

1.5 Results of the Assessment

1.5.1 Fishing mortality and VPA (Tables 4.13–4.18 and Figures 4.1A and 4.1B)

The tuning diagnostics of the final XSA (predation included) are given in Table 4.13. 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 4.10, 4.14, and 4.15, respectively, while the stock biomass at age and the spawning biomass at age are given in Tables 4.16 and 4.17. A summary of landings, fishing mortality, stock biomass, spawning stock biomass, and recruitment since 1950 is given in Table 4.18 and Figures 4.1A and 4.1B.

Compared to last year, the fishing mortality in 1999 increased considerably to 0.55. In addition to this, the shift in the exploitation pattern towards younger fish observed last year is still apparent. Current fishing mortality is well above the F_{pa} value of 0.35.

The spawning stock biomass in 1999 decreased by 9% and is now estimated at 118,000 t. Total biomass continues to decline further down to 209,000 t in 1999, less than half of the 1994–95 level.

1.5.2 Recruitment (Tables 4.5–4.6, 4.15, 4.19)

The estimates of the 1996–1998 year classes at age 3, derived from the XSA (Table 4.15), are 144, 62 and 410 millions, respectively. The RCT3 estimate of the 1999 year class is 130 million at age 3 (Table 4.6). The long-term geometric mean is 96 million individuals.

1.5.3 Yield per Recruit (Table 4.20, Figure 4.1C)

The yield per recruit analysis using the fishing pattern and stock parameters for 2000 from the management option input table gave an estimate of $F_{0.1}$ = 0.22, while F_{max} was not defined. The *status quo* exploitation level is F_{99} = 0.55.

1.5.4 Catch options for 2000 (Table 4.21)

The expected catch of 62,000 t in 2000 gives F = 0.47 and the spawning stock biomass will decline from 89,225 t in 2000 to 84091 t in 2001. A *status quo* F (0.55) in 2001 corresponds to a catch of 96,490 t, which would imply a slight increase of the spawning stock to 90,519 t in 2002. Although the 1990 year class is not longer predominant, the reduction of the stock is not so marked as expected last year. Fishing mortality below 0.66 (1.25 times F_{sq}) in 2000 would keep SSB above the proposed B_{pa} level of 80,000 t.

1.6 Biological Reference Points

1.6.1 Biomass reference points (Figure 4.4)

Historically, a SSB below 50,000 t has produced only poor year classes (Figure 4.4) and ACFM proposes this as B_{lim}. $\mathbf{B_{pa}}$ is proposed at 80,000 t, which gives a 95% probability of maintaining SSB above $B_{lim,}$ taking into account the uncertainty in the assessments and stock dynamics. The Working Group agrees with the approach and the values proposed by ACFM.

1.6.2 Fishing mortality reference points

A F_{pa} of 0.35, corresponding to F_{med}, was accepted by the ACFM. The stock has sustained higher fishing mortality for most of the period after 1950 without collapsing, however a low SSB has often resulted. ACFM also estimated F_{loss} and used the median value of 0.49 as F_{lim}. This value is considered to have a high probability of keeping F below F_{lim}. The Working Group also agrees with the approach and the value proposed by ACFM for F_{lim}.

1.7 Medium-Term Forecasts and Management Scenarios

1.7.1 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 96 million.

1.7.2 Methods

Single option predictions were run using IFAP and following standard procedures. In addition, a risk analysis was performed for North-east Arctic haddock, where only uncertainty in the initial stock estimate and the recruitment was taken into account. The simulation period was 2000–2003.

The uncertainty of the stock estimate in 2000 was modelled using a lognormal distribution with a standard error equal to the external error of the XSA. Recruitment was modelled using a lognormal distribution with a standard error of 0.3 for year classes 97–99. For year classes 2000 and 2001 the standard error of the historical series of recruitment at age 3 was used, limiting the maximum and minimum values to the one observed in the series. This value is somewhat above the external standard error from the XSA for year classes 97 and 98, in recognition of the uncertainty in predation-induced M.

1.7.3 Results (Tables 4.22–4.23 and Figures 4.1D and 4.5)

In Figure 4.1D the catch level in 2001 and spawning stock biomass level in 2002 are plotted against the fishing mortality, in 2001. In Table 4.22, the results of the medium-term prediction are given, for 0.25, 0.5, 0.64 (F_{pa}) and 1.0 * F_{sq}. Detailed output of the prediction for F_{pa} is also given (Table 4.23). In the medium term, the spawning stock will increase above 100,000 t when fishing at $F_{sq,}$ with catches in the range of 96,000–144,000 t. On the other hand, fishing at F_{pa} the spawning stock will increase well above $B_{pa,}$ with catches progressively increasing from 65,000 t in 2001 to 110,000 in 2004.

The text table below shows the main results of the risk analysis (Figure 4.5).

F	Basis	Landings 2001	SSB 2002	P (SSB< B_{pa}) in 2003
0.14	0.25* $\mathbf{F}_{99}$	28	126	< 5%
0.28	0.5* $\mathbf{F}_{99}$	53	113	< 5%
0.35	$\mathbf{F}_{pa}$	66	106	< 5%
0.55	$\mathbf{F}_{99}$	97	91	< 5%

Weights in '000 t

1.8 Comments to the Assessment and Forecasts

As shown by the retrospective analysis (Figure 4.2) , the assessment is unstable. In spite of the large uncertainty about the stock level, the Working Group concludes that the spawning stock is close to B_{pa} in 2000. The extent of the decline of the stock expected last year as the influence of the 1990 year class is reduced, has not occurred. Improved growth and maturity, together with low levels of predation by cod have contributed to slow the decline. In addition, above average year classes are expected to enter in the fishable stock in 2001 and 2002.

The results of the forecast will depend on the realisation of the predicted high weights, earlier maturity and low natural mortality, namely for the incoming 1998 and 1999 year classes. This will very much depend on the development of the capelin and cod stocks in the near future. For the medium term prediction, the persistence of the current situation is uncertain and the predictions for the terminal years should be taken with caution.

The bias in the assessment is partially related to the strong dynamics of the very abundant year classes periodically recruiting to the stock. The methods being developed for cod should in the future also be suitable for haddock, but will not be attempted before they are accepted for the cod assessment (section 3.10).

The fishing mortality corresponding to the TAC = 62,000 t in 2000 has been adjusted upwards from 0.35 (as calculated by ACFM in November 99) to 0.47 in the current assessment. The reason for this adjustment is considered to be a combination of the differences in the input for prediction both in weights in the catch and in exploitation pattern between assessments in addition to the bias in XSA towards underestimating fishing mortality in the assessment year (see Figure 4.2).

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	45,403	47,756	1,110	94,269
1999 [1]	35,816	41,710	4,181	81,707

[1] Provisional figures, Norwegian catches on Russian quotas are included

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

	Sub-area I		Division IIa		Division IIb
Year	Trawl	Others	Trawl	Others	Trawl
1967	73.8	34.3	20.5	7.5	0.4
1968	98.1	42.9	31.4	8.6	0.7
1969	41.3	47.7	33.1	7.1	1.3
1970	36.7	22.8	20.2	6.4	0.5
1971	27.3	29.0	15.0	6.6	0.4
1972	193.4	27.8	34.4	7.6	2.2
1973	241.2	42.5	13.9	9.4	13.0
1974	133.1	25.9	39.9	7.1	15.1
1975	103.5	18.2	34.6	9.7	9.7
1976	77.7	16.4	28.1	9.5	5.6
1977	57.6	14.6	19.9	8.6	9.5
1978	53.9	10.1	15.7	14.8	1.0
1979	47.8	16.0	20.3	18.9	0.6
1980	30.5	23.7	14.8	18.9	0.1
1981	19.0	17.9	21.8	18.7	0.5
1982	9.0	8.9	18.5	10.5	-
1983	3.7	3.8	7.6	6.3	0.2
1984	1.6	2.4	6.4	6.9	0.1
1985	24.4	6.0	4.5	6.3	0.1
1986	51.7	18.1	12.8	13.2	0.7
1987	77.8	31.6	22.1	16.1	3.0
1988	27.5	16.5	33.6	13.5	0.7
1989	21.5	9.8	11.7	11.8	0.4
1990	5.9	9.2	4.8	5.6	0.3
1991	9.8	9.0	7.8	6.6	0.4
1992	21.2	9.5	9.3	12.9	1.0
1993	37.9	9.7	18.0	9.0	3.0
1994	57.8	13.0	29.5	14.2	6.9
1995	58.0	12.3	33.2	20.9	14.1
1996	98.5	14.5	34.8	22.5	3.3
1997	57.4	20.8	42.5	25.3	2.5
1998	25.8	19.6	24.7	23.0	0.7
1999 [1]	26.9	8.9	23.6	18.1	4.2

[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	1,903	241	854	385	68,747	257	1,229	20,559	94	94,269
1999 [1]	397	64	252	437	48,632	649	694	30,520	62	81,707

[1] Provisional figures, Norwegian catches on Russian quotas are included.
[2] USSR prior to 1991.

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

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

* Preliminary data, revised in august meeting.
(Data provided by Working Group members).

Table 4.5

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

4	41	2	(No. of surveys	No. of years	VPA Column No.)
1959	244	7	-11	-11	-11
1960	277	30	-11	-11	-11
1961	323	32	-11	-11	-11
1962	101	5	-11	-11	-11
1963	242	16	-11	-11	-11
1964	293	11	-11	-11	-11
1965	20	0.3	-11	-11	-11
1966	17	0.3	1	-11	-11
1967	166	3	8	-11	-11
1968	97	0.3	0.3	-11	-11
1969	1028	31	29	-11	-11
1970	272	10	64	-11	-11
1971	54	3	26	-11	-11
1972	49	2	16	-11	-11
1973	57	13	26	-11	-11
1974	115	15	51	-11	-11
1975	172	163	60	-11	-11
1976	135	6	38	-11	-11
1977	19	1	33	-11	-11
1978	6	0.3	12	-11	-11
1979	8	0.3	20	-11	-11
1980	5	0.3	15	3.1	7
1981	9	0.3	3	3.9	9
1982	260	23	38	2919.3	0.3
1983	537	40	62	3832.6	1685
1984	85	9	78	1901.1	1809
1985	43	5	27	665	680
1986	18	0.2	39	163.8	111
1987	25	0.4	10	35.4	20
1988	85	2	13	81.2	58
1989	210	3	14	644.1	493
1990	698	81	61	2006	1938
1991	299	17	117	1659.4	859
1992	84	20	87	727.9	1424
1993	91	6	64	603.2	848
1994	103	14	64	1463.6	1380
1995	41	10	25	309.5	249
1996	127	9	39	1268	779
1997	-11	-11	21	212.9	246
1998	-11	11	59	1244.9	856
1999	-11	12	25	847.1	1024

R-T-1	Russian Bottom Trawl Survey, coastal areas and southern part of the Barents Sea	age 0+
INT0GP	International 0 Group Survey, logarithmic indices (from 1985)	(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 :
c:\hadrct00.txt
NORTHEAST ARCTIC HADDOCK : recruits as 3 year-olds (inc. data for ages 0 & 1)
Data for 4 surveys over 20 years : 1980 - 1999

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

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

Forecast/Hindcast variance correction used.

Yearclass = 1997

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-T-1									
INT0GP	.07	1.36	2.12	.195	12	21.00	2.76	2.541	.069
N-BST1	.91	-1.10	.87	.625	17	5.37	3.77	1.005	.440
N-BSA1	1.17	-2.41	1.84	.270	17	5.51	4.06	2.105	.100
						VPA Mean =	4.63	1.067	.391

Yearclass = 1998

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-T-1	1.13	2.15	.86	.614	17	2.48	4.96	.991	.283
INT0GP	.06	1.69	1.91	.210	13	59.00	5.33	2.217	.057
N-BST1	.94	-1.28	.83	.607	18	7.13	5.41	.967	.297
N-BSA1	1.18	-2.48	1.63	.288	18	6.75	5.46	1.874	.079
						VPA Mean =	4.61	.989	.284

Yearclass = 1999

Survey/ Series	Regression: Slope	Inter- cept	Std Error	Rsquare	No. Pts	Prediction: Index Value	Predicted Value	Std Error	WAP Weights
R-T-1	1.14	2.12	.88	.584	17	2.56	5.04	1.035	.258
INT0GP	.06	1.72	1.89	.209	13	25.00	3.24	2.251	.055
N-BST1	.98	-1.56	.84	.585	18	6.74	5.06	.977	.290
N-BSA1	1.17	-2.54	1.49	.310	18	6.93	5.60	1.746	.091
						VPA Mean =	4.63	.948	.307

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1997	58	4.06	.67	.31	.21	62	4.14
1998	157	5.06	.53	.17	.10		
1999	130	4.87	.53	.24	.21		

Table 4.7

Run title : Arctic Haddock (run: XSALMO08/X08)

At 28/08/2000 13:00

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

YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
AGE										
1	0	4069	0	392	1726	0	97	828	153	169
2	4446	222	13674	8031	493	989	3012	243	2312	2425
3	3189	65643	6012	64528	6563	1154	16437	2074	1727	20318
4	37949	9178	151996	13013	154696	10689	5922	24704	5914	7826
5	35344	18014	13634	70781	5885	176678	14713	7942	31438	7243
6	18849	13551	9850	5431	27590	4993	127879	12535	5820	14040
7	28868	6808	4693	2867	3233	28273	3182	46619	12748	3154
8	9199	6850	3237	1080	1302	1445	8003	1087	17565	2237
9	1979	3322	2434	424	712	271	450	1971	822	5918
10	1093	1182	606	315	319	100	200	356	1072	285
11	853	734	534	393	126	50	80	17	226	316
12	867	178	185	202	68	30	60	0	79	71
13	712	81	138	121	51	15	30	33	89	4
+gp	545	355	23	289	298	5	15	126	207	109
0 TOTALNU	143893	130187	207016	167867	203062	224692	180080	98535	80172	64115
TONSLAN	132125	120077	127660	123920	156788	202286	213924	123583	112672	88211
SOPCOF %	45	65	51	57	60	47	55	57	61	80

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

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	2319	362	0	3	149	0	0	0	0	0
2	3632	5531	4536	2151	832	3483	2559	53	33	1058
3	40117	15430	39604	28567	22305	5911	26157	15917	657	1520
4	71280	56858	30947	72995	49162	46161	22469	41373	67632	1963
5	13718	63354	49028	19036	30592	40032	62724	13505	41267	44526
6	7138	8706	33923	13627	5800	12578	28840	25736	7748	18956
7	6268	3578	3209	9290	3518	1672	5711	8878	15599	3611
8	1587	4407	1344	1243	2709	970	578	1617	5292	4925
9	2352	788	1778	561	831	893	435	218	655	1624
10	2015	527	243	410	104	122	188	175	182	315
11	497	1287	247	80	206	204	186	155	101	43
12	70	67	483	84	235	123	25	75	115	43
13	30	60	20	168	121	14	8	27	18	14
+gp	12	20	8	44	69	457	22	14	52	9
0 TOTALNU	151035	160975	165370	148259	116633	112620	149902	107743	139351	78607
TONSLAN	155454	193234	187888	146744	98900	118079	160621	136486	181726	130502
SOPCOF %	84	80	74	74	62	69	66	79	79	80

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

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	480	15	133	0	281	1321	3475	184	46	0
2	276	3535	9369	5916	3713	4355	7496	18456	2033	48
3	23004	1978	230217	70205	9684	10037	13989	55967	47311	17540
4	2408	24359	22245	258773	41702	14088	13449	22043	18812	35290
5	1870	1257	42846	24018	88112	33871	6808	7368	4076	10645
6	21996	918	3196	6873	5828	49711	20789	2586	1389	1429
7	7948	9279	1606	419	4138	2135	40044	7781	1626	812
8	1974	3056	6737	423	382	1236	1247	11043	2596	546
9	1978	826	2630	1681	618	92	1350	311	6215	1466
10	726	1043	897	525	2043	131	193	388	162	2310
11	166	369	989	147	935	500	280	96	258	181
12	26	130	538	339	276	147	652	101	3	87
13	52	27	53	68	457	53	332	84	74	2
+gp	44	8	67	27	202	234	340	98	65	53
0 TOTALNU	62948	46800	321523	369414	158371	117911	110444	126506	84666	70409
TONSLAN	86601	78908	265317	320065	221138	175758	137218	110158	95422	103623
SOPCOF %	75	101	86	83	86	81	62	77	95	112

Table 4.7. (Continued)

Table 1	Catch numbers at age		Numbers*10**-3							
YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0	1	2	0	0	1	96	8	0	0
2	0	68	29	162	252	2288	690	154	46	180
3	627	486	883	704	456	29548	25596	3928	794	1050
4	22878	2561	900	1930	841	1153	61470	88297	9031	3951
5	21794	22124	3372	884	836	546	1013	52611	50868	12305
6	2971	10685	12203	1374	307	715	376	586	19465	23032
7	250	1034	2625	3282	765	316	346	207	382	3423
8	504	162	344	906	2250	634	144	123	65	247
9	230	162	75	52	499	1312	295	74	35	11
10	842	72	80	37	70	416	484	119	44	36
11	1299	330	91	29	25	50	112	175	142	12
12	111	564	320	21	36	5	35	87	135	22
13	35	27	204	21	44	1	3	4	22	17
+gp	15	42	34	91	185	57	7	19	11	15
0 TOTALNU	51556	38318	21162	9493	6566	37042	90667	146392	81040	44301
TONSLAN	87889	77153	46955	21607	17661	41270	96585	150659	91744	55122
SOPCOF %	103	98	93	91	91	97	90	98	99	96

Table 1	Catch numbers at age		Numbers*10**-3							
YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	6	21	1258	117	11	33	69	75	11	248
2	294	329	2668	455	388	206	413	266	2139	479
3	518	3968	12342	13398	3202	1347	1704	2303	2532	20149
4	1174	1967	12652	25902	45943	13565	5790	6347	14301	7622
5	1871	1886	2411	13154	34257	74583	36543	12086	8628	16085
6	4138	2876	1740	2784	8750	21227	74463	33929	7671	5728
7	6754	4442	2070	973	1709	3530	10834	49680	12607	3327
8	851	4422	2619	1297	693	385	1980	4810	18708	5607
9	389	398	2737	2131	1200	310	438	557	1173	5762
10	50	21	241	2011	1844	469	295	192	238	516
11	3	1	12	314	1655	344	251	161	39	116
12	3	7	4	55	281	627	228	134	36	51
13	9	2	1	9	46	39	790	121	50	14
+gp	15	7	1	6	2	2	23	147	113	65
0 TOTALNU	16075	20347	40756	62606	99981	116667	133821	110808	68246	65769
TONSLAN	25816	33605	53886	77619	121365	138423	173525	148741	94269	81707
SOPCOF %	96	96	100	100	100	100	100	100	100	100

Table 4.8

Run title : Arctic Haddock (run: XSALMO08/X08)

At 28/08/2000 13:00

Table 2 Catch weights at age (kg)

	YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
	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	SOPCOF/	.4483	.6468	.5115	.5709	.5998	.4730	.5526	.5668	.6119	.7979

Table 2 Catch weights at age (kg)

	YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
	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	SOPCOF/	.8371	.8017	.7438	.7422	.6155	.6922	.6598	.7910	.7910	.8023

Table 2 Catch weights at age (kg)

	YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	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	SOPCOF/	.7531	1.0074	.8566	.8267	.8597	.8093	.6228	.7678	.9477	1.1247

Table 4.8 (Continued)

Table 2 Catch weights at age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
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	1.5200	1.5700	.9200	.8600	.6400	.5800	.8000
4	1.0300	1.0300	1.0300	1.8600	1.9900	1.6600	1.2500	.8600	.8400	.8900
5	1.7900	1.7900	1.7900	2.1000	2.4200	2.3900	1.8800	1.3300	1.0500	1.1700
6	2.3800	2.3800	2.3800	2.3800	2.6800	2.7100	2.4100	2.4500	1.4300	1.3700
7	2.8600	2.8600	2.8600	2.8600	2.9300	2.8900	2.6600	2.9800	1.9700	1.7100
8	3.3300	3.3300	3.3300	3.3300	3.3700	3.2200	3.0400	2.9800	2.5200	2.0100
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 SOPCOF/	1.0321	.9828	.9337	.9107	.9105	.9654	.9013	.9825	.9923	.9617

Table 2 Catch weights at age (kg)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	.2500	.0000	.0400	.0900	.2500	.1900	.1000	.1000	.1200	.0850
2	.6400	.0000	.2800	.3000	.4400	.3100	.2400	.3900	.5300	.2290
3	.8900	.7700	.8400	.5900	.5400	.6300	.6400	.6600	.7100	.7340
4	1.2200	1.3100	1.3600	1.0600	.8800	.6600	.7900	.9900	.9000	1.0590
5	1.4000	1.6100	1.7000	1.5200	1.3300	1.0600	1.0400	1.0900	1.2700	1.2670
6	1.6000	1.8600	1.9600	1.8400	1.7400	1.6800	1.3400	1.2200	1.3800	1.5480
7	1.7700	2.1100	2.2900	2.1800	2.0600	2.1100	1.8100	1.4800	1.5400	1.6560
8	2.1600	2.3400	2.3900	2.3000	2.2000	2.3400	2.2900	1.9900	1.7900	1.7900
9	3.7000	2.9300	2.3200	2.5200	2.5000	2.6700	2.3100	2.2600	2.3700	2.0160
10	4.4100	2.3400	2.8800	2.6400	2.5800	2.9100	3.1800	2.2600	2.5100	2.5010
11	5.4000	5.4000	3.1400	3.1100	2.8900	3.0200	2.6200	2.9800	2.6800	2.6420
12	6.7000	6.7000	2.9200	3.8000	2.8200	3.0700	3.3700	2.7800	3.4300	2.7360
13	7.4000	7.4000	2.2800	2.8600	3.2400	2.7400	3.2700	2.8300	2.7600	3.2750
+gp	8.0000	8.0000	3.2900	4.4100	3.1500	3.1500	3.1500	3.1500	3.1500	2.9680
0 SOPCOF/	.9562	.9581	.9983	.9997	.9976	1.0015	.9988	.9987	.9992	1.0041

Table 4.9

Run title : Arctic Haddock (run: XSALMO08/X08)

At 28/08/2000 13:00

Table 3 Stock weights at age (kg)

YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
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	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
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	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
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	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	.0000	.0000	.0000	.0520	.0360	.0360	.0420	.0380	.0230	.0390
2	.0000	.0000	.0000	.1330	.1960	.1330	.1030	.0880	.1170	.1160
3	.6600	.6600	.6600	.4800	.2890	.4350	.2960	.2090	.2140	.2790
4	1.0300	1.0300	1.0300	1.0430	.9640	.7730	.7760	.4190	.3860	.4410
5	1.7900	1.7900	1.7900	1.6410	1.8100	1.8740	1.5300	.9190	.6200	.6790
6	2.3800	2.3800	2.3800	2.0810	2.5060	2.4560	2.2620	2.2400	1.1240	1.0050
7	2.8600	2.8600	2.8600	2.5920	2.2400	2.6880	2.2630	2.8600	1.5690	1.4150
8	3.3300	3.3300	3.3300	3.3300	3.3300	3.3300	3.3300	3.1000	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	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	.0430	.0520	.0450	.0330	.0280	.0290	.0290	.0320	.0230	.0270
2	.1270	.1410	.1350	.1010	.0910	.0890	.0940	.0960	.1140	.0900
3	.2640	.3730	.3420	.2980	.2340	.2150	.2080	.2040	.2340	.2820
4	.7300	.7740	.8200	.8080	.5400	.3620	.4480	.3880	.4590	.5920
5	.9450	1.4380	1.5190	1.4300	1.0590	.8030	.6850	.6840	.8280	1.0170
6	1.2910	1.6300	1.9620	2.0020	1.5310	1.4440	1.1250	1.1080	1.1920	1.4880
7	1.5570	1.7930	2.2400	2.2650	1.9390	1.9500	1.8450	1.4680	1.4620	1.6530
8	2.0040	2.2330	2.3200	3.0450	2.5090	2.9130	2.4300	2.4420	1.9660	1.9140
9	2.7160	2.7310	2.5680	3.3910	2.3740	2.9340	2.8150	3.2180	3.1550	2.5390
10	4.4100	3.0920	3.5250	3.4000	2.6210	3.0330	3.3230	3.3330	3.2000	2.8150
11	5.4000	5.4000	5.4000	4.2000	3.1600	3.1630	3.4790	4.6480	3.6000	3.6000
12	6.7000	6.7000	6.7000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000	4.0000
13	7.4000	7.4000	7.4000	4.4000	4.4000	4.4000	4.4000	4.4000	4.4000	4.4000
+gp	8.0000	8.0000	8.0000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000

Table 4.10

Run title : Arctic Haddock (run: XSALMO08/X08)

At 28/08/2000 13:00

Table 4 Natural Mortality (M) at age

YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
AGE										
1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
13	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
13	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4 Natural Mortality (M) at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
13	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4.10 (continued)

Table 4	Natural Mortality (M) at age									
YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0.2	0.2	0.2	0.2	1.054	1.5687	2.5681	3.6653	0.592	1.1217
2	0.2	0.2	0.2	0.2	0.2505	0.2088	1.4791	0.2	0.2249	0.2
3	0.2	0.2	0.2	0.2	0.2094	0.2	0.6364	0.2	0.4574	0.2
4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
13	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4	Natural Mortality (M) at age									
YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0.5945	0.543	1.7089	2.2329	1.8775	2.4322	2.9101	1.9023	3.4402	2.206
2	0.5335	0.2713	0.3795	0.6172	0.8332	1.1171	1.0094	0.6901	0.441	0.3451
3	0.3716	0.2	0.206	0.2625	0.3	0.374	0.7795	0.4958	0.264	0.2002
4	0.2	0.2	0.2	0.2272	0.2177	0.376	0.2532	0.2497	0.2843	0.2
5	0.2	0.2	0.2	0.298	0.2127	0.3071	0.2227	0.2303	0.2378	0.2
6	0.2	0.2	0.2	0.2	0.2008	0.2099	0.2077	0.2104	0.2	0.2
7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
8	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
11	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
13	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
+gp	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 4.11

Run title : Arctic Haddock (run: XSALMO08/X08)

At 28/08/2000 13:00

Table 5 Proportion mature at age

YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
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	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500
5	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300
6	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300
7	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800
8	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800
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
+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	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
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	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500
5	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300
6	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300
7	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800
8	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800
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
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5 Proportion mature at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
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	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500
5	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300	.2300
6	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300	.5300
7	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800	.8800
8	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800	.9800
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
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 4.11 (Continued)

Table 5 Proportion mature at age

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
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	.0100	.0900	.1700	.0700	.0200	.0000	.0000	.0000	.0000
4	.0500	.1200	.5500	.7000	.1400	.0800	.2200	.0100	.0300	.0400
5	.2300	.6400	.7300	1.0000	.3500	.8000	.5300	.2100	.3300	.3000
6	.5300	.7300	.9300	1.0000	.4700	.9300	.8600	.5300	.5100	.6300
7	.8800	.9600	.9600	1.0000	.7400	.9600	.8600	1.0000	1.0000	.8200
8	.9800	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
+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	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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	.0200	.0150	.0000	.0000	.0000	.0000	.0000	.0100
4	.0200	.0700	.1300	.2190	.0170	.0200	.0000	.0300	.0500	.1700
5	.3000	.3000	.5000	.4900	.1300	.1200	.1000	.1000	.2800	.5000
6	.5400	.5000	.6200	.7600	.4100	.4200	.3600	.2900	.5000	.7100
7	.7700	.8000	.7700	.7900	.9000	.8100	.7800	.6000	.6600	.8100
8	.8700	.9200	.8000	.8800	.8800	.8800	.8600	.8200	.8100	.9100
9	.8000	1.0000	.9400	.8800	1.0000	1.0000	.9000	1.0000	.9100	.9200
10	1.0000	1.0000	1.0000	.8700	1.0000	.8700	.9300	.8300	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	.9700	1.0000	.9000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	.9400	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
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 4.12

The SAS System 12:53 Monday, August 28, 2000

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
1999	1	289.0	61.0	196.0	39.0	37.0	8.0	3.0

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

FLT02: 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	.	140	50	210	600	180	10	3
1981	.	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
1999	1	5090	320	650	190	100	20	10

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

FLT03: 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	1.02	6514.0	206.0	68.0	3.0	4.0	12.0
1999	0.96	1093.0	1427.3	183.7	45.7	12.2	3.1

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

FLT04: Norway bottom trawl survey, Jan-Mar, age 1–7, shifted, revised94 (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
1998	1	576	598	122	102	28	10	17	11
1999	1	4522	272	354	84	40	8	3	7

Table 4.13

Lowestoft VPA Version 3.1

25/08/2000 16:41

Extended Survivors Analysis

Arctic Haddock (run: XSALMO08/X08)

CPUE data from file fleet

Catch data for 50 years. 1950 to 1999. Ages 1 to 14.

Flee	First year	Last year	First age	Last age	Alpha	Beta
FLT01:	1983	1999	1	7	.900	1.000
FLT02:	1980	1999	1	7	.990	1.000
FLT03:	1985	1999	8	13	.000	1.000
FLT04:	1982	1999	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 26 iterations

1

Table 4.13 (Continued)

Regression weights

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

Fishing mortalities

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000
2	.003	.001	.003	.001	.003	.001	.002	.004	.012	.007
3	.025	.053	.068	.022	.013	.021	.028	.027	.059	.168
4	.101	.135	.238	.204	.104	.079	.132	.192	.284	.264
5	.118	.233	.245	.443	.465	.264	.355	.471	.457	.637
6	.188	.269	.351	.496	.647	.604	.494	.676	.641	.651
7	.242	.317	.316	.339	.656	.595	.733	.740	.581	.646
8	.303	.248	.312	.335	.432	.295	.815	.884	.701	.558
9	.746	.226	.239	.453	.596	.349	.647	.566	.550	.482
10	.674	.076	.207	.277	.930	.493	.666	.668	.507	.501
11	.169	.024	.057	.456	.387	.430	.538	.996	.269	.499
12	.231	.741	.125	.394	.999	.247	.572	.626	.628	.678
13	.422	.238	.213	.456	.681	.343	.563	.693	.505	.536

XSA population numbers (Thousands)

	AGE									
YEAR	1	2	3	4	5	6	7	8	9	10
1990	4.93E	1.45E+	2.55E+	1.35E+	1.85E+	2.67E+	3.47E+	3.60E+	8.18E+	1.13E+02
1991	1.74E	2.72E+	8.51E+	1.72E+	1.00E+	1.35E+	1.81E+	2.23E+	2.18E+	3.18E+02
1992	3.02E	1.01E+	2.07E+	6.60E+	1.23E+	6.50E+	8.44E+	1.08E+	1.42E+	1.42E+03
1993	1.70E	5.47E+	6.88E+	1.58E+	4.26E+	7.87E+	3.74E+	5.04E+	6.47E+	9.19E+03
1994	1.85E	1.82E+	2.95E+	5.17E+	1.02E+	2.03E+	3.92E+	2.18E+	2.95E+	3.37E+03
1995	3.52E	2.83E+	7.88E+	2.15E+	3.75E+	5.20E+	8.70E+	1.67E+	1.16E+	1.33E+03
1996	1.84E	3.09E+	9.23E+	5.31E+	1.37E+	2.12E+	2.30E+	3.93E+	1.02E+	6.71E+02
1997	1.52E	1.00E+	1.12E+	4.12E+	3.61E+	7.67E+	1.05E+	9.06E+	1.42E+	4.36E+02
1998	2.74E	2.27E+	5.01E+	6.66E+	2.65E+	1.79E+	3.16E+	4.10E+	3.06E+	6.62E+02
1999	5.31E	8.78E+	1.44E+	3.62E+	3.77E+	1.32E+	7.72E+	1.45E+	1.67E+	1.45E+03

Estimated population abundance at 1st Jan 2000

0.00	5.85E+	6.18E+	9.97E+	2.28E+	1.63E+	5.65E+	3.31E+	6.79E+	8.43E+03

Taper weighted geometric mean of the VPA populations:

1.43	1.78E+	9.96E+	6.15E+	3.91E+	1.97E+	9.15E+	4.18E+	1.75E+	6.94E+02

Standard error of the weighted Log(VPA populations) :

1.1	1.088	1.107	1.211	1.293	1.342	1.381	1.453	1.459	1.3552

Table 4.13 (Continued)

YEAR	AGE 11	12	13
1990	2.14E	1.61E+	2.89E+01
1991	4.70E	1.48E+	1.04E+01
1992	2.41E	3.76E+	5.77E+00
1993	9.48E	1.86E+	2.72E+01
1994	5.70E	4.92E+	1.03E+02
1995	1.09E	3.17E+	1.48E+02
1996	6.66E	5.79E+	2.03E+03
1997	2.82E	3.18E+	2.68E+02
1998	1.83E	8.53E+	1.39E+02
1999	3.26E	1.14E+	3.73E+01

Estimated population abundance at 1st Jan 2000

	7.18	1.62E+	4.75E+01

Taper weighted geometric mean of the VPA populations:

	2.89	1.39E+	5.65E+01

Standard error of the weighted Log(VPA populations) :

	1.4	1.537	1.6833
1			

Log catchability residuals.

Fleet : FLT01: Russian botto

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	99.99	99.99	99.99	1.79	.91	.21	.02	.30	-.28	-.45
2	99.99	99.99	99.99	2.57	.77	.74	.21	-.41	-.26	.42
3	99.99	99.99	99.99	.90	.98	.81	-.34	.06	-.31	-.65
4	99.99	99.99	99.99	.19	.03	-.26	.02	-.06	-.45	-.48
5	99.99	99.99	99.99	-1.31	.16	.60	-.41	-.03	-.47	.08
6	99.99	99.99	99.99	99.99	-2.27	.15	-1.85	-3.13	-.22	.69
7	99.99	99.99	99.99	99.99	99.99	99.99	-1.05	-.94	-2.53	1.11
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	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.74	.35	.36	-.11	-.46	-.35	-.27	-.29	-.06	.21
2	.39	-.02	.43	.16	-.10	-.58	-.50	-.55	-.05	.29
3	1.27	-.16	.27	.40	.13	-.51	-.44	-.74	.05	.27
4	1.13	-.45	-.19	.69	.34	-.55	-.03	-.11	-.16	.22
5	1.25	-.36	-.35	.40	.12	-.42	.58	-.59	-.45	.40
6	1.26	-.49	.32	.55	.37	.38	.99	-.33	-.61	.18
7	.95	.52	.59	.61	-.52	.23	1.15	-1.43	.03	-.11
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 4.13 (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 L	-6.779	-6.9404
S.E(Lo	1.001	1.0091

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Interce	RSqua	No Pts	Reg s.e	Mean Log q
1	.82	1.388	9.30	.86	17	.44	-8.25
2	.84	1.098	7.93	.83	17	.51	-7.14
3	.76	1.501	7.88	.79	17	.58	-6.72
4	.89	.890	7.06	.87	17	.49	-6.57
5	.72	2.099	7.76	.85	17	.57	-6.67

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

Age	Slope	t-value	Interce	RSqua	No Pts	Reg s.e	Mean Q
6	.70	2.181	7.71	.84	16	.61	-6.78
7	.86	.709	7.27	.72	14	.89	-6.94
1							

Fleet : FLT02: Norway acoust

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	99.99	99.99	.76	.13	.46	.15	-.05	-.70	-.19	-.31
2	99.99	99.99	.60	.78	.43	.16	.22	-.53	.36	-.54
3	99.99	99.99	.51	.74	.86	.26	-.04	-.38	-.09	-.33
4	99.99	99.99	.69	.52	.11	-.78	-.14	-.66	-.07	-.22
5	99.99	99.99	.24	.77	.59	1.03	.02	-.54	-.40	-.07
6	99.99	99.99	.64	-.65	.62	.75	1.04	-.25	.22	.48
7	99.99	99.99	1.00	-1.59	.85	1.12	1.45	1.55	-.06	.10
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									

Table 4.13 (Continued)

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.57	.01	.36	.48	.30	-.09	-.60	.05	-.31	-.06
2	.14	-.06	.00	.12	-.09	-.15	-.01	.23	-.25	.17
3	.09	-.42	.04	.17	-.17	.17	.06	.14	-.14	.14
4	-.09	-.30	-.40	.22	.14	-.08	.08	.37	-.07	.69
5	-.15	-.72	-.92	.22	.38	-.11	.14	.17	.21	.56
6	-.57	-1.70	-.89	-.94	.16	.57	.83	.74	-.41	.59
7	-.33	-.99	-.23	-.60	-.33	.02	.28	.56	-.60	.19
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 L	-6.24(	-5.9941
S.E(Lo	.805	.6701

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Interce	RSqua	No Pts	Reg s.e	Mean Log q
1	.77	2.139	7.15	.90	18	.39	-5.06
2	.78	2.848	6.77	.94	18	.28	-5.28
3	.81	2.678	6.48	.95	18	.26	-5.29
4	.73	2.879	7.01	.92	18	.37	-5.54
5	.67	2.918	7.47	.88	18	.49	-5.92

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

Age	Slope	t-value	Interce	RSqua	No Pts	Reg s.e	Mean Q
6	.83	1.178	6.87	.82	18	.65	-6.24
7	1.22	-1.242	5.32	.77	18	.79	-5.99
1							

Table 4.13 (Continued)

Fleet : FLT03: Norwegian tra

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	99.99	99.99	99.99	99.99	99.99	.53	.96	.66	-.65	-.12
9	99.99	99.99	99.99	99.99	99.99	1.38	1.56	1.84	-2.19	-2.45
10	99.99	99.99	99.99	99.99	99.99	-.20	1.72	.83	.20	.78
11	99.99	99.99	99.99	99.99	99.99	.73	1.07	1.68	2.03	.55
12	99.99	99.99	99.99	99.99	99.99	1.97	3.10	2.47	1.77	.94
13	99.99	99.99	99.99	99.99	99.99	2.66	2.37	1.28	1.16	-.98

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	-.40	-.85	-.54	-.45	.03	-1.19	1.58	1.08	.37	-.38
9	-2.18	-.58	.02	.14	.27	-.05	1.77	.99	-.11	.16
10	-3.79	-1.00	.31	-.44	.96	.23	1.26	-.78	.14	.41
11	-2.01	-3.02	-1.51	.20	-.25	.31	1.45	1.26	-1.46	.85
12	.61	.07	.38	.41	1.21	.09	.85	1.07	-.25	.66
13	-.58	.20	-.70	.17	1.27	99.99	1.44	.82	.31	.35

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	-1.8123	-2.2600	-2.1010	-2.4469	-2.4469	-2.4469
S.E(Log q)	.8287	1.2957	1.2636	1.4899	1.1632	1.0925

Table 4.13 (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	1.01	-.048	1.76	.76	15	.88	-1.81
9	.80	.938	3.33	.69	15	1.04	-2.26
10	.77	1.038	3.13	.68	15	.97	-2.10
11	.71	1.381	3.39	.70	15	1.02	-2.45
12	1.01	-.055	1.61	.79	15	.85	-1.64
13	.89	.700	2.14	.82	14	.86	-1.92
1							

Fleet : FLT04: Norway bottom

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	99.99	99.99	.13	.76	.90	.15	.64	-.06	-.34	-.46
2	99.99	99.99	.65	1.47	.80	-.10	.77	.17	.59	-.71
3	99.99	99.99	.16	.33	1.46	-.11	.27	.54	.43	-.39
4	99.99	99.99	.53	.26	.39	-.37	-.12	.10	.37	-.14
5	99.99	99.99	.69	.55	.96	.80	99.99	.00	-.06	.11
6	99.99	99.99	.27	-1.64	-.37	-.25	99.99	-1.24	.86	.66
7	99.99	99.99	.52	-.74	-.89	.58	99.99	99.99	-.59	1.26
8	99.99	99.99	99.99	-.41	.41	.23	99.99	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	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	.44	.44	.16	.36	-.23	-.07	-.18	-.24	-.27	-.22
2	-.32	.08	-.14	.33	.09	-.14	.10	-.14	-.35	-.14
3	-.31	-.33	.03	.02	.11	.44	.17	-.12	-.32	-.45
4	.37	-.35	-.44	-.16	-.01	.35	.20	.21	-.37	.02
5	.07	-.23	-.42	-.34	.26	.19	.10	-.20	-.02	-.05
6	-.63	-.75	-.50	-1.24	.60	1.05	1.21	.36	-.31	-.22
7	.28	.04	-.87	-1.13	99.99	.48	1.00	.33	-.19	-.45
8	99.99	.53	-.43	-.34	-.10	99.99	-.31	.87	-.37	.08
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 4.13 (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	8
Mean Log q	-6.3466	-6.5579	-6.9569
S.E(Log q)	.8312	.7398	.4686

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.85	1.481	6.22	.91	18	.36	-4.84
2	.83	1.578	6.33	.89	18	.40	-5.11
3	.84	1.551	6.22	.90	18	.39	-5.18
4	.74	3.451	6.90	.95	18	.30	-5.44
5	.65	4.681	7.53	.95	17	.30	-5.89

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
6	.66	3.869	7.59	.93	17	.36	-6.35
7	.81	1.148	7.10	.82	15	.59	-6.56
8	.96	.216	7.04	.83	11	.48	-6.96
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1998

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weight	Estimated F
FLT01: Russian botto	717946.	.490	.000	.00	1	.196	.000
FLT02: Norway acoust	549994.	.423	.000	.00	1	.264	.000
FLT03: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT04: Norway bottom	470241.	.389	.000	.00	1	.311	.000
P shrinkage mean	177790.	1.09					.000
F shrinkage mean	946693.	.50					.000

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
584615.	.22	.18	5	.822	.000

Table 4.13 (Continued)

Age 2 Catchability dependent on age and year class strength

Year class = 1997

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weight	Estimated F
FLT01: Russian botto	67434.	.349	.173	.50	2	.192	.006
FLT02: Norway acoust	61852.	.241	.228	.94	2	.401	.006
FLT03: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT04: Norway bottom	50079.	.282	.063	.22	2	.294	.008
P shrinkage mean	99572.	1.11					.004
F shrinkage mean	89631.	.50					.004

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
61752.	.15	.09	8	.616	.007

Age 3 Catchability dependent on age and year class strength

Year class = 1996

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weight	Estimated F
FLT01: Russian botto	92436.	.302	.158	.52	3	.171	.180
FLT02: Norway acoust	96597.	.188	.125	.67	3	.443	.173
FLT03: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT04: Norway bottom	70930.	.229	.062	.27	3	.298	.229
P shrinkage mean	61505.	1.21					.260
F shrinkage mean	608869.	.50					.030

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
99741.	.13	.18	11	1.435	.168

Table 4.13 (Continued)

Age 4 Catchability dependent on age and year class strength

Year class = 1995

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	19795.	.262	.168	.64	4	.173	.299
FLT02: Norway acoust	24244.	.170	.241	1.42	4	.413	.250
FLT03: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT04: Norway bottom	20054.	.188	.072	.38	4	.339	.296
P shrinkage mean	39090.	1.29					.162
F shrinkage mean	40037.	.50					.159

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
22782.	.11	.10	14	.896	.264

Age 5 Catchability dependent on age and year class strength

Year class = 1994

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	12866.	.241	.186	.77	5	.166	.757
FLT02: Norway acoust	17767.	.163	.101	.62	5	.354	.598
FLT03: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT04: Norway bottom	14461.	.163	.076	.47	5	.376	.696
P shrinkage mean	19736.	1.34					.552
F shrinkage mean	29139.	.50					.405

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
16336.	.11	.08	17	.746	.637

1

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

Year class = 1993

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	3983.	.239	.102	.43	6	.165	.834
FLT02: Norway acoust	6495.	.162	.100	.62	6	.348	.587
FLT03: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT04: Norway bottom	5644.	.161	.074	.46	6	.362	.651

Table 4.13 (Continued)

F shrinkage mean	6063.	.50					.618

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5646.	.11	.06	19	.541	.651

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

Year class = 1992

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	2589.	.255	.094	.37	7	.154	.771
FLT02: Norway acoust	3682.	.174	.083	.48	7	.330	.598
FLT03: Norwegian tra	1.	.000	.000	.00	0	.000	.000
FLT04: Norway bottom	3432.	.171	.122	.71	7	.330	.630
F shrinkage mean	3173.	.50					.667

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3314.	.13	.06	22	.431	.646

1

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

Year class = 1991

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	7239.	.260	.152	.58	7	.115	.531
FLT02: Norway acoust	6654.	.174	.133	.76	7	.254	.567
FLT03: Norwegian tra	4661.	.863	.000	.00	1	.042	.736
FLT04: Norway bottom	7770.	.207	.055	.26	8	.369	.503
F shrinkage mean	5771.	.50					.631

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6791.	.15	.06	24	.375	.558

Table 4.13 (Continued)

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

Year class = 1990

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	9044.	.267	.272	1.02	7	.090	.455
FLT02: Norway acoust	9949.	.177	.100	.57	7	.203	.421
FLT03: Norwegian tra	11117.	.772	.102	.13	2	.064	.385
FLT04: Norway bottom	8363.	.212	.137	.65	8	.299	.485
F shrinkage mean	7174.	.50					.546

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
8429.	.19	.07	25	.362	.482

1

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

Year class = 1989

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	1194.	.280	.160	.57	7	.051	.330
FLT02: Norway acoust	885.	.190	.088	.46	7	.110	.424
FLT03: Norwegian tra	1125.	.754	.304	.40	3	.100	.347
FLT04: Norway bottom	1225.	.233	.158	.68	8	.192	.323
F shrinkage mean	501.	.50					.659

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
718.	.29	.13	26	.449	.501

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

Year class = 1988

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	177.	.291	.129	.44	7	.040	.466
FLT02: Norway acoust	146.	.198	.106	.54	7	.084	.542
FLT03: Norwegian tra	356.	.737	.286	.39	4	.109	.258
FLT04: Norway bottom	128.	.230	.109	.48	8	.144	.599
F shrinkage mean	151.	.50					.528

Table 4.13 (Continued)

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
162.	.32	.07	27	.229	.499

1

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

Year class = 1987

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	49.	.298	.254	.85	7	.040	.663
FLT02: Norway acoust	34.	.202	.139	.69	7	.086	.862
FLT03: Norwegian tra	41.	.672	.527	.78	5	.130	.756
FLT04: Norway bottom	30.	.201	.106	.53	6	.074	.935
F shrinkage mean	54.	.50					.620

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
48.	.35	.11	26	.303	.678

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

Year class = 1986

Fleet		Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT01: Russian botto	23.	.300	.248	.83	7	.022	.439
FLT02: Norway acoust	13.	.204	.165	.81	7	.048	.672
FLT03: Norwegian tra	23.	.727	.189	.26	6	.143	.438
FLT04: Norway bottom	16.	.201	.157	.78	8	.069	.583
F shrinkage mean	17.	.50					.548

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
18.	.37	.05	29	.139	.536

Table 4.14

Run title : Arctic Haddock (run: SVPLMO06/V06)

At 25/08/2000 17:03

Traditional vpa using file input for terminal F

Table 8 Fishing mortality (F) at age

YEAF	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
AGE										
3	0.0544	0.1401	0.1123	0.0715	0.0608	0.0246	0.1132	0.0439	0.028	0.0715
4	0.5956	0.2181	0.549	0.3752	0.244	0.1331	0.1695	0.2479	0.1695	0.1706
5	0.8103	0.6381	0.5791	0.5381	0.2901	0.4844	0.2729	0.359	0.5709	0.3225
6	0.7987	0.8772	0.901	0.4817	0.4156	0.4276	0.7943	0.3944	0.4875	0.5449
7	1.1602	0.7756	0.9008	0.7363	0.5963	1.018	0.5355	0.777	0.9052	0.5369
8	0.9344	1.0115	1.1293	0.5332	0.921	0.5891	0.9464	0.3516	0.7781	0.3831
9	0.5334	1.1382	1.4057	0.4137	0.8312	0.4894	0.3657	0.6472	0.4915	0.6644
10	0.528	0.7185	0.6468	0.6776	0.6333	0.2542	0.8346	0.5539	0.9212	0.3142
11	0.9257	0.8384	0.8647	1.2501	0.6419	0.1869	0.3319	0.1472	0.8466	0.7888
12	1.7824	0.496	0.5211	1.0038	0.7561	0.3055	0.3572	0	2.0716	0.7176
13	0.953	0.849	0.9258	0.7853	0.7659	0.3658	0.57	0.3403	1.0378	0.5776
+gp	0.953	0.849	0.9258	0.7853	0.7659	0.3658	0.57	0.3403	1.0378	0.5776
0 FBAR	0.8412	0.6273	0.7325	0.5328	0.3865	0.5158	0.4431	0.4446	0.5333	0.3937

Table 8 Fishing mortality (F) at age

YEAF	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
3	0.2008	0.1691	0.1996	0.1216	0.0798	0.0671	0.1277	0.0623	0.037	0.1024
4	0.3797	0.4831	0.5945	0.6799	0.3158	0.2351	0.3868	0.3043	0.4029	0.1478
5	0.5041	0.6908	1.0448	0.9334	0.6898	0.4597	0.5753	0.4254	0.5646	0.508
6	0.6086	0.7061	1.0422	0.984	0.8556	0.6909	0.7161	0.4947	0.464	0.5546
7	0.503	0.7177	0.6211	0.954	0.7553	0.6499	0.8009	0.5022	0.64	0.4101
8	0.5736	0.8176	0.6579	0.5241	0.8427	0.4807	0.4902	0.5554	0.6422	0.426
9	0.9026	0.6337	0.9724	0.6435	0.8208	0.7619	0.4131	0.3455	0.4589	0.4137
10	0.4998	0.517	0.4071	0.6267	0.2306	0.2617	0.3506	0.2902	0.5437	0.419
11	1.4777	0.7015	0.4906	0.2264	0.7628	0.9519	0.8032	0.5473	0.271	0.2351
12	0.396	0.827	0.6285	0.3063	2.1653	1.7276	0.2754	0.9309	1.0635	0.1769
13	0.779	0.7054	0.6358	0.4662	0.9777	0.8498	0.4697	0.5385	0.6031	0.3359
+gp	0.779	0.7054	0.6358	0.4662	0.9777	0.8498	0.4697	0.5385	0.6031	0.3359
0 FBAR	0.4989	0.6494	0.8256	0.8878	0.6541	0.5089	0.6198	0.4316	0.5179	0.4051

Table 8 Fishing mortality (F) at age

YEAF	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
3	0.1677	0.0231	0.2856	0.3365	0.2214	0.258	0.3229	0.7675	0.3643	0.1554
4	0.2334	0.2689	0.3846	0.6005	0.3427	0.5757	0.6513	1.2815	0.6441	0.51
5	0.2048	0.1836	1.0626	0.9492	0.4205	0.5182	0.6146	0.9453	0.8945	0.9722
6	0.5098	0.1466	0.9623	0.4694	0.6381	0.4463	0.7081	0.5018	0.4544	0.9638
7	0.4782	0.4202	0.4094	0.3036	0.5792	0.5114	0.7992	0.6377	0.6911	0.5281
8	0.4132	0.3405	0.6192	0.1784	0.5004	0.3388	0.6447	0.5344	0.4535	0.5268
9	0.3025	0.3038	0.5533	0.3047	0.4263	0.2131	0.7642	0.3247	0.6628	0.5033
10	0.3288	0.2584	0.6316	0.2	0.7446	0.1488	0.9202	0.5182	0.28	0.5578
11	0.408	0.2769	0.4164	0.1955	0.6501	0.4039	0.5383	2.2954	0.7962	0.5778
12	0.2179	0.654	0.828	0.2444	0.6756	0.195	1.5097	0.3783	0.4314	0.6972
13	0.3355	0.3683	0.6162	0.2243	0.6038	0.2587	0.8849	0.8225	0.5284	0.5765
+gp	0.3355	0.3683	0.6162	0.2243	0.6038	0.2587	0.8849	0.8225	0.5284	0.5765
0 FBAR	0.3565	0.2548	0.7047	0.5806	0.4951	0.5129	0.6933	0.8415	0.671	0.7435

Table 4.14 (Continued)

Table 8 Fishing mortality (F) at age

YEAF	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	0.0374	0.1001	0.1306	0.1786	0.0557	0.1356	0.0666	0.0524	0.0231	0.0682
4	0.3109	0.2099	0.2709	0.4629	0.3349	0.1951	0.4574	0.4539	0.1636	0.1768
5	0.6938	0.5603	0.4684	0.4655	0.3738	0.3787	0.2626	0.9209	0.5171	0.3494
6	0.8248	0.9102	0.7031	0.3537	0.2906	0.6375	0.4886	0.2386	1.1415	0.4697
7	0.43	0.7876	0.5939	0.4105	0.3405	0.5484	0.7468	0.5503	0.2415	0.6192
8	0.7456	0.5523	0.669	0.4199	0.5516	0.5266	0.5221	0.6593	0.3319	0.243
9	0.4421	0.5729	0.5395	0.195	0.4323	0.7395	0.501	0.5621	0.3942	0.0852
10	0.6126	0.2399	0.6274	0.5634	0.4349	0.7928	0.6808	0.3872	0.7893	0.9212
11	0.7167	0.5196	0.5388	0.4899	0.9687	0.6418	0.5101	0.565	1.1421	0.5144
12	0.8749	0.8091	1.5791	0.226	2.6455	0.5145	1.4271	0.9851	1.231	0.5238
13	0.6842	0.5409	0.7997	0.3776	1.0231	0.6111	0.6769	0.5939	0.7348	0.4739
+gp	0.6842	0.5409	0.7997	0.3776	1.0231	0.6111	0.6769	0.5939	0.7348	0.4739
0 FBAR	0.5649	0.617	0.5091	0.4231	0.3349	0.4399	0.4889	0.5409	0.5159	0.4038

Table 8 Fishing mortality (F) at age

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	FBAR 97-99
3	0.0248	0.0534	0.0688	0.0226	0.0128	0.0209	0.0272	0.0266	0.0595	0.1679	0.0847
4	0.1013	0.1361	0.2395	0.2046	0.105	0.0792	0.1329	0.1928	0.2848	0.2645	0.2474
5	0.1187	0.234	0.2458	0.4427	0.4663	0.2641	0.356	0.4712	0.4573	0.6371	0.5219
6	0.189	0.2693	0.3517	0.4965	0.647	0.6047	0.4951	0.6745	0.6411	0.6513	0.6556
7	0.2427	0.3177	0.3168	0.3396	0.6556	0.5958	0.7334	0.7386	0.5805	0.6462	0.6551
8	0.3034	0.248	0.3138	0.3356	0.4328	0.2962	0.8121	0.8805	0.6992	0.558	0.7126
9	0.7439	0.2266	0.2393	0.4549	0.5956	0.3514	0.6469	0.5658	0.5497	0.4815	0.5323
10	0.6717	0.0765	0.2085	0.2777	0.9266	0.4932	0.6671	0.6671	0.5067	0.5009	0.5582
11	0.1694	0.0239	0.0571	0.4578	0.3875	0.4315	0.5385	0.9918	0.2704	0.4989	0.587
12	0.2311	0.7365	0.1257	0.3959	0.992	0.2478	0.5724	0.6247	0.6272	0.6783	0.6434
13	0.4224	0.2379	0.2127	0.4557	0.6811	0.3434	0.563	0.6927	0.5046	0.5361	0.5778
+gp	0.4224	0.2379	0.2127	0.4557	0.6811	0.3434	0.563	0.6927	0.5046	0.5361	
0 FBAR	0.1629	0.2393	0.2884	0.3709	0.4685	0.386	0.4294	0.5193	0.4909	0.5498	

Table 4.15

Run title : Arctic Haddock (run: SVPLMO06/V06)

At 25/08/2000 17:03

Traditional vpa using file input for terminal F

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

YEAF	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
AGE										
3	66401	552707	62333	1030188	122540	52309	169104	53254	68972	324528
4	92385	51486	393359	45614	785226	94405	41785	123630	41728	54911
5	69301	41693	33892	185992	25663	503712	67658	28876	78996	28837
6	37314	25233	18033	15550	88905	15721	254080	42163	16510	36544
7	45528	13745	8593	5997	7864	48037	8392	94003	23271	8302
8	16463	11683	5182	2858	2351	3547	14210	4022	35385	7706
9	5236	5295	3479	1371	1373	766	1611	4516	2317	13305
10	2914	2515	1389	698	742	490	385	915	1936	1160
11	1535	1407	1004	596	290	323	311	137	431	631
12	1118	498	498	346	140	125	219	183	97	151
13	1259	154	248	242	104	54	75	126	150	10
+gp	964	675	41	579	607	18	38	479	348	271
0 TOT	340417	707092	528051	1290031	1035805	719506	557868	352303	270139	476356

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

YEAF	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
AGE										
3	242519	109130	240726	274815	320310	100310	240268	290554	19930	17204
4	247369	162440	75449	161433	199246	242125	76793	173137	223522	15724
5	37908	138543	82042	34090	66966	118951	156699	42706	104567	122317
6	17102	18747	56847	23629	10975	27505	61501	72170	22851	48680
7	17351	7618	7575	16414	7232	3819	11285	24606	36029	11763
8	3973	8590	3043	3333	5177	2782	1633	4148	12192	15555
9	4301	1833	3105	1290	1616	1825	1409	819	1949	5252
10	5606	1428	796	961	555	582	697	763	474	1008
11	694	2784	697	434	421	361	367	402	467	226
12	235	130	1130	349	283	161	114	135	190	292
13	60	129	46	494	211	27	23	71	43	54
+gp	24	43	19	129	120	869	64	37	125	35
0 TOT	577141	451416	471476	517372	613110	499316	550854	609546	422341	238110

Traditional vpa using file input for terminal F

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

YEAF	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
3	163906	95473	1017665	269594	53611	48488	55634	113796	169924	134081
4	12715	113473	76381	626215	157659	35177	30671	32980	43245	96642
5	11105	8243	70997	42568	281249	91624	16195	13092	7497	18592
6	60260	7408	5617	20087	13490	151225	44679	7171	4165	2509
7	22889	29634	5238	1757	10285	5835	79238	18019	3555	2165
8	6391	11617	15938	2848	1062	4718	2865	29173	7797	1458
9	8318	3461	6766	7025	1951	527	2753	1231	13997	4056
10	2843	5032	2092	3185	4241	1043	349	1050	728	5907
11	543	1675	3182	911	2135	1649	736	114	512	451
12	146	296	1040	1718	613	913	901	352	9	189
13	200	96	126	372	1101	255	615	163	197	5
+gp	169	28	159	148	487	1128	630	190	173	132
0 TOT	289485	276437	1205200	976427	527884	342582	235265	217331	251800	266187

Table 4.15 (Continued)

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

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	18857	5623	7938	4735	9324	256480	535288	84761	43368	17557
4	93973	14872	4165	5703	3242	7153	183357	265026	65851	26823
5	47513	56378	9871	2601	2939	1899	4818	95011	137821	45778
6	5758	19437	26357	5059	1337	1656	1065	3034	30973	67278
7	784	2066	6404	10683	2908	819	717	535	1957	8098
8	1045	417	770	2895	5802	1694	387	278	253	1258
9	705	406	197	323	1557	2736	819	188	118	148
10	2008	371	187	94	217	828	1069	406	88	65
11	2768	891	239	82	44	115	307	443	226	33
12	207	1107	434	114	41	14	50	151	206	59
13	77	71	404	73	75	2	7	10	46	49
+gp	33	110	67	317	313	136	16	46	23	44
0 TOT	173726	101749	57033	32679	27801	273532	727899	449888	280929	167191

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 50-97	AMST 50-97
3	25291	84112	205152	680789	291419	77933	91292	111028	49787	143445	0	96106	188150
4	13427	17014	65284	155858	511902	213144	52506	40746	65848	36026	99271	67094	130562
5	18403	9934	12157	42066	101200	370712	135199	35687	26178	37272	22640	39464	76262
6	26429	13380	6436	7785	20057	51319	209398	75796	17695	13063	16137	19137	37484
7	34439	17912	8368	3707	3879	8592	22724	103695	31284	7631	5576	8656	17173
8	3569	22119	10674	4991	2161	1649	3877	8935	40563	14333	3274	3796	6677
9	808	2158	14132	6385	2921	1148	1004	1409	3033	16504	6717	1792	3123
10	112	314	1408	9107	3317	1318	661	430	655	1433	8349	881	1552
11	21	47	238	936	5648	1075	659	278	181	323	711	449	822
12	16	15	37	184	485	3139	572	315	84	113	161	210	411
13	29	10	6	27	102	147	2006	264	138	37	47	83	211
+gp	48	36	6	18	4	8	58	321	312	171	100		
TOTAL	122590	167052	323899	911854	943097	730182	519955	378905	235757	270351	162982		

Table 4.16

Run title : Arctic Haddock (run: SVPLMO06/V06)

At 25/08/2000 17:03

Traditional vpa using file input for terminal F

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

	YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
	AGE										
	3	19648	235934	21043	388183	48512	16331	61677	19923	27854	170895
	4	42662	34299	207239	26823	485132	45995	23784	72181	26299	45126
	5	55616	48269	31031	190074	27554	426497	66926	29299	86521	41185
	6	39816	38842	21953	21129	126920	17698	334174	56881	24043	69395
	7	58377	25426	12570	9792	13491	64987	13264	152395	40723	18945
	8	24578	25163	8826	5433	4696	5587	26149	7592	72099	20474
	9	8685	12671	6584	2897	3047	1341	3294	9471	5245	39279
	10	5762	7172	3133	1758	1964	1021	937	2288	5223	4083
	11	3717	4915	2772	1836	941	824	928	418	1423	2718
	12	3359	2159	1708	1324	561	397	811	694	396	808
	13	4176	737	940	1023	461	188	309	527	677	59
	+gp	3456	3493	169	2643	2912	68	167	2173	1702	1733
0	TOTALI	269854	439080	317969	652917	716191	580934	532421	353841	292205	414699

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

	YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
	AGE										
	3	133985	57745	118179	134610	130128	45828	104635	151685	10405	9110
	4	213279	134139	57804	123402	126323	172633	52191	141058	182120	12994
	5	56800	198822	109235	45286	73784	147390	185079	60466	148063	175658
	6	34071	35771	100637	41736	16078	45313	96582	135864	43020	92952
	7	41538	17468	16115	34840	12731	7561	21297	55665	81511	26991
	8	11076	22934	7538	8237	10611	6413	3587	10926	32117	41556
	9	13322	5438	8546	3544	3679	4674	3439	2396	5704	15591
	10	20693	5049	2612	3147	1507	1777	2029	2661	1655	3567
	11	3137	12054	2800	1739	1398	1349	1307	1718	1996	977
	12	1316	696	5633	1738	1168	745	504	713	1009	1569
	13	374	767	255	2711	959	136	114	415	254	320
	+gp	162	276	110	768	591	4810	339	233	794	222
0	TOTALI	529752	491160	429465	401756	378959	438630	471103	563800	508650	381506

Traditional vpa using file input for terminal F

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

	YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	AGE										
	3	81469	63479	575322	147101	30418	25900	22867	57665	106283	99531
	4	9863	117743	67388	533240	139602	29324	19674	26081	42213	111957
	5	14970	14865	108857	62994	432790	132735	18054	17993	12717	37431
	6	108008	17763	11451	39523	27600	291290	66225	13105	9394	6717
	7	49299	85380	12833	4154	25288	13506	141135	39566	9635	6963
	8	16027	38970	45461	7840	3039	12716	5941	74587	24606	5462
	9	23177	12902	21443	21489	6204	1578	6343	3497	49080	16880
	10	9442	22356	7901	11613	16078	3721	958	3554	3044	29297
	11	2208	9115	14717	4065	9912	7207	2474	472	2619	2737
	12	736	1995	5968	9515	3532	4948	3761	1809	60	1424
	13	1116	716	798	2276	7007	1530	2833	927	1383	42
	+gp	1020	229	1090	977	3348	7302	3137	1169	1313	1190
0	TOTALI	317335	385513	873230	844786	704818	531758	293403	240423	262347	319631

Table 4.16 (Continued)

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

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	12845	3647	4892	2070	2454	107703	142806	17404	9209	4711
4	99899	15055	4006	5417	2846	5338	128241	109098	25223	11377
5	87778	99184	16498	3887	4844	3435	6644	85783	84792	29894
6	14143	45465	58572	9588	3050	3926	2171	6677	34546	65029
7	2313	5808	17101	25217	5932	2124	1462	1503	3046	11020
8	3592	1366	2393	8779	17592	5445	1162	847	834	4030
9	2692	1476	680	1088	5247	9773	2732	684	432	528
10	9138	1608	772	377	873	3523	4250	1761	384	276
11	15429	4728	1205	403	215	601	1492	2351	1210	170
12	1432	7289	2713	696	251	88	300	992	1371	380
13	589	514	2788	493	502	17	44	71	338	351
+gp	273	864	502	2311	2283	1052	112	364	183	335
0 TOTALI	250123	187004	112120	60327	46090	143026	291417	227534	161571	128100

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

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
3	6430	30058	71091	203190	68128	16790	18978	22638	11782	40681
4	9438	12617	54242	126129	276168	77316	23509	15801	30567	21448
5	16746	13686	18712	60248	107070	298293	92558	24397	21920	38121
6	32856	20894	12795	15609	30679	74256	235437	83937	21331	19548
7	51635	30769	18993	8409	7515	16788	41901	152145	46255	12685
8	6888	47321	25090	15222	5417	4813	9415	21808	80650	27590
9	2113	5645	36771	21686	6929	3374	2824	4532	9677	42142
10	474	931	5030	31013	8686	4007	2196	1434	2120	4057
11	110	241	1305	3937	17832	3408	2292	1291	658	1170
12	103	94	253	739	1938	12582	2286	1259	341	454
13	204	74	43	119	447	649	8821	1161	614	163
+gp	367	278	47	90	22	38	292	1603	1578	861
0 TOTALI	127365	162608	244372	486391	530829	512313	440508	332007	227493	208922

Table 4.17

Run title : Arctic Haddock (run: SVPLMO06/V06)

At 25/08/2000 17:03

Traditional vpa using file input for terminal F

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

	YEAR	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
	AGE										
	3	0	0	0	0	0	0	0	0	0	0
	4	2133	1715	10362	1341	24257	2300	1189	3609	1315	2256
	5	12792	11102	7137	43717	6338	98094	15393	6739	19900	9472
	6	21102	20586	11635	11198	67268	9380	177112	30147	12743	36779
	7	51372	22374	11062	8617	11872	57188	11673	134107	35836	16672
	8	24087	24659	8649	5325	4602	5475	25626	7440	70657	20065
	9	8685	12671	6584	2897	3047	1341	3294	9471	5245	39279
	10	5762	7172	3133	1758	1964	1021	937	2288	5223	4083
	11	3717	4915	2772	1836	941	824	928	418	1423	2718
	12	3359	2159	1708	1324	561	397	811	694	396	808
	13	4176	737	940	1023	461	188	309	527	677	59
	+gp	3456	3493	169	2643	2912	68	167	2173	1702	1733
0	TOTSPBIO	140642	111584	64151	81680	124221	176276	237439	197612	155117	133923

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

	YEAR	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
	AGE										
	3	0	0	0	0	0	0	0	0	0	0
	4	10664	6707	2890	6170	6316	8632	2610	7053	9106	650
	5	13064	45729	25124	10416	16970	33900	42568	13907	34055	40401
	6	18058	18959	53338	22120	8521	24016	51188	72008	22801	49265
	7	36553	15372	14181	30659	11203	6654	18741	48985	71730	23752
	8	10854	22475	7387	8072	10399	6285	3515	10707	31474	40725
	9	13322	5438	8546	3544	3679	4674	3439	2396	5704	15591
	10	20693	5049	2612	3147	1507	1777	2029	2661	1655	3567
	11	3137	12054	2800	1739	1398	1349	1307	1718	1996	977
	12	1316	696	5633	1738	1168	745	504	713	1009	1569
	13	374	767	255	2711	959	136	114	415	254	320
	+gp	162	276	110	768	591	4810	339	233	794	222
0	TOTSPBIO	128196	133522	122878	91083	62714	92977	126355	160796	180578	177038

Traditional vpa using file input for terminal F

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

	YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	AGE										
	3	0	0	0	0	0	0	0	0	0	0
	4	493	5887	3369	26662	6980	1466	984	1304	2111	5598
	5	3443	3419	25037	14489	99542	30529	4152	4138	2925	8609
	6	57244	9414	6069	20947	14628	154384	35099	6945	4979	3560
	7	43383	75134	11293	3655	22253	11885	124199	34818	8479	6128
	8	15707	38191	44552	7683	2979	12462	5822	73096	24114	5352
	9	23177	12902	21443	21489	6204	1578	6343	3497	49080	16880
	10	9442	22356	7901	11613	16078	3721	958	3554	3044	29297
	11	2208	9115	14717	4065	9912	7207	2474	472	2619	2737
	12	736	1995	5968	9515	3532	4948	3761	1809	60	1424
	13	1116	716	798	2276	7007	1530	2833	927	1383	42
	+gp	1020	229	1090	977	3348	7302	3137	1169	1313	1190
0	TOTSPBIO	157970	179359	142238	123371	192463	237013	189763	131728	100106	80817

Table 4.17 (Continued)

Table 15	Spawning stock biomass with SOP (spawning time)				Tonnes					
YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
3	0	36	440	352	172	2154	0	0	0	0
4	4995	1807	2203	3792	398	427	28213	1091	757	455
5	20189	63478	12043	3887	1696	2748	3522	18014	27981	8968
6	7496	33189	54472	9588	1434	3651	1867	3539	17619	40968
7	2036	5576	16417	25217	4389	2039	1257	1503	3046	9037
8	3520	1366	2393	8779	17592	5445	1162	847	834	4030
9	2692	1476	680	1088	5247	9773	2732	684	432	528
10	9138	1608	772	377	873	3523	4250	1761	384	276
11	15429	4728	1205	403	215	601	1492	2351	1210	170
12	1432	7289	2713	696	251	88	300	992	1371	380
13	589	514	2788	493	502	17	44	71	338	351
+gp	273	864	502	2311	2283	1052	112	364	183	335
0 TOTSPBIO	67788	121931	96628	56984	35053	31519	44952	31217	54157	65497

Table 15	Spawning stock biomass with SOP (spawning time)				Tonnes					
YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
3	0	0	1422	3048	0	0	0	0	0	407
4	189	883	7051	27622	4695	1546	0	474	1528	3646
5	5024	4106	9356	29522	13919	35795	9256	2440	6138	19060
6	17742	10447	7933	11863	12578	31188	84757	24342	10665	13879
7	39759	24615	14625	6643	6763	13598	32683	91287	30528	10275
8	5993	43535	20072	13395	4767	4235	8097	17883	65326	25107
9	1690	5645	34565	19083	6929	3374	2542	4532	8806	38771
10	474	931	5030	26982	8686	3486	2042	1190	2120	4057
11	110	241	1305	3937	17297	3408	2063	1291	658	1170
12	103	94	253	739	1938	11827	2286	1259	341	454
13	204	74	43	119	447	649	8821	1161	614	163
+gp	367	278	47	90	22	38	292	1603	1578	861
0 TOTSPBIO	71655	90850	101701	143043	78040	109144	152838	147462	128303	117851

Table 4.18

Run title : Arctic Haddock (run: SVPLMO06/V06)

At 25/08/2000 17:03

Table 17 Summary (with SOP correction)

Traditional vpa using file input for terminal F

	RE Age 3	TOTAL	TOTSPI	LANDII	YIELD/S	SOPCO	FBAR 4- 7
1950	66401	269854	140642	132125	0.9394	0.4483	0.8412
1951	552707	439080	111584	120077	1.0761	0.6468	0.6273
1952	62333	317969	64151	127660	1.99	0.5115	0.7325
1953	1030188	652917	81680	123920	1.5171	0.5709	0.5328
1954	122540	716191	124221	156788	1.2622	0.5998	0.3865
1955	52309	580934	176276	202286	1.1476	0.473	0.5158
1956	169104	532421	237439	213924	0.901	0.5526	0.4431
1957	53254	353841	197612	123583	0.6254	0.5668	0.4446
1958	68972	292205	155117	112672	0.7264	0.6119	0.5333
1959	324528	414699	133923	88211	0.6587	0.7979	0.3937
1960	242519	529752	128196	155454	1.2126	0.8371	0.4989
1961	109130	491160	133522	193234	1.4472	0.8017	0.6494
1962	240726	429465	122878	187888	1.5291	0.7438	0.8256
1963	274815	401756	91083	146744	1.6111	0.7422	0.8878
1964	320310	378959	62714	98900	1.577	0.6155	0.6541
1965	100310	438630	92977	118079	1.27	0.6922	0.5089
1966	240268	471103	126355	160621	1.2712	0.6598	0.6198
1967	290554	563800	160796	136486	0.8488	0.791	0.4316
1968	19930	508650	180578	181726	1.0064	0.791	0.5179
1969	17204	381506	177038	130502	0.7371	0.8023	0.4051
1970	163906	317335	157970	86601	0.5482	0.7531	0.3565
1971	95473	385513	179359	78908	0.4399	1.0074	0.2548
1972	1017665	873230	142238	265317	1.8653	0.8566	0.7047
1973	269594	844786	123371	320065	2.5943	0.8267	0.5806
1974	53611	704818	192463	221138	1.149	0.8597	0.4951
1975	48488	531758	237013	175758	0.7416	0.8093	0.5129
1976	55634	293403	189763	137218	0.7231	0.6228	0.6933
1977	113796	240423	131728	110158	0.8363	0.7678	0.8415
1978	169924	262347	100106	95422	0.9532	0.9477	0.671
1979	134081	319631	80817	103623	1.2822	1.1247	0.7435
1980	18857	250123	67788	87889	1.2965	1.0321	0.5649
1981	5623	187004	121931	77153	0.6328	0.9828	0.617
1982	7938	112120	96628	46955	0.4859	0.9337	0.5091
1983	4735	60327	56984	21607	0.3792	0.9107	0.4231
1984	9324	46090	35053	17661	0.5038	0.9105	0.3349
1985	256480	143026	31519	41270	1.3094	0.9654	0.4399
1986	535288	291417	44952	96585	2.1486	0.9013	0.4889
1987	84761	227534	31217	150659	4.8262	0.9825	0.5409
1988	43368	161571	54157	91744	1.694	0.9923	0.5159
1989	17557	128100	65497	55122	0.8416	0.9617	0.4038
1990	25291	127365	71655	25816	0.3603	0.963	0.1629
1991	84112	162608	90850	33605	0.3699	0.9581	0.2393
1992	205152	244372	101701	53886	0.5298	1.0132	0.2884
1993	680789	486391	143043	77619	0.5426	1.0016	0.3709
1994	291419	530829	78040	121365	1.5552	0.9991	0.4685
1995	77933	512313	109144	138423	1.2683	1.0021	0.386
1996	91292	440508	152838	173525	1.1354	0.9994	0.4294
1997	111028	332007	147462	148741	1.0087	0.9995	0.5193
1998	49787	227493	128303	94269	0.7347	1.0113	0.4909
1999	143445	208922	117851	81707	0.6933	1.0057	0.5498
Arith. Mean	184489	376365	119604	122814	1.1361		.5210
0 Units	(Thousai	(Tonnes	(Tonnes	(Tonnes)			

Table 4.19

The SAS System 12:53 Monday, August 28, 2000
North-East Arctic haddock (Sub-areas I and II)

Prediction with management option table: Input data

Year: 2000

Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	61752.000	0.2002	0.0050	0.0000	0.0000	0.258	0.1201	0.722
4	99271.000	0.2000	0.1350	0.0000	0.0000	0.526	0.2902	0.980
5	22640.000	0.2000	0.4250	0.0000	0.0000	0.923	0.5782	1.269
6	16137.000	0.2000	0.6550	0.0000	0.0000	1.340	0.6828	1.464
7	5576.000	0.2000	0.7600	0.0000	0.0000	1.558	0.6481	1.598
8	3274.000	0.2000	0.9200	0.0000	0.0000	1.940	0.6642	1.790
9	6717.000	0.2000	0.9400	0.0000	0.0000	2.847	0.5448	2.193
10	8349.000	0.2000	0.9850	0.0000	0.0000	3.008	0.5323	2.506
11	711.000	0.2000	1.0000	0.0000	0.0000	3.600	0.4064	2.661
12	161.000	0.2000	1.0000	0.0000	0.0000	4.000	0.6897	3.083
13	47.000	0.2000	1.0000	0.0000	0.0000	4.400	0.5498	3.018
14+	100.000	0.2000	1.0000	0.0000	0.0000	5.000	0.5498	3.059
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	410163.00	0.2002	0.0050	0.0000	0.0000	0.258	0.1201	0.722
4	.	0.2000	0.1350	0.0000	0.0000	0.526	0.2902	0.980
5	.	0.2000	0.4250	0.0000	0.0000	0.923	0.5782	1.269
6	.	0.2000	0.6550	0.0000	0.0000	1.340	0.6828	1.464
7	.	0.2000	0.7600	0.0000	0.0000	1.558	0.6481	1.598
8	.	0.2000	0.9200	0.0000	0.0000	1.940	0.6642	1.790
9	.	0.2000	0.9400	0.0000	0.0000	2.847	0.5448	2.193
10	.	0.2000	0.9850	0.0000	0.0000	3.008	0.5323	2.506
11	.	0.2000	1.0000	0.0000	0.0000	3.600	0.4064	2.661
12	.	0.2000	1.0000	0.0000	0.0000	4.000	0.6897	3.083
13	.	0.2000	1.0000	0.0000	0.0000	4.400	0.5498	3.018
14+	.	0.2000	1.0000	0.0000	0.0000	5.000	0.5498	3.059
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
3	130000.00	0.2002	0.0050	0.0000	0.0000	0.258	0.1201	0.722
4	.	0.2000	0.1350	0.0000	0.0000	0.526	0.2902	0.980
5	.	0.2000	0.4250	0.0000	0.0000	0.923	0.5782	1.269
6	.	0.2000	0.6550	0.0000	0.0000	1.340	0.6828	1.464
7	.	0.2000	0.7600	0.0000	0.0000	1.558	0.6481	1.598
8	.	0.2000	0.9200	0.0000	0.0000	1.940	0.6642	1.790
9	.	0.2000	0.9400	0.0000	0.0000	2.847	0.5448	2.193
10	.	0.2000	0.9850	0.0000	0.0000	3.008	0.5323	2.506
11	.	0.2000	1.0000	0.0000	0.0000	3.600	0.4064	2.661
12	.	0.2000	1.0000	0.0000	0.0000	4.000	0.6897	3.083
13	.	0.2000	1.0000	0.0000	0.0000	4.400	0.5498	3.018
14+	.	0.2000	1.0000	0.0000	0.0000	5.000	0.5498	3.059
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANLMO02
Date and time: 29AUG00:17:45

Table 4.20

The SAS System 12:53 Monday, August 28, 2000

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

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.516	10092.523	3.079	8566.999	3.079	8566.999
0.0500	0.0275	0.102	180.837	5.010	8258.636	2.610	6783.432	2.610	6783.432
0.1000	0.0550	0.181	308.302	4.617	6910.932	2.250	5482.255	2.250	5482.255
0.1500	0.0825	0.244	400.522	4.302	5893.410	1.968	4507.845	1.968	4507.845
0.2000	0.1100	0.296	468.721	4.045	5107.798	1.741	3762.262	1.741	3762.262
0.2500	0.1375	0.339	520.120	3.832	4489.601	1.556	3181.310	1.556	3181.310
0.3000	0.1649	0.375	559.508	3.651	3995.061	1.403	2721.492	1.403	2721.492
0.3500	0.1924	0.406	590.149	3.497	3593.657	1.275	2352.520	1.275	2352.520
0.4000	0.2199	0.433	614.311	3.363	3263.598	1.165	2052.813	1.165	2052.813
0.4500	0.2474	0.457	633.602	3.246	2989.010	1.072	1806.682	1.072	1806.682
0.5000	0.2749	0.478	649.182	3.143	2758.126	0.991	1602.528	0.991	1602.528
0.5500	0.3024	0.497	661.895	3.051	2562.089	0.921	1431.639	0.921	1431.639
0.6000	0.3299	0.514	672.370	2.969	2394.138	0.859	1287.391	0.859	1287.391
0.6500	0.3574	0.529	681.076	2.895	2249.048	0.804	1164.677	0.804	1164.677
0.7000	0.3849	0.542	688.370	2.828	2122.738	0.756	1059.523	0.756	1059.523
0.7500	0.4124	0.555	694.523	2.766	2011.985	0.713	968.805	0.713	968.805
0.8000	0.4399	0.567	699.747	2.710	1914.222	0.674	890.042	0.674	890.042
0.8500	0.4674	0.577	704.207	2.658	1827.383	0.639	821.248	0.639	821.248
0.9000	0.4948	0.587	708.033	2.610	1749.798	0.607	760.823	0.607	760.823
0.9500	0.5223	0.596	711.328	2.566	1680.099	0.578	707.467	0.578	707.467
1.0000	0.5498	0.605	714.176	2.525	1617.165	0.551	660.116	0.551	660.116
1.0500	0.5773	0.613	716.643	2.486	1560.067	0.527	617.894	0.527	617.894
1.1000	0.6048	0.620	718.784	2.450	1508.031	0.505	580.076	0.505	580.076
1.1500	0.6323	0.627	720.645	2.416	1460.409	0.485	546.060	0.485	546.060
1.2000	0.6598	0.634	722.263	2.384	1416.654	0.466	515.339	0.466	515.339
1.2500	0.6873	0.640	723.670	2.354	1376.304	0.448	487.489	0.448	487.489
1.3000	0.7148	0.646	724.890	2.325	1338.967	0.432	462.150	0.432	462.150
1.3500	0.7423	0.652	725.948	2.298	1304.305	0.416	439.017	0.416	439.017
1.4000	0.7698	0.657	726.861	2.272	1272.028	0.402	417.829	0.402	417.829
1.4500	0.7972	0.662	727.647	2.247	1241.888	0.389	398.364	0.389	398.364
1.5000	0.8247	0.667	728.318	2.224	1213.668	0.376	380.430	0.376	380.430
1.5500	0.8522	0.672	728.888	2.201	1187.179	0.364	363.860	0.364	363.860
1.6000	0.8797	0.676	729.367	2.180	1162.257	0.353	348.510	0.353	348.510
1.6500	0.9072	0.681	729.765	2.159	1138.758	0.343	334.257	0.343	334.257
1.7000	0.9347	0.685	730.089	2.139	1116.554	0.333	320.990	0.333	320.990
1.7500	0.9622	0.689	730.347	2.120	1095.534	0.324	308.614	0.324	308.614
1.8000	0.9897	0.693	730.546	2.102	1075.597	0.315	297.046	0.315	297.046
1.8500	1.0172	0.696	730.690	2.085	1056.656	0.306	286.209	0.306	286.209
1.9000	1.0447	0.700	730.786	2.068	1038.631	0.298	276.041	0.298	276.041
1.9500	1.0722	0.703	730.838	2.051	1021.452	0.291	266.481	0.291	266.481
2.0000	1.0997	0.707	730.850	2.035	1005.056	0.283	257.478	0.283	257.478
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDLMO04
Date and time : 29AUG00:10:51
Computation of ref. F: Simple mean, age 4 - 7
F-0.1 factor : 0.3987
F-max factor : Not found
F-0.1 reference F : 0.2192
F-max reference F : Not found
Recruitment : Single recruit

Table 4.21

The SAS System 12:53 Monday, August 28, 2000
North-East Arctic haddock (Sub-areas I and II)

Prediction with management option table

Year: 2000					Year: 2001						Year: 2002	
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	
0.8577	0.4716	173787	89225	62000	0.0000	0.0000	252513	84091	0	376275	141687	
.	.	.	.	.	0.0500	0.0275	.	84091	5796	370967	138421	
.	.	.	.	.	0.1000	0.0550	.	84091	11473	365782	135243	
.	.	.	.	.	0.1500	0.0825	.	84091	17034	360715	132151	
.	.	.	.	.	0.2000	0.1100	.	84091	22483	355764	129141	
.	.	.	.	.	0.2500	0.1375	.	84091	27822	350926	126211	
.	.	.	.	.	0.3000	0.1649	.	84091	33053	346196	123360	
.	.	.	.	.	0.3500	0.1924	.	84091	38181	341574	120585	
.	.	.	.	.	0.4000	0.2199	.	84091	43208	337054	117883	
.	.	.	.	.	0.4500	0.2474	.	84091	48135	332636	115254	
.	.	.	.	.	0.5000	0.2749	.	84091	52966	328315	112694	
.	.	.	.	.	0.5500	0.3024	.	84091	57704	324090	110201	
.	.	.	.	.	0.6000	0.3299	.	84091	62350	319958	107775	
.	.	.	.	.	0.6500	0.3574	.	84091	66906	315916	105412	
.	.	.	.	.	0.7000	0.3849	.	84091	71376	311962	103112	
.	.	.	.	.	0.7500	0.4124	.	84091	75761	308094	100872	
.	.	.	.	.	0.8000	0.4399	.	84091	80064	304309	98691	
.	.	.	.	.	0.8500	0.4674	.	84091	84286	300605	96566	
.	.	.	.	.	0.9000	0.4948	.	84091	88430	296981	94497	
.	.	.	.	.	0.9500	0.5223	.	84091	92497	293433	92482	
.	.	.	.	.	1.0000	0.5498	.	84091	96490	289960	90519	
.	.	.	.	.	1.0500	0.5773	.	84091	100410	286560	88608	
.	.	.	.	.	1.1000	0.6048	.	84091	104259	283230	86745	
.	.	.	.	.	1.1500	0.6323	.	84091	108039	279970	84931	
.	.	.	.	.	1.2000	0.6598	.	84091	111752	276778	83163	
.	.	.	.	.	1.2500	0.6873	.	84091	115399	273650	81441	
.	.	.	.	.	1.3000	0.7148	.	84091	118981	270587	79763	
.	.	.	.	.	1.3500	0.7423	.	84091	122501	267586	78128	
.	.	.	.	.	1.4000	0.7698	.	84091	125960	264646	76534	
.	.	.	.	.	1.4500	0.7972	.	84091	129359	261764	74981	
.	.	.	.	.	1.5000	0.8247	.	84091	132700	258940	73468	
.	.	.	.	.	1.5500	0.8522	.	84091	135985	256172	71993	
.	.	.	.	.	1.6000	0.8797	.	84091	139214	253459	70555	
.	.	.	.	.	1.6500	0.9072	.	84091	142388	250799	69153	
.	.	.	.	.	1.7000	0.9347	.	84091	145510	248191	67787	
.	.	.	.	.	1.7500	0.9622	.	84091	148581	245633	66455	
.	.	.	.	.	1.8000	0.9897	.	84091	151601	243125	65156	
.	.	.	.	.	1.8500	1.0172	.	84091	154572	240664	63890	
.	.	.	.	.	1.9000	1.0447	.	84091	157495	238251	62655	
.	.	.	.	.	1.9500	1.0722	.	84091	160371	235883	61451	
.	.	.	.	.	2.0000	1.0997	.	84091	163201	233559	60276	
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	

Notes: Run name : MANLMO02
Date and time : 29AUG00:10:21
Computation of ref. F: Simple mean, age 4 - 7
Basis for 2000 : TAC constraints

Table 4.22

The SAS System 12:53 Monday, August 28, 2000
North-East Arctic haddock (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 Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2000	0.8577	0.4716	48897	61998	224735	173787	56709	89225	56709	89225
2001	0.2500	0.1375	25640	27822	550245	252515	60241	84093	60241	84093
2002	0.2500	0.1375	37654	43415	557309	350927	108269	126213	108269	126213
2003	0.2500	0.1375	49123	63119	518308	434869	174221	207224	174221	207224
2004	0.2500	0.1375	48653	67785	476063	479623	202658	286890	202658	286890
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLMO01
Date and time : 29AUG00:09:52
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

The SAS System 12:53 Monday, August 28, 2000
North-East Arctic haddock (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 Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2000	0.8577	0.4716	48897	61998	224735	173787	56709	89225	56709	89225
2001	0.5000	0.2749	49204	52967	550245	252515	60241	84093	60241	84093
2002	0.5000	0.2749	67815	76772	536119	328317	99271	112695	99271	112695
2003	0.5000	0.2749	82146	103621	473853	379767	150170	172115	150170	172115
2004	0.5000	0.2749	74411	100814	410057	381609	158357	215367	158357	215367
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLMO01
Date and time : 29AUG00:09:52
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

The SAS System 12:53 Monday, August 28, 2000
North-East Arctic haddock (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 Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2000	0.8577	0.4716	48897	61998	224735	173787	56709	89225	56709	89225
2001	0.6366	0.3500	61288	65694	550245	252515	60241	84093	60241	84093
2002	0.6366	0.3500	81743	91650	525278	316992	94798	106041	94798	106041
2003	0.6366	0.3500	95266	118998	452495	354054	138941	156156	138941	156156
2004	0.6366	0.3500	82566	110116	380864	339485	139224	185267	139224	185267
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLMO01
Date and time : 29AUG00:09:52
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

The SAS System 12:53 Monday, August 28, 2000
North-East Arctic haddock (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 Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2000	0.8577	0.4716	48897	61998	224735	173787	56709	89225	56709	89225
2001	1.0000	0.5498	91017	96491	550245	252515	60241	84093	60241	84093
2002	1.0000	0.5498	111895	122432	498680	289961	84227	90520	84227	90520
2003	1.0000	0.5498	118400	144222	403791	297460	114214	122191	114214	122191
2004	1.0000	0.5498	92737	118472	320500	255350	100822	126693	100822	126693
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLMO01
Date and time : 29AUG00:09:52
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

Table 4.23

Single option prediction: Detailed tables

Year: 2000 F-factor: 0.8577 Reference F: 0.4716

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.1030	5487	3962	61752	15932	309	80	309	80
4	0.2489	19908	19499	99271	52167	13402	7043	13402	7043
5	0.4959	8089	10261	22640	20885	9622	8876	9622	8876
6	0.5856	6546	9583	16137	21624	10570	14163	10570	14163
7	0.5559	2175	3476	5576	8685	4238	6600	4238	6600
8	0.5697	1301	2329	3274	6352	3012	5843	3012	5843
9	0.4673	2290	5022	6717	19123	6314	17976	6314	17976
10	0.4566	2795	7002	8349	25110	8224	24733	8224	24733
11	0.3486	191	508	711	2560	711	2560	711	2560
12	0.5916	66	203	161	644	161	644	161	644
13	0.4716	16	49	47	207	47	207	47	207
14+	0.4716	34	105	100	500	100	500	100	500
Total		48897	61998	224735	173787	56709	89225	56709	89225
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2001 F-factor: 0.6366 Reference F: 0.3500

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.0765	27395	19779	410163	105822	2051	529	2051	529
4	0.1847	6993	6850	45600	23963	6156	3235	6156	3235
5	0.3681	17794	22572	63367	58456	26931	24844	26931	24844
6	0.4347	3633	5318	11289	15127	7394	9908	7394	9908
7	0.4126	2269	3626	7356	11457	5590	8707	5590	8707
8	0.4228	824	1475	2618	5080	2409	4673	2409	4673
9	0.3468	405	888	1516	4317	1425	4058	1425	4058
10	0.3389	903	2262	3447	10365	3395	10210	3395	10210
11	0.2587	898	2391	4330	15588	4330	15588	4330	15588
12	0.4391	133	411	411	1643	411	1643	411	1643
13	0.3500	20	59	73	321	73	321	73	321
14+	0.3500	20	62	75	376	75	376	75	376
Total		61288	65694	550245	252515	60241	84093	60241	84093
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2002 F-factor: 0.6366 Reference F: 0.3500

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.0765	8683	6269	130000	33540	650	168	650	168
4	0.1847	47698	46720	311033	163448	41989	22065	41989	22065
5	0.3681	8715	11055	31037	28632	13191	12168	13191	12168
6	0.4347	11555	16916	35905	48112	23518	31514	23518	31514
7	0.4126	1846	2950	5984	9320	4548	7084	4548	7084
8	0.4228	1255	2246	3986	7734	3668	7115	3668	7115
9	0.3468	375	823	1405	3999	1320	3759	1320	3759
10	0.3389	230	576	878	2640	865	2600	865	2600
11	0.2587	417	1110	2011	7239	2011	7239	2011	7239
12	0.4391	888	2738	2737	10948	2737	10948	2737	10948
13	0.3500	58	176	217	954	217	954	217	954
14+	0.3500	23	70	85	427	85	427	85	427
Total		81743	91650	525278	316992	94798	106041	94798	106041
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

The SAS System 12:53 Monday, August 28, 2000
North-East Arctic haddock (Sub-areas I and II)

Table 4.23 (Continued)

Single option prediction: Detailed tables

(cont.)

Year: 2003 F-factor: 0.6366 Reference F: 0.3500

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.0765	6412	4629	96000	24768	480	124	480	124
4	0.1847	15118	14808	98581	51804	13308	6994	13308	6994
5	0.3681	59446	75408	211698	195291	89972	82999	89972	82999
6	0.4347	5659	8285	17586	23565	11519	15435	11519	15435
7	0.4126	5872	9383	19034	29645	14465	22530	14465	22530
8	0.4228	1021	1827	3243	6292	2984	5788	2984	5788
9	0.3468	571	1253	2138	6088	2010	5723	2010	5723
10	0.3389	213	534	813	2445	801	2408	801	2408
11	0.2587	106	283	512	1843	512	1843	512	1843
12	0.4391	412	1271	1271	5084	1271	5084	1271	5084
13	0.3500	389	1174	1445	6356	1445	6356	1445	6356
14+	0.3500	47	144	174	872	174	872	174	872
Total		95266	118998	452495	354054	138941	156156	138941	156156
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 2004 F-factor: 0.6366 Reference F: 0.3500

Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
3	0.0765	6412	4629	96000	24768	480	124	480	124
4	0.1847	11164	10935	72798	38256	9828	5164	9828	5164
5	0.3681	18841	23900	67097	61897	28516	26306	28516	26306
6	0.4347	38602	56513	119951	160734	78568	105281	78568	105281
7	0.4126	2876	4596	9322	14520	7085	11035	7085	11035
8	0.4228	3246	5811	10315	20012	9490	18411	9490	18411
9	0.3468	465	1019	1740	4953	1635	4656	1635	4656
10	0.3389	324	812	1238	3722	1219	3667	1219	3667
11	0.2587	98	262	474	1707	474	1707	474	1707
12	0.4391	105	324	324	1295	324	1295	324	1295
13	0.3500	181	545	671	2952	671	2952	671	2952
14+	0.3500	251	769	934	4670	934	4670	934	4670
Total		82566	110116	380864	339485	139224	185267	139224	185267
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRLMO01
Date and time : 29AUG00:10:59
Computation of ref. F: Simple mean, age 4 - 7
Prediction basis : F factors

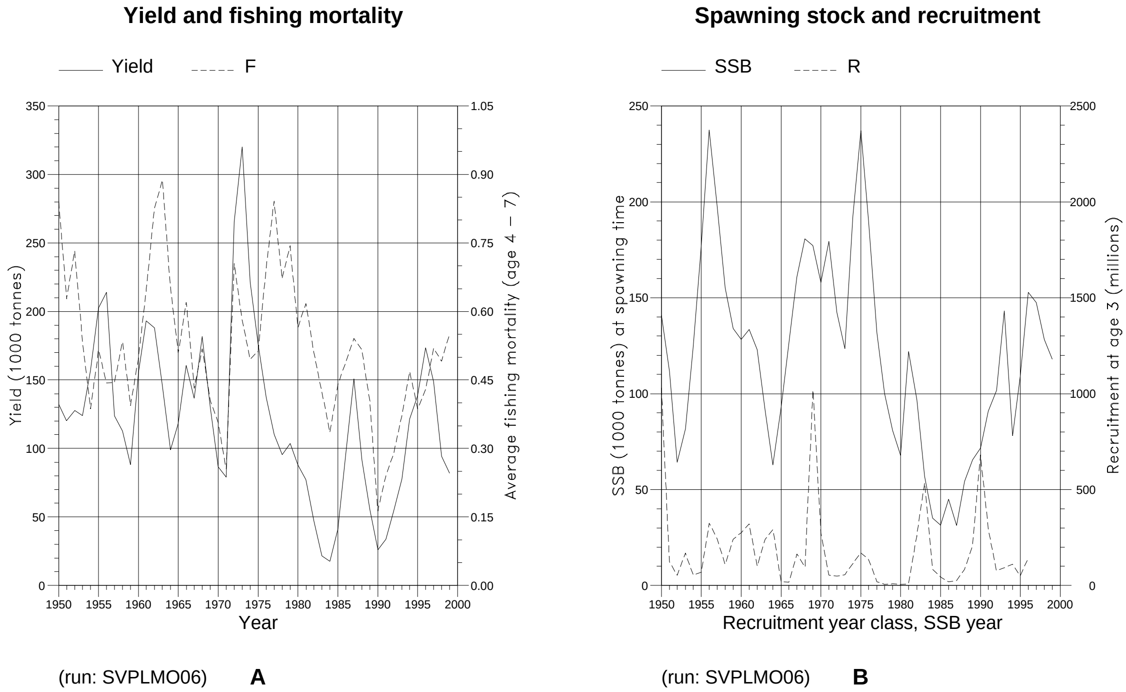


Figure 4.1 A-B Fish Stock Summary. North-east Arctic haddock (Sub-areas I and II)

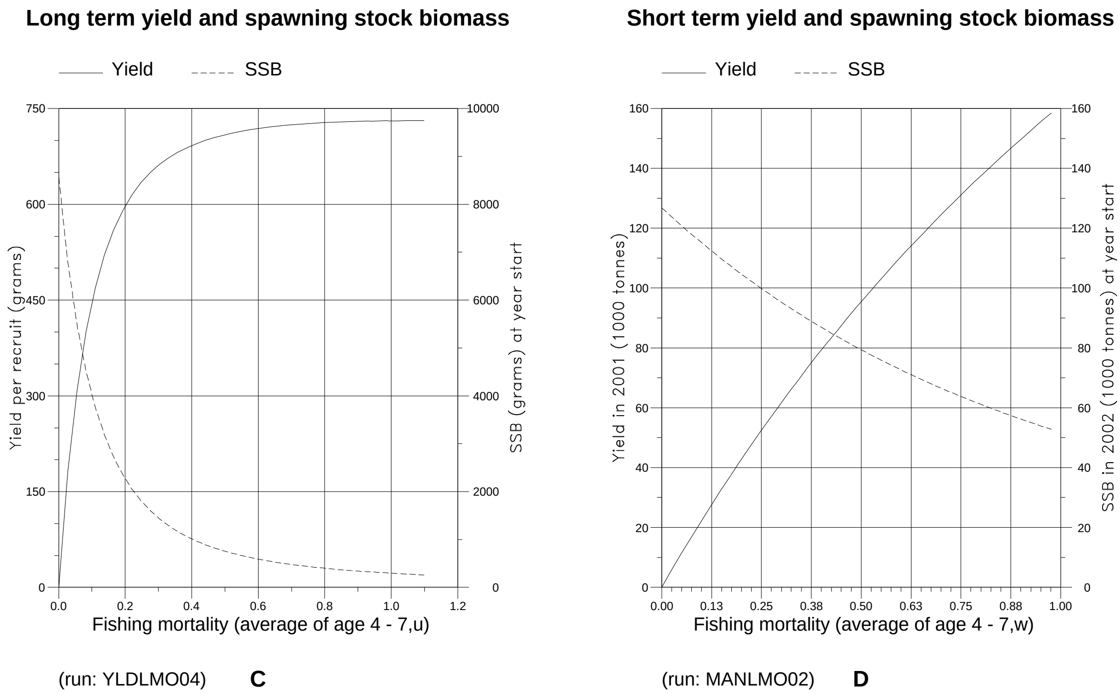


Figure 4.1 C-D Fish Stock Summary. North-east Arctic haddock (Sub-areas I and II)

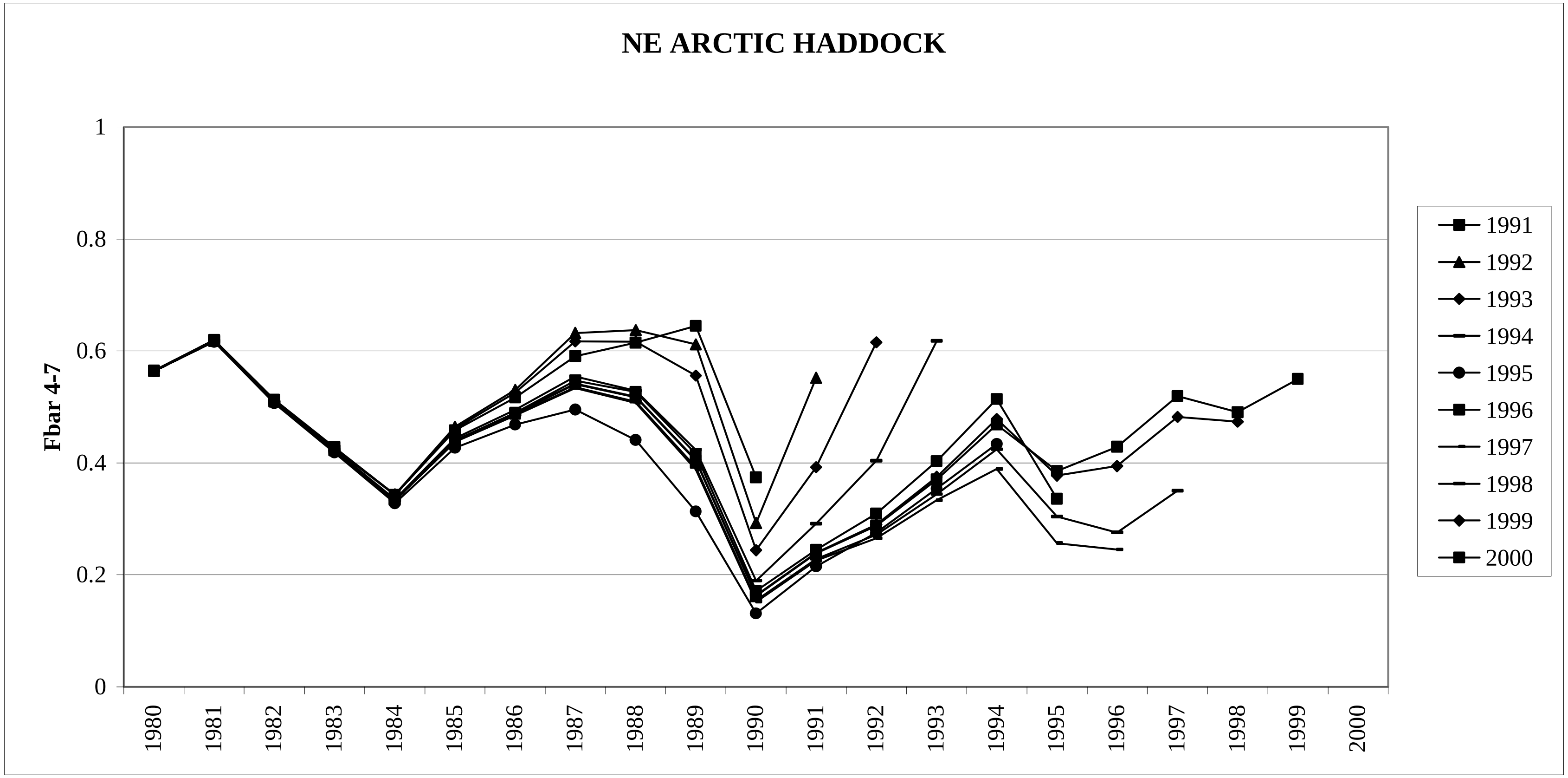

NE ARCTIC HADDOCK
Fbar 4-7
1
0.8
0.6
0.4
0.2
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

Figure 4.2

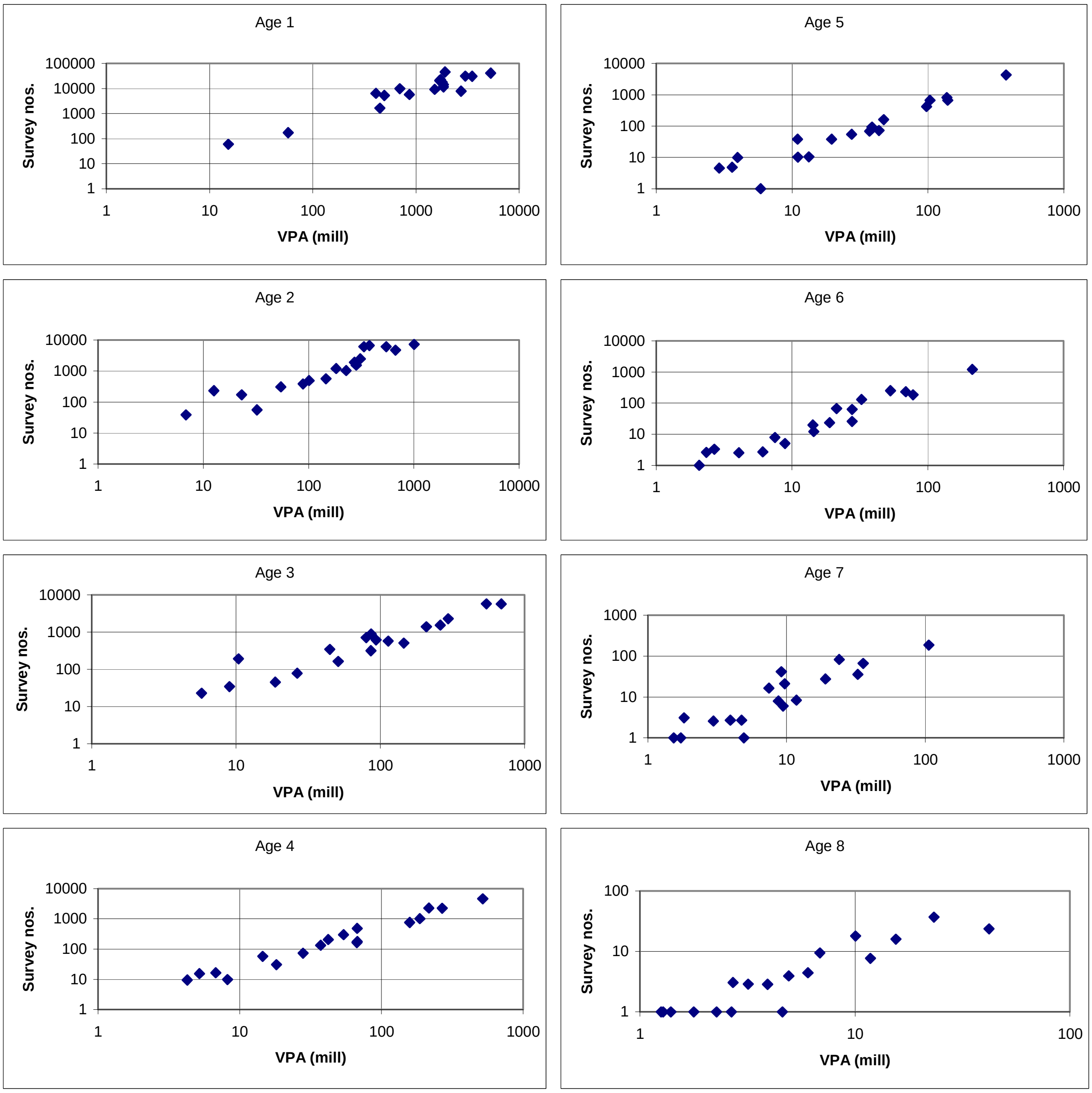


Figure 4.3.a NE Artic Haddock abundance index from the Norwegian bottom trawl survey plotted against VPA results on stock number at age.

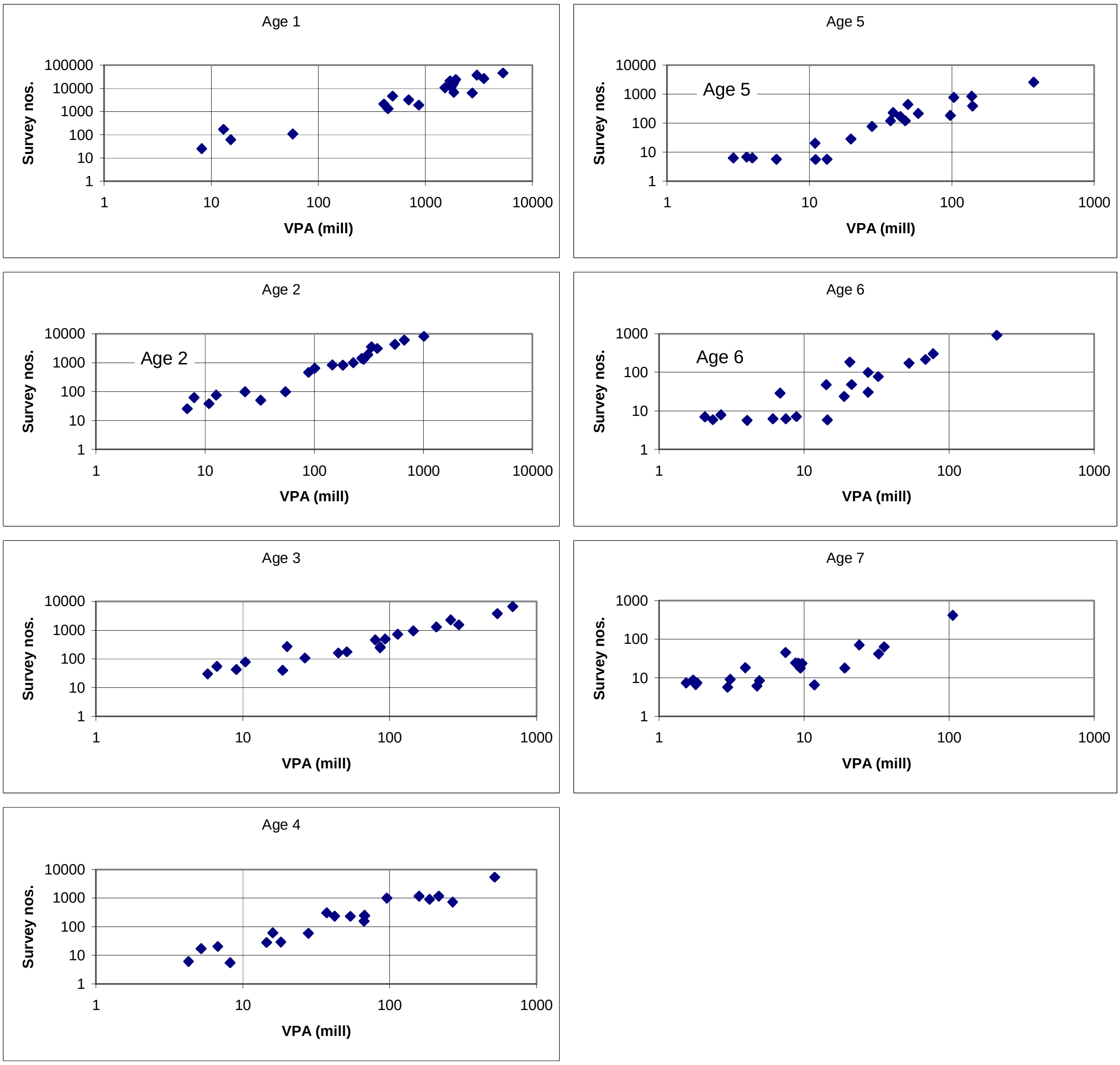


Figure 4.3.b NE Artic Haddock abundance index from the Norwegian acoustic survey plotted against VPA results on stock number at age

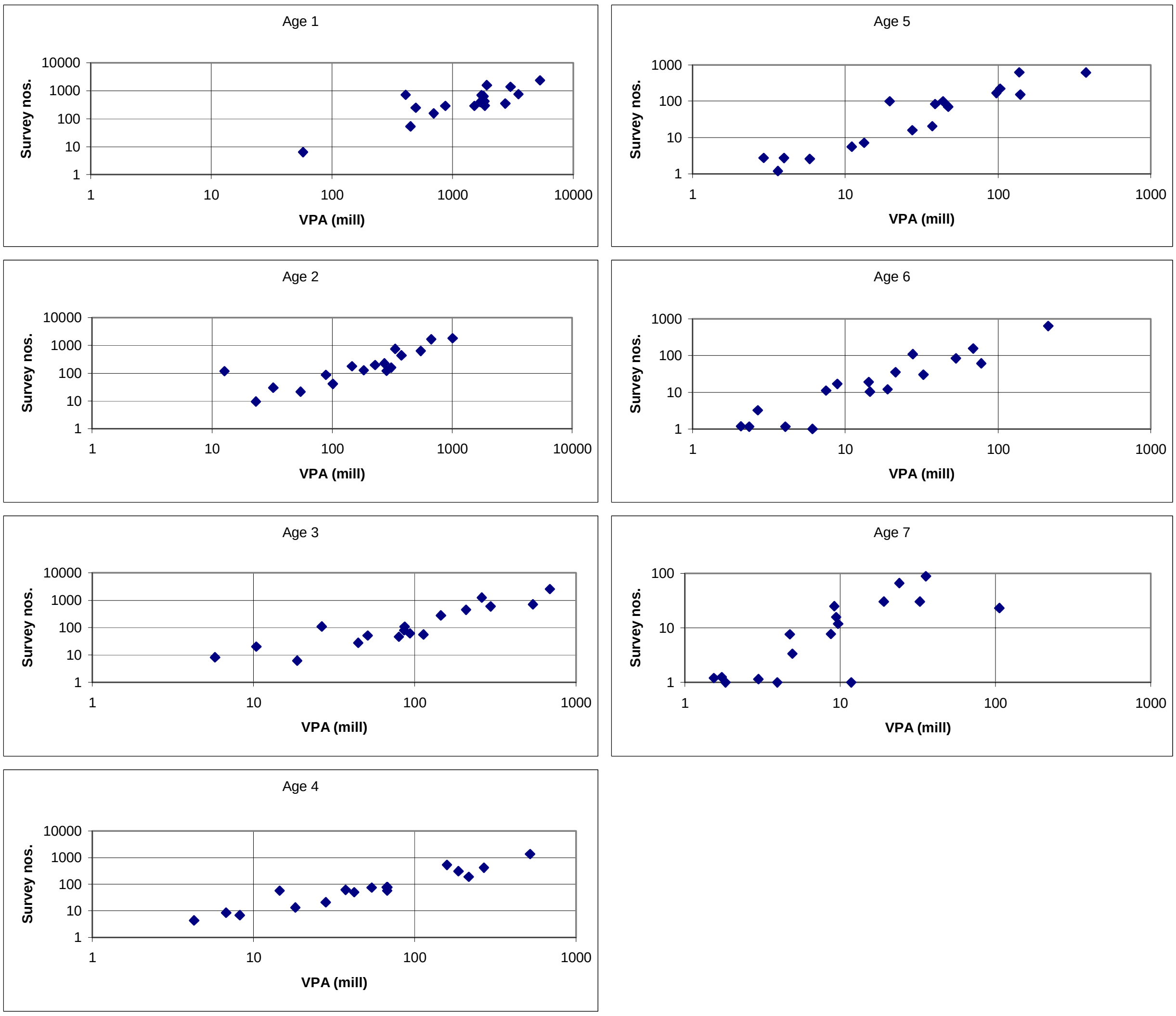


Figure 4.3.c NE Arctic Haddock abundance index from the Russian bottom trawl survey plotted again V results on stock number at age

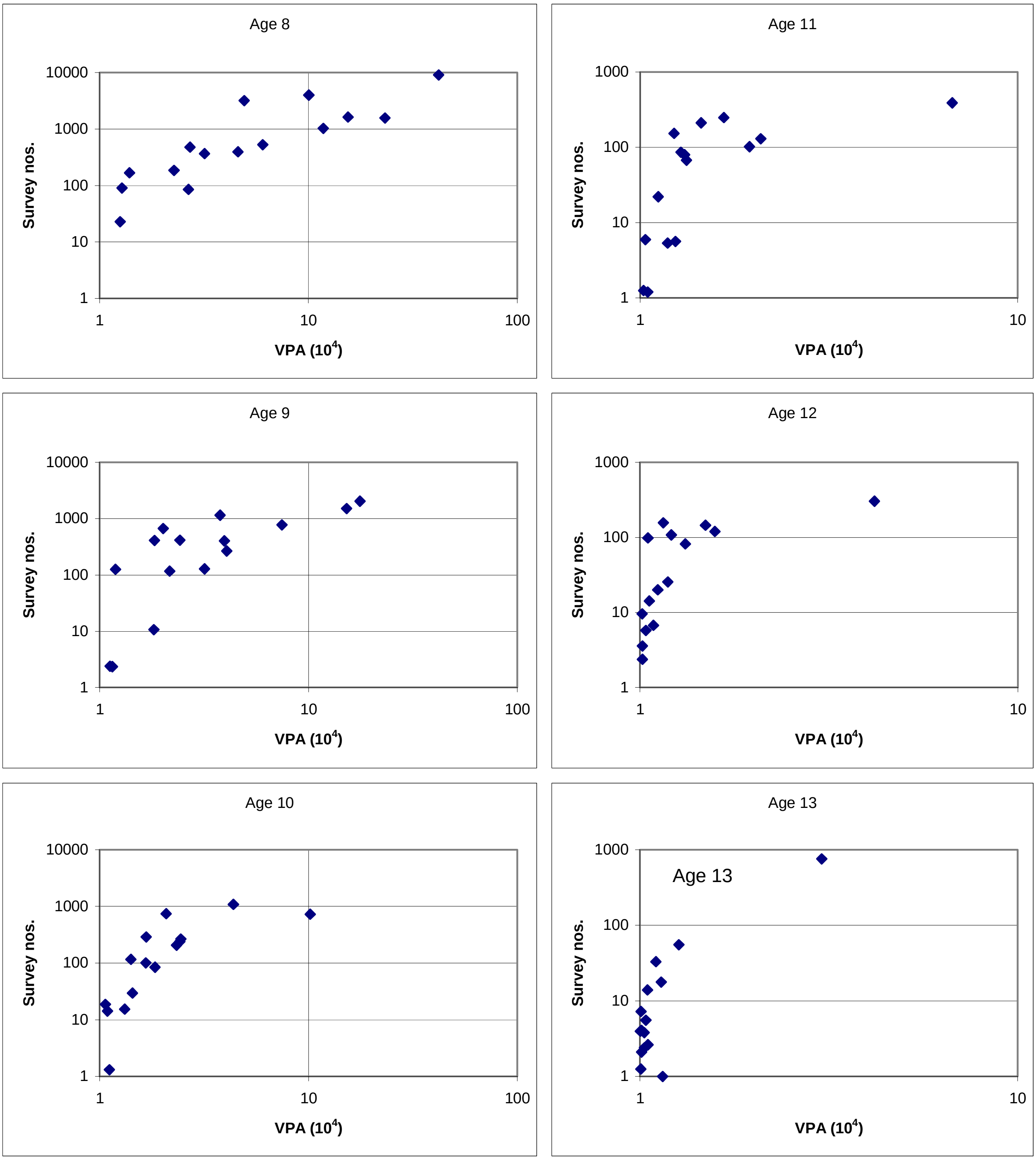


Figure 4.3.d NE Arctic Haddock abundance index from the Norwegian bottom trawl commercial fleet plotte results on stock number at age

North – East Arctic haddock (Sub – areas I an II)

28 –8 - 2000

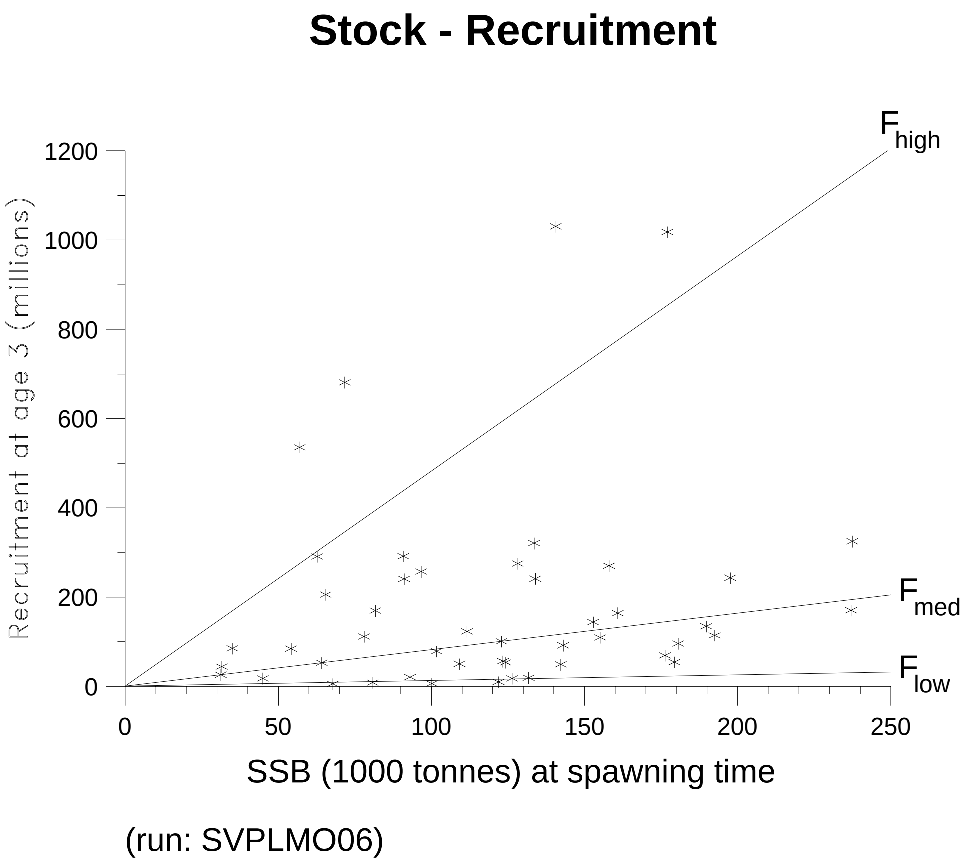


Figure 4.4

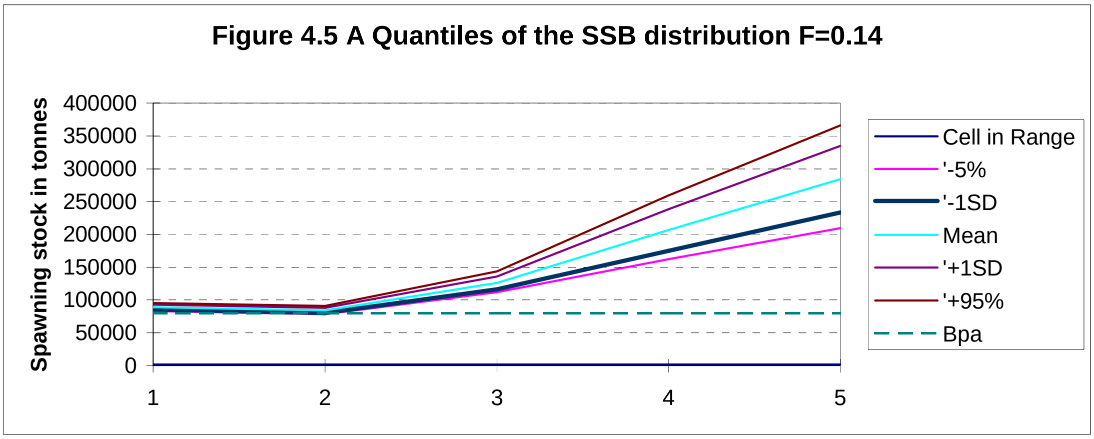


Figure 4.5 A Quantiles of the SSB distribution F=0.14
Spawning stock in tonnes
400000
350000
300000
250000
200000
150000
100000
50000
0
1
2
3
4
5
Cell in Range
'-5%
'-1SD
Mean
'+1SD
'+95%
Bpa

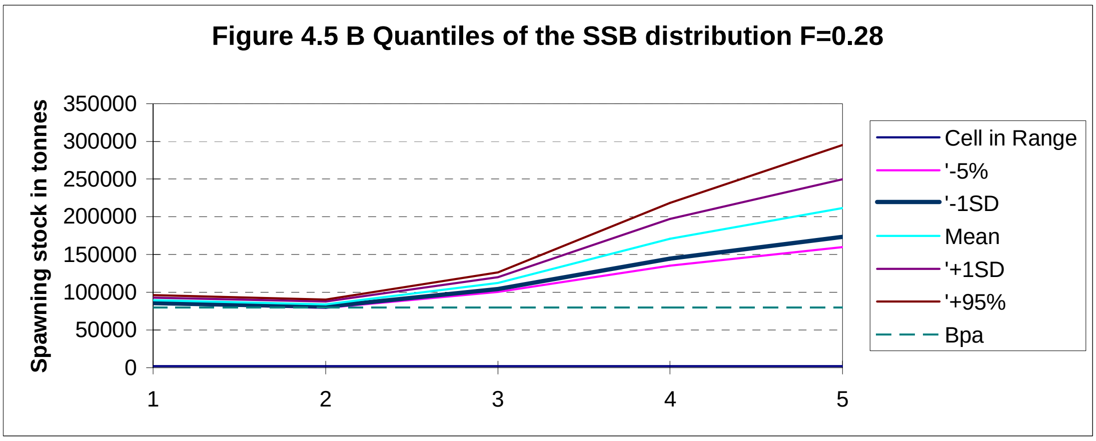


Figure 4.5 B Quantiles of the SSB distribution F=0.28
Spawning stock in tonnes
350000
300000
250000
200000
150000
100000
50000
0
1
2
3
4
5
Cell in Range
'-5%
'-1SD
Mean
'+1SD
'+95%
Bpa

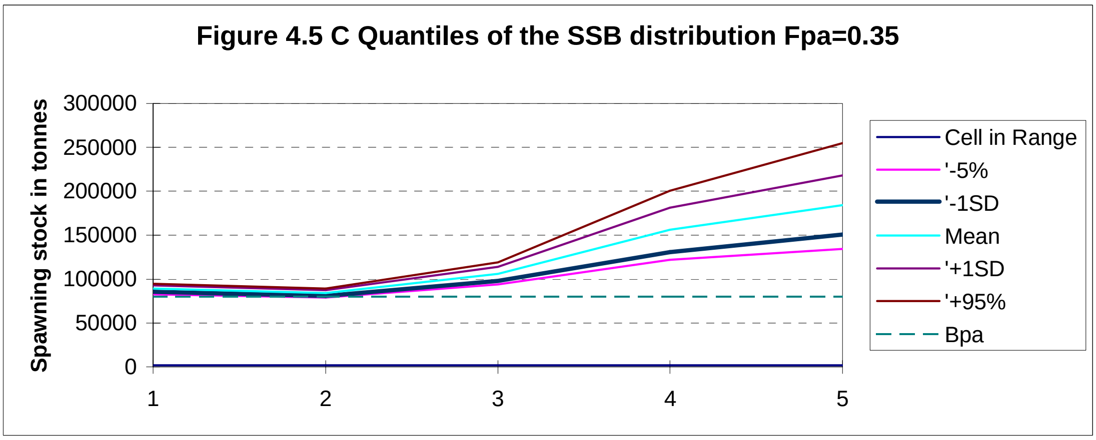


Figure 4.5 C Quantiles of the SSB distribution Fpa=0.35
Spawning stock in tonnes
300000
250000
200000
150000
100000
50000
0
1
2
3
4
5
Cell in Range
'-5%
'-1SD
Mean
'+1SD
'+95%
Bpa

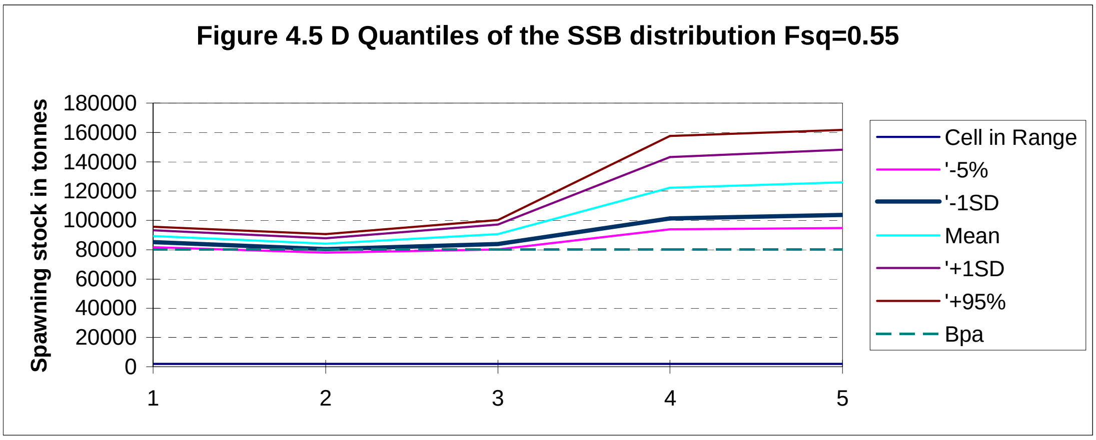


Figure 4.5 D Quantiles of the SSB distribution Fsq=0.55
Spawning stock in tonnes
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
1
2
3
4
5
Cell in Range
'-5%
'-1SD
Mean
'+1SD
'+95%
Bpa

Figure 4.6 A Quantiles of the catch distribution F=0.14

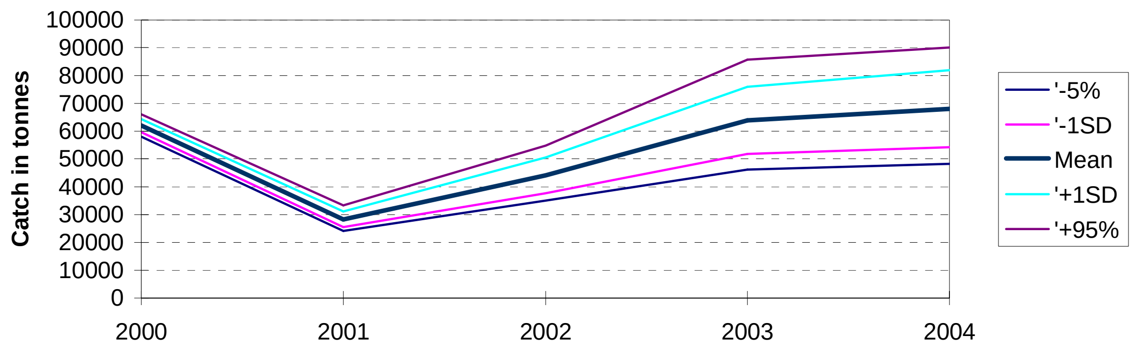


Figure 4.6 B Quantiles of the catch distribution F=0.28

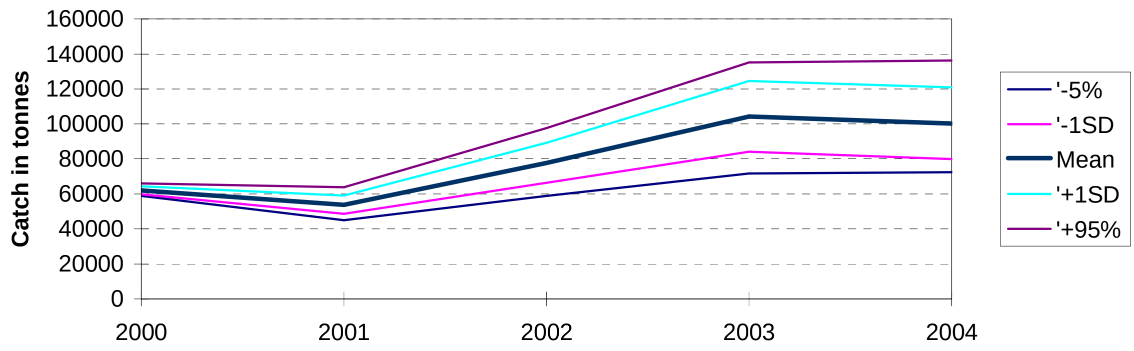


Figure 4.6 C Quantiles of the catch distribution Fpa=0.35

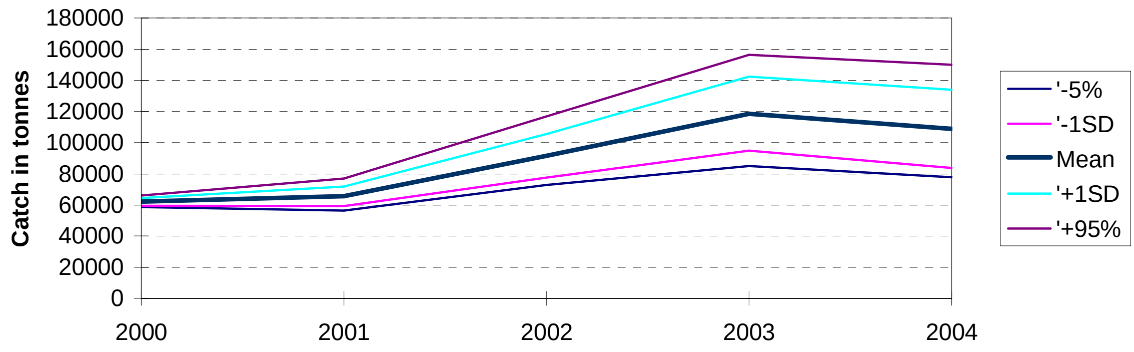


Figure 4.6 D Quantiles of the catch distribution Fsq=0.55

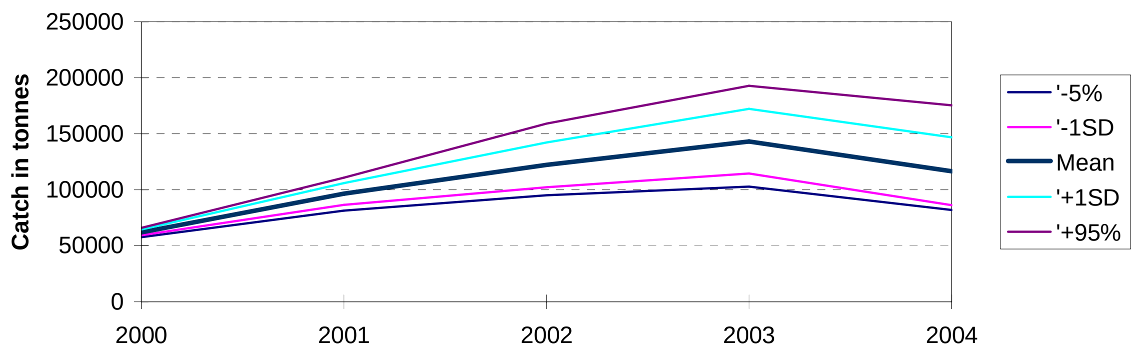


Table B1 North-East Arctic HADDOCK. Results from the Norwegian bottom trawl survey in the Barents Sea in January-March. Index of number of fish at age. Indices for 1983-1998 revised August 1999.

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

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

Table 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 0	1	2	3	4	5	6	7	8	9	Older	Total
						Sub-area I						
1983	39.9	97.3	16.5	0.8	0.7	+					1.1	156.3
1984	9.7	100.2	110.6	2.8	0.4	0.2	+				0.7	224.6
1985	3.9	19.1	213.4	168.8	0.8	0.2	0.1	-			0.3	406.6
1986	0.2	2.3	16.6	58.1	27.6	0.1	+	+	+		-	105.0
1987	0.4	1.4	2.5	12.5	34.2	8.6	+	+	-	+		59.8
1988	1.9	0.4	1.1	2.8	6.2	11.6	1.1	+	+	+		25.2
1989	3.3	3.0	3.6	0.7	2.5	7.1	13.9	1.8	0.1	+		36.0
1990	71.7	22.2	18.6	13.2	7.5	13.2	13.3	10.3	0.6	0.1		170.7
1991	15.9	61.5	27.5	10.8	1.6	0.6	1.0	3.3	2.6	0.3		125.1
1992	19.6	44.2	180.6	52.1	8.4	0.7	1.0	1.6	1.3	0.2		309.7
1993	5.5	8.1	69.2	371.5	78.4	10.2	1.4	0.7	0.8	1.8		547.7
1994	13.5	6.7	8.0	65.9	146.0	15.9	1.7	0.1	0.2	0.7		258.8
1995	9.9	12.7	6.5	4.0	26.8	77.6	7.3	1.0	0.1	0.5		146.3
1996	5.0	3.1	5.6	3.4	7.7	62.3	56.5	4.8	0.4	0.6		149.3
1997[1]	2.7	6.9	3.2	5.3	5.5	1.5	4.5	1.7	1.5	-		32.7
1998	10.5	2.9	17.2	6.7	7.8	0.6	0.9	2.1	0.7	+		49.4
1999	6.9	34.9	8.8	34.0	5.3	5.6	1.2	0.3	0.9	0.3		98.2
						Division IIa						
1983	5.4	5.5	0.1	0.2	0.3	0.1					1.0	12.6
1984	4.9	14.4	5.6	0.1	0.1	0.1	-				0.2	25.4
1985	3.8	7.0	11.7	4.1	0.1	-	+	-			0.1	26.8
1986	0.4	0.3	3.5	10.4	2.9	0.1	+	+	-		-	17.6
1987	-	-	-	-	0.3	0.3	-	-	-	-		0.6
1988	1.0	0.1	-	+	0.2	0.5	0.2	-	-	-		2.1
1989	0.1	0.7	2.7	+	0.1	0.1	0.1	-	-	-		3.8
1990	6.1	0.9	0.9	0.1	0.1	0.1	0.1	0.1	-	-		8.4
1991	5.7	3.8	0.6	0.1	+	-	-	-	-	-		10.2
1992	1.2	2.3	5.6	2.3	3.0	0.3	0.3	0.4	0.4	-		15.9
1993	1.8	1.1	1.5	4.5	2.5	0.8	0.2	0.1	0.2	0.2		12.8
1994	1.0	0.6	0.5	3.1	15.9	4.4	1.5	+	0.1	0.1		27.2
1995	5.0	8.5	6.3	5.3	6.2	23.9	4.1	0.6	+	0.2		60.1
1996	29.2	4.1	25.0	8.1	4.9	9.1	13.4	1.3	0.4	0.1		95.7
1997	1.2	2.8	0.8	1.3	0.7	0.6	0.9	0.5	0.1	-		8.9
1998	23.2	7.8	15.5	1.1	2.4	3.2	0.5	2.8	0.8	0.1		57.3
1999	34.8	34.1	4.3	16.9	3.9	6.3	1.7	0.9	1.2	0.5		104.6

Cont'd

Table B2 (continued)

Year	Age 0	1	2	3	4	5	6	7	8	9	Older	Total
						Division IIb						
1983	22.1	9.9	0.2	0.1	+	+					0.1	32.4
1984	2.2	14.3	1.8	-	-	-	-				+	18.3
1985	1.4	10.2	61.4	5.1	+	+	+	-			+	78.1
1986	+	0.2	3.1	7.2	1.4	-	-	+	+		-	12.0
1987	-	-	0.1	0.7	1.4	0.5	+	-	-	-		2.8
1988	0.2	-	-	+	0.3	1.1	0.2	-	+	-		1.8
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
1999	8.6	20.1	1.8	1.2	0.5	0.3	0.1	-	0.2	0.1		7.5
						Total - Sub-area I and Divisions IIa and IIb						
1983	29.8	59.2	9.5	0.5	0.4	+					0.8	100.2
1984	6.4	58.6	58.4	1.5	0.2	0.1	+				0.3	125.5
1985	3.0	14.4	134.3	90.0	0.4	0.1	0.1	-			0.2	242.7
1986	0.2	1.4	10.7	36.3	16.4	0.1	+	+	+		+	65.1
1987	0.3	0.9	1.7	8.3	22.5	5.7	+	+	-	+		39.4
1988	1.3	0.3	0.7	1.7	4.0	7.6	0.8	+	+	+		16.4
1989	2.2	1.8	2.4	0.4	1.4	4.1	8.1	1.1	0.1	+		21.6
1990	44.8	14.3	10.6	7.3	4.2	7.3	7.4	5.7	0.3	0.1		102.0
1991	16.7	42.9	17.6	6.2	0.9	0.3	0.6	1.8	1.5	0.2		88.7
1992	16.4	28.2	128.6	34.6	5.0	0.4	0.6	0.9	0.8	0.1		215.6
1993	3.5	4.8	35.7	198.5	35.6	4.8	0.8	0.4	0.4	-		284.5
1994	9.1	4.9	5.8	44.2	101.4	11.6	1.5	0.1	0.1	0.5		179.2
1995	6.4	7.2	4.2	3.1	12.3	37.0	4.0	0.5	0.1	0.3		75.1
1996[1]	6.0	2.3	5.7	2.8	4.9	36.2	33.4	2.9	0.3	0.3		94.8
1997[1]	1.8	4.6	1.9	3.2	3.2	1.0	2.7	1.0	0.8	-		20.2
1998	10.7	2.9	11.5	3.8	4.6	0.8	0.5	1.5	0.5	+		36.8
1999	11.7	28.9	6.1	19.6	3.9	3.7	0.8	0.3	0.7	0.7		76.4

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

Table 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.

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

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

Table 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.

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

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

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

	Year	Age									
Norway		1	2	3	4	5	6	7			
	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			
	2000	15.8	22.5	30.3	41.6	47.7	50.8	51.1			
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	-
	1999	-	22.8	27.4	40.1	47.4	50.9	54.6	55.9	58.0	61.6

[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.

Norway

Year	Age 1	2	3	4	5	6	7
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
2000	32	108	269	720	1,068	1,341	1,430

Russia

Year	Age 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	-	-
1999	-	104	191	648	1,049	1,251	1,544	1,608	1,814	2,210	2,978

[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 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. 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.

1 March 1999 the minimum landing size was increased from 35–40 cm to 45 cm for trawl and conventional gears, and to 40–42 cm for purse seine, with an exception for the first 3000 t purse seine catch between 62° N and 65° 30 N, where the minimum landing size still is 35 cm.

5.1.2 Landings prior to 2000 (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, however, again showed a decreasing trend. 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 in 1997 was 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, but due to overfishing the total catch was 153,822 t.

Based on the stock assessment made in August 1998 and a precautionary fishing mortality (F_{pa}) of 0.26 ACFM advised a TAC for 1999 of less than 87,000 t. Due to continuing reports from Norwegian fishermen of high saithe abundance and increased abundance indices of adult fish in the most recent acoustic saithe survey, Norwegian authorities asked for an updated advice. IMR therefore 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 1998 were applied together with acoustic abundance indices from the latest survey and updated fishing effort and CPUE data from the purse seine and trawl fisheries 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. 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, while provisional reports of landings in 1999 indicate overfishing to a total of 150,272 t.

5.1.3 Expected landings in 2000

In August 1999 both options of the December 1998 assessment were revised with updated catch-at-age data and commercial CPUE data (ICES 2000/ACFM:3). The results of the assessment were similar to those obtained in December 1998. Also the management option tables (catch options) for 1999, which were the basis for the IMR advice to the Norwegian authorities, were updated and presented in the report. However, taking into account the probability of a new assessment at IMR 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 were given.

ACFM, however, chose to give an advice based on the August 1999 assessment, and recommended a TAC for 2000 of less than 89,000 t (F_{pa}-level). ACFM also commented upon the inconsistency between the CPUE in the commercial fishery and the survey. ACFM requested that all series should be included in the tuning, but recommended an evaluation of the data before the next assessment. Norwegian authorities again asked IMR for their advice for year 2000 catch options, and IMR made a new standard assessment to base their advice upon. The assessment showed an increase in Fs from 1998 to 1999 to levels well above F_{pa} and a decline in SSB towards B_{pa}. A catch in 2000 corresponding to F_{pa} would be 95,000 t, with about 25% increase in SSB at the beginning of 2001, while a F_{99} (0.44) catch of 145,000 t would reduce the SSB further. A precautionary management requires a plan for bringing the biological reference points within the limit values. To meet these requirements IMR advised a gradual reduction of F towards F_{pa}, and suggested that a F of 0.35 in 2000 could be an appropriate first step. The corresponding catch would be 125,000 t, and Norwegian authorities set the TAC for 2000 at this level. Landings in 2000 are expected to be around the TAC of 125,000 t.

5.2 Status of Research

5.2.1 Fishing effort and catch-per-unit-effort (Tables C1–C3)

Traditionally indices of fishing effort in the purse seine fishery have been based on the number of vessels of 20–24.9 m length (Table C1a). This category has in recent years accounted for about 35–45% of the purse seine landings, and constitutes most of the specialised saithe purse seiners. The effort (number of vessels) of this length category is raised by the catches to represent the total purse seine effort. From 1994 to 1997 this fishing effort increased by nearly 40% and from 1997 to 1998 by over 70%. 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 total number of vessels participating in a fishery is perhaps not a good measure of effort. Many of the vessels which have taken part in the fishery the last decade have accounted for only a small fraction of the purse seine catches (Table C1b). Roughly half of the vessels have caught less than 100 tonnes per year, and the sum of these catches are only about 5–10% of the total purse seine catch. Therefore, the number of vessels catching more than 100 tonnes annually seems to be a more representative and more stable measure of effort in the purse seine fishery. These numbers have been raised to the total purse seine catch (Table C1b), and the new effort series show a smaller decrease in later years than the old one (40 and 70%, respectively). Exploratory XSA runs showed higher scaled weights for the CPUE-series based on the new effort data (Mehl, WD 20 2000). The WG decided to use the new data in the assessment.

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. Work is in progress to estimates new CPUE indices based on the logbook database having daily resolution (Mehl, WD 20 2000).

The combined effort index should reflect the main trends in total effort (Table C3). The total effort increased by almost 50% from 1997 to 1998 and continued to increase somewhat in 1999. As mentioned above, this 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). 2-year-old saithe, mainly inhabiting the fjords and more coastal areas, are also represented in the survey, although highly variable from year to year. In 1997 and 1998 there was a large increase in the abundance of age 5 and older saithe, confirming reports from the fishery. In 1999 the abundance of these age groups decreased somewhat, but was still at a high level compared to years before 1997 (Mehl 2000). Abundance indices for ages 2–5 from 1988 and onwards have traditionally been used for tuning, but including older ages as a 6+ group in the tuning series improved the scaled weights a little (Mehl, WD 20 2000). The WG decided to apply this series in the 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 (Berg and Albert, WD 33 2000), 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. Combining these indices with indices from the regular saithe survey in the tuning series did, however, not influence the assessment much. The WG therefore decided to only apply indices from the regular saithe survey in the assessment since this series is longer.

5.3 Data Used in the Assessment

5.3.1 Catch numbers-at-age (Table 5.3)

The age composition of Norwegian landings in 1998 was revised, resulting in only minor changes. Age composition data for 1999 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 5.14)

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, data from the new purse seine tuning series, and CPUE from the trawl fisheries. Due to low catches of age 2 saithe in the purse seine fishery in later years, this age group was excluded from the tuning 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. An observer program aiming at establishing a 0-group index series has just started. 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 have been conflicting results between the catch and survey data, especially for the 1993 year class.

5.3.7 Prediction data (Table 5.14)

The input data for the predictions based on results from the XSA-analysis are given in Table 5.14. The stock number at age in 2000 was taken from the XSA for age 5 and older. The recruitment at age 2 and 3 in 1999 (1996 and 1997 year classes) was estimated using RCT3 (Section 5.5.2). The corresponding numbers at age 3 and 4 in 2000 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 (1960–1996) of 210 million was used for the 1998 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 1997–1999 has been used, scaled to the 1999 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, Figures 5.2A–C)

Extended Survivors Analysis (XSA) was used for the assessment with the same settings as last year in the analyses. Catchability was assumed to be independent of stock size for all ages. The tuning diagnostics are given in Table 5.6. Figures 5.2A-C show plots of the tuning indices versus stock numbers from the VPA.

5.4.2 Recruitment (Tables 5.12–5.13, Figures 5.3 B–C)

Estimates of the recruiting year classes up to the 1995 year class from the XSA were accepted. Catches of age group 2 have declined to very low levels in recent years (Table 5.3), and retrospective analysis shows that estimates of recruitment at age 2 in the last VPA year have been unreliable (Figures 5.3B). Estimates of recruitment at age 3 have been somewhat more precise (Figure 5.3C). However, in the last two years catches of 3-year-olds have also been low. The low catch in 1998 may be due to a weak 1995 year class, while the relatively low catch in 1999 was probably caused by the new minimum landing size introduced in 1999. RCT3-runs were therefore conducted to estimate both the 1996 and 1997 year classes, with 2 and 3 year olds from the survey as input for the estimation.

5.5 Results of the Assessment

5.5.1 Fishing mortalities and VPA (Tables 5.7–5.11, Figures 5.1A-B, 5.3A-C)

The fishing mortality ($F_{3–6}$) in 1998 was 0.29, which is well below the value of 0.39 from last year's assessment (Figure 5.3A). Using the RCT3 estimation of the 1996 year class gives a fishing mortality ($F_{3–6}$) in 1999 of 0.37.

The XSA-estimates of the 1996–1997 year classes are not considered to be valid and these estimates are therefore put in brackets (Tables 5.8–5.9). In Table 5.11 the long-term average recruitment and recalculated total biomass are presented. The 1990–1991 year classes are still abundant, and the 1992 year class is well represented in the catches. The 1993 year class is weak, and 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 1995 year class is poor both in the XSA-estimate and in the survey, while the 1996 year class so far is below average in the XSA-estimate but one of the strongest in the survey.

The SOP corrected stock and spawning stock biomass tables are included (Tables 5.9–5.11). The total biomass was at a maximum in 1993 and the SSB in 1998. Since then both has decreased somewhat. 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 5.11–5.13)

The RCT3 estimates (with 2-year-olds as input, Table 5.12) of the 1997 year class is 213 million individuals, while the RCT3 estimate (with 3-year-olds as input and back calculating the strength as 2 year olds, Table 5.13) of the 1996 year class gives 267 million individuals. Since the latter year class comes out as one of the strongest in the survey it was decided to use the RCT3 estimates for both the 1996 and 1997 year class and the long-term geometric mean of 210 million individuals for the 1998 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 an examination of the stock-recruitment plot ACFM reduced the B_{pa} to 150,000 t (ICES 1998A).

5.6.2 Fishing mortality reference points (Table 5.15, Figures 5.1C, 5.4)

Yield and SSB per recruit were based on the parameters in Table 5.14 and are presented in Table 5.15. $F_{0.1}$ and F_{max} were estimated to be 0.09 and 0.17, respectively, which is slightly above the values of 0.08 and 0.14 obtained last year. The plot of SSB versus recruitment is shown in Figure 5.4. F_{low}, $F_{med,}$ and F_{high} were not recalculated. The values obtained in 1998 were 0.17, 0.32, and 0.58, respectively. ACFM estimated F_{pa} using the formula $F_{pa} = F_{lim} \cdot e^{-1.645\sigma}$, with $\sigma = 0.3$ giving a $F_{pa} = 0.26$ based on an estimated $F_{lim} = 0.45$ (ICES 1998b).

5.7 Catch Options for 2001 (Short-Term Predictions) (Tables 5.16)

The management option table (Table 5.16) shows that the expected catch of 125,000 t in 2000 will reduce fishing mortality from F_{99} *(status quo)* of 0.37 to 0.31. The *status quo* catch in 2001 is 154,000 t compared to a catch at F_{pa} of 115,000 t. A catch in 2001 corresponding to the expected fishing mortality in 2000 is 135,000 t. The SSB is expected to increase in 2000 from 199,000 t to 218,000 t in the beginning of 2001. None of the catch options above will reduce the SSB, and at F_{pa} the SSB will increase to 257,000 t in 2002. This is well above the B_{pa} of 150,000 t.

5.8 Medium-Term Forecasts and Management Scenarios (Table 5.17, Figure 5.1D)

5.8.1 Input data and methods

The input data were the same as used for the short term predictions (Table 5.14). A spreadsheet doing single option prediction was run under the program @RISK, Latin Hypercubed, using 500 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 1960–1996, and the corresponding values were 210, 105, 78, and 464 million, respectively.

5.8.2 Results

Single option predictions for $F_{pa,}$ $F_{2000,}$ and $F_{status\ quo}$ are given in Table 5.17, and Figures 5.5A-C and 5.6A-C show the corresponding SSB and catch distributions with quantiles from the @RISK simulations for the period 2001–2005. At $F_{status\ quo}$ the catch will decrease a little from 154,000 t to 146,000 t at the end of the period, and the SSB will be reduced to 210,000 t. A fishing mortality at the 2000 level will stabilize the catches at about 146,000 t, and the SSB will increase to 257,000 t in 2005. At F_{pa} both catches and SSB will increase in the whole period to 145,000 t and 310,000 t in 2005, respectively.

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	% probability of going below B_{pa}				
	2001	2002	2003	2004	2005
$F_{pa} = 0.26$	0	0	0	0	0
$F_{2000} = 0.31$	0	0	0	0	0
$F_{sq} = 0.37$	0	0	1	2	4

If recruitment over the next several years is represented by a lognormal distribution about the long term average, there is at F_{pa} and F_{2000} no risk of going below B_{pa} in the period. Also at F_{sq} the risk is quite low, but it increases towards the end of the period.

5.9 Comments on the Assessment and the Forecast

During the 1990s the stock recovered somewhat after a long period of low stock size. For a couple of years the state of the stock has been uncertain due to a large inconsistency between commercial and survey CPUE data. In the present assessment, with revised CPUE-tuning data, the stock situation appears more optimistic, although the SSB has decreased in the two last years. The predictions show that the SSB will increase from 2000 to 2001 and be at a level well above B_{pa}. In recent years there has also been a tendency to overestimate the fishing mortality in the assessment year (Figure 5.3A). The exploitation patterns are now better than in the past, and the new increased minimum landing size will probably improve the exploitation patterns further.

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. 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	366 [2]	932	437 [2]	2,936	144,468		49 [2]	3,836	407 [2]	355		36 [2]	153,822
1999 [1]	179 [2]	638 [2]	655 [2]	2,473	141,828	-	18 [2]	3,929	35 [2]	339		178 [2]	150,272

[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	44.4	58.2	27.6	23.6	153.8
1999 [1]	39.2	57.9	29.7	23.5	150.3

[1] Provisional figures.
[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 Catch numbers at age

Run title : Arctic Saithe (run: XSASME02/X02)

At 23/08/2000 11:58

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

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
2,	7381,	4936,	1246,	2815,	20308,	30430,	7450,	6952,	5297,	4090,
3,	10509,	17824,	37266,	42050,	9001,	37115,	22392,	29664,	25196,	77333,
4,	13083,	9131,	11131,	28925,	59601,	5001,	54537,	24836,	18384,	11949,
5,	13545,	12506,	4421,	5888,	13154,	26300,	13124,	35956,	5101,	16939,
6,	5064,	3799,	8290,	4650,	2718,	10142,	12899,	4125,	8282,	4747,
7,	4883,	1332,	2427,	3861,	3472,	2861,	4652,	5616,	787,	4798,
8,	2401,	968,	1024,	1099,	2655,	2110,	1374,	2916,	1913,	1126,
9,	1315,	520,	938,	1075,	1251,	2733,	933,	1413,	900,	1711,
10,	743,	405,	451,	697,	1221,	699,	965,	1397,	577,	675,
+gp,	1525,	1229,	1728,	1777,	3559,	3593,	2900,	3493,	1166,	511,
TOTALNUM,	60449,	52650,	68922,	92837,	116940,	120984,	121226,	116368,	67603,	123879,
TONSLAND,	136006,	109821,	122841,	148036,	198110,	184548,	201860,	191191,	107181,	140379,
SOPCOF %,	128,	144,	125,	120,	117,	107,	110,	100,	113,	98,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	25952,	19842,	11608,	13829,	21159,	81601,	54151,	31662,	45758,	28334,
3,	43540,	77019,	65178,	76296,	36782,	60832,	125030,	99049,	48969,	61963,
4,	62846,	59280,	52389,	25206,	44027,	11691,	30576,	34317,	27685,	23328,
5,	13987,	26961,	29146,	26911,	15671,	16366,	7947,	10140,	12476,	14122,
6,	16189,	9556,	10186,	16031,	20419,	4436,	8712,	2062,	4534,	4400,
7,	5122,	9592,	5616,	7114,	12148,	7808,	3435,	4332,	1468,	2901,
8,	7950,	2901,	3547,	3935,	4802,	6789,	3212,	1456,	1848,	963,
9,	2504,	4352,	1865,	2871,	3258,	2914,	2679,	1606,	938,	1356,
10,	3697,	2195,	2140,	2610,	2505,	2350,	1724,	963,	976,	438,
+gp,	2799,	5490,	3149,	3924,	3821,	4140,	2880,	1134,	2150,	1192,
TOTALNUM,	184586,	217188,	184824,	178727,	164592,	198927,	240346,	186721,	146802,	138997,
TONSLAND,	260404,	244732,	210508,	215659,	262301,	233453,	242486,	182808,	154465,	164234,
SOPCOF %,	96,	80,	82,	82,	97,	102,	100,	101,	103,	114,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	18226,	10467,	17225,	11638,	14624,	2216,	3311,	3867,	5017,	11157,
3,	40796,	83954,	34733,	17244,	41466,	48917,	22115,	17869,	8126,	12378,
4,	36644,	21822,	65052,	23768,	33233,	11974,	12895,	49829,	35847,	19915,
5,	9211,	21528,	13060,	32700,	12064,	7189,	6062,	4339,	32827,	32643,
6,	6379,	3619,	8212,	3226,	11204,	5279,	4525,	3118,	4560,	18751,
7,	3200,	2550,	1054,	3008,	1135,	3740,	2805,	3490,	2328,	1939,
8,	1338,	2008,	1251,	1177,	1772,	775,	1399,	755,	1219,	377,
9,	147,	369,	461,	760,	560,	878,	351,	620,	966,	191,
10,	730,	279,	263,	247,	557,	134,	454,	257,	320,	179,
+gp,	1629,	629,	448,	760,	897,	701,	285,	797,	102,	149,
TOTALNUM,	118300,	147225,	141759,	94528,	117512,	81803,	54202,	84941,	91312,	97679,
TONSLAND,	154379,	175516,	170903,	155405,	158796,	107147,	70458,	91679,	114508,	122664,
SOPCOF %,	100,	100,	100,	100,	100,	99,	99,	102,	99,	100,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	11543,	6135,	14333,	3379,	1432,	70,	961,	326,	35,	68,
3,	21002,	73878,	49750,	26933,	9369,	16402,	10225,	14827,	3100,	9196,
4,	13463,	11619,	26640,	63451,	38499,	48351,	57448,	13295,	16261,	11008,
5,	8996,	5395,	4865,	26254,	48587,	37268,	18667,	43309,	11981,	20697,
6,	9152,	5066,	5594,	3427,	17617,	32240,	17805,	13029,	31918,	10010,
7,	7735,	2988,	4850,	1636,	1772,	4842,	17861,	11219,	8405,	19939,
8,	1126,	2009,	3353,	1263,	517,	572,	2765,	5837,	5556,	4286,
9,	154,	272,	1480,	950,	305,	139,	485,	755,	2881,	3512,
10,	121,	81,	291,	650,	275,	280,	202,	63,	731,	1938,
+gp,	253,	132,	267,	106,	697,	305,	443,	160,	397,	379,
TOTALNUM,	73545,	107575,	111423,	128049,	119070,	140469,	126862,	102820,	81265,	81033,
TONSLAND,	95393,	107326,	127606,	153584,	146544,	168174,	171498,	143760,	153822,	150272,
SOPCOF %,	100,	99,	100,	100,	100,	100,	100,	100,	100,	100,

Table 5.4 Catch weights at age

Run title : Arctic Saithe (run: XSASME02/X02)

At 23/08/2000 11:58

Table 2 Catch weights at age (kg)

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
2,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,
3,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,
4,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,
5,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,
6,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,
7,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,
8,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,
9,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,
10,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,
+gp,	8.0300,	8.0390,	7.9240,	7.8510,	7.7810,	7.9590,	8.1060,	7.9940,	7.7160,	7.4790,
SOPCOFAC,	1.2793,	1.4354,	1.2489,	1.2026,	1.1684,	1.0721,	1.0963,	.9990,	1.1338,	.9756,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,	.3400,
3,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,	.7100,
4,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,	1.1100,
5,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,	1.6300,
6,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,	2.3300,
7,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,	3.1600,
8,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,	4.0300,
9,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,	4.8700,
10,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,	5.6300,
+gp,	7.4040,	7.0520,	7.4770,	7.3850,	7.2170,	7.1270,	7.3200,	7.3940,	7.5270,	7.8090,
SOPCOFAC,	.9575,	.7953,	.8212,	.8167,	.9694,	1.0155,	1.0020,	1.0061,	1.0278,	1.1388,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	.4500,	.4300,	.5100,	.6000,	.5300,	.3800,	.3200,	.3400,	.3300,	.4500,
3,	.7900,	.7300,	.7700,	1.0500,	.7100,	.7500,	.5900,	.5300,	.6200,	.7400,
4,	1.2700,	1.4000,	1.1200,	1.3300,	1.2600,	1.3300,	1.2200,	.8400,	.8700,	.9700,
5,	2.0300,	2.0500,	2.0200,	1.8600,	2.0200,	2.0700,	1.9700,	1.6600,	1.3100,	1.3900,
6,	2.5500,	2.7600,	2.6100,	2.8000,	2.7000,	2.6300,	2.3000,	2.3200,	2.4300,	1.8100,
7,	3.2900,	3.3000,	3.2700,	4.0000,	3.8800,	3.2800,	2.8700,	2.9700,	3.8700,	3.0200,
8,	4.3400,	4.3800,	3.9100,	4.1800,	4.4700,	3.9600,	3.7200,	4.0000,	5.3800,	3.7600,
9,	5.1500,	5.9500,	4.6900,	5.3300,	5.3600,	4.5400,	4.3000,	4.7200,	5.8300,	4.6400,
10,	5.7500,	6.3900,	5.6300,	5.6800,	6.0600,	5.5500,	4.6900,	5.4400,	5.3600,	4.7500,
+gp,	6.9370,	6.8410,	7.5580,	8.6650,	7.1900,	8.0120,	6.5970,	6.9040,	7.4480,	7.5000,
SOPCOFAC,	.9991,	.9975,	.9961,	.9991,	.9997,	.9930,	.9929,	1.0154,	.9902,	.9978,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	.5400,	.4000,	.4500,	.4600,	.3500,	.5000,	.4000,	.3800,	.3500,	.6400,
3,	.7600,	.7200,	.7000,	.6300,	.5200,	.5600,	.5900,	.6200,	.6800,	.6800,
4,	1.0800,	1.1900,	1.1000,	1.0200,	.7400,	.7800,	.8200,	.9200,	1.0000,	1.0400,
5,	1.5600,	1.7800,	1.9800,	1.7000,	1.2200,	1.2100,	1.3200,	1.1900,	1.4800,	1.4400,
6,	2.1200,	2.2400,	2.3400,	2.5000,	2.1600,	1.7400,	1.8300,	1.6600,	1.8700,	1.9400,
7,	2.4000,	2.8600,	2.8100,	2.8800,	3.1900,	2.8000,	2.4700,	2.3100,	2.5800,	2.3200,
8,	3.6500,	3.3200,	3.2500,	3.0900,	3.9700,	3.7400,	3.7200,	3.1000,	3.0700,	2.9600,
9,	3.6000,	4.5300,	4.0600,	3.7000,	4.6200,	4.4000,	4.4900,	4.3400,	4.1200,	3.7300,
10,	6.3700,	5.7000,	6.1900,	6.1900,	5.2800,	5.2800,	5.3000,	6.0400,	5.4500,	4.6500,
+gp,	4.7950,	7.1250,	7.3760,	8.1750,	6.0720,	7.4510,	7.0160,	7.6200,	8.0520,	6.0830,
SOPCOFAC,	1.0001,	.9912,	1.0000,	1.0008,	1.0038,	.9999,	.9999,	1.0011,	1.0015,	.9996,

Table 5.5 Tuning data

SAI-ARCT: North-East Arctic saithe (Sub-areas I and II)

FLT03: Norway Ac Survey

Year	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6+
1988	1	15.7	22.5	19.0	7.1	0.6
1989	1	24.8	28.4	17.0	10.1	12.4
1990	1	99.6	31.9	14.7	5.1	7.4
1991	1	87.8	104.0	4.6	4.0	7.1
1992	1	163.5	273.6	57.5	6.2	8.8
1993	1	106.9	227.7	103.9	12.7	3.2
1994	1	34.4	87.8	112.4	39.5	10.0
1995	1	38.7	165.2	87.0	46.8	20.0
1996	1	37.0	118.9	214.7	32.1	19.3
1997	1	5.1	36.7	185.8	79.8	61.7
1998	1	43.6	96.5	200.6	70.0	96.7
1999	1	61.1	233.8	72.9	62.2	47.8

FLT02: Norway Purse Seine

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1989	109	5250	8521	18211	2880	24
1990	56	7207	3319	2582	1845	673
1991	99	43110	1907	453	162	95
1992	89	29527	5214	89	45	38
1993	72	8010	24251	1302	39	23
1994	79	6365	16182	8997	1151	90
1995	52	5524	13357	4368	1335	105
1996	82	4053	36274	6022	2610	589
1997	92	9665	6691	18403	1852	1329
1998	130	1994	9690	5302	10330	1226
1999	133	5347	5580	9883	2219	2808

FLT05: Norway Trawl

Year	Fishing effort	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1976	36.8	11184.0	583.0	1080.0	1137.0	869.0	612.0	332.0	284.0
1977	52.7	4557.0	9047.0	3260.0	202.0	660.0	322.0	361.0	209.0
1978	51.3	488.0	3104.0	3440.0	1400.0	319.0	591.0	254.0	304.0
1979	42.7	7374.0	6538.0	2340.0	762.0	845.0	419.0	294.0	129.0
1980	57.4	10270.0	10301.0	1726.0	2891.0	1392.0	406.0	24.0	108.0
1981	71.0	5698.0	12137.0	10877.0	1901.0	1053.0	1351.0	83.0	108.0
1982	58.2	1719.0	10344.0	10006.0	5519.0	420.0	306.0	215.0	134.0
1983	57.7	3341.0	10024.0	14949.0	2189.0	1720.0	535.0	181.0	60.0
1984	85.5	14876.0	25819.0	7038.0	7161.0	656.0	744.0	180.0	176.0
1985	63.7	10070.0	6177.0	3844.0	3877.0	2446.0	441.0	564.0	66.0
1986	45.2	4388.0	8150.0	4078.0	3172.0	2044.0	779.0	208.0	215.0
1987	30.1	470.0	7862.0	2452.0	1169.0	1405.0	189.0	153.0	67.0
1988	50.4	1539.0	2241.0	14077.0	3031.0	1438.0	609.0	346.0	137.0
1989	59.8	3923.0	9038.0	9226.0	8659.0	1154.0	178.0	83.0	150.0
1990	60.4	8909.0	7960.0	3932.0	3722.0	3967.0	479.0	54.0	66.0
1991	51.5	20741.0	7106.0	2683.0	2456.0	1516.0	1044.0	139.0	37.0
1992	57.6	10361.0	13228.0	3067.0	2269.0	2660.0	2029.0	890.0	214.0
1993	68.0	10746.0	26279.0	17961.0	1947.0	657.0	604.0	190.0	240.0
1994	78.7	1456.0	16229.0	28224.0	10542.0	1045.0	151.0	68.0	83.0
1995	106.4	7626.0	27085.0	24940.0	21565.0	2560.0	329.0	18.0	61.0
1996	74.7	3663.0	13890.0	8701.0	9304.0	10312.0	763.0	152.0	3.0
1997	41.4	3754.0	3968.0	16671.0	5899.0	4059.0	1910.0	179.0	20.0
1998	65.8	418.0	3077.0	3485.0	12286.0	3600.0	1875.0	399.0	159.0
1999	69.7	2254.0	3250.0	6725.0	4306.0	9090.0	1586.0	989.0	262.0

Table 5.6 Tuning diagnostics

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

Arctic Saithe (run: XSASME04/X04)

CPUE data from file fleet

Catch data for 40 years. 1960 to 1999. Ages 2 to 11.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FLT02: Norway Purse ,	1989,	1999,	3,	7,	.000,	1.000
FLT03: Norway Ac Sur,	1988,	1999,	2,	6,	.750,	.850
FLT05: Norway Trawl ,	1976,	1999,	3,	10,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 8

Terminal population estimation :

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

S.E. of the mean to which the estimates are shrunk = .500

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

Prior weighting not applied

Tuning converged after 20 iterations

Regression weights

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

Fishing mortalities

Age,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999
2,	.045,	.015,	.051,	.017,	.004,	.001,	.007,	.006,	.000,	.002
3,	.464,	.447,	.159,	.127,	.059,	.056,	.126,	.142,	.068,	.082
4,	.504,	.510,	.285,	.312,	.269,	.478,	.285,	.240,	.229,	.361
5,	.402,	.386,	.416,	.507,	.419,	.454,	.341,	.362,	.354,	.509
6,	.575,	.416,	.909,	.586,	.778,	.548,	.409,	.426,	.499,	.569
7,	.729,	.371,	.925,	.753,	.700,	.502,	.680,	.493,	.542,	.680
8,	.671,	.416,	.957,	.661,	.569,	.511,	.607,	.493,	.486,	.594
9,	.394,	.332,	.625,	.809,	.323,	.290,	1.172,	.327,	.484,	.660
10,	.509,	.371,	.721,	.627,	.580,	.559,	.907,	.436,	.610,	.717

XSA population numbers (Thousands)

	AGE								
YEAR ,	2,	3,	4,	5,	6,	7,	8,	9,	10,
1990 ,	2.89E+05,	6.25E+04,	3.76E+04,	3.00E+04,	2.31E+04,	1.65E+04,	2.55E+03,	5.23E+02,	3.35E+02,
1991 ,	4.64E+05,	2.27E+05,	3.21E+04,	1.86E+04,	1.65E+04,	1.07E+04,	6.52E+03,	1.07E+03,	2.89E+02,
1992 ,	3.21E+05,	3.75E+05,	1.19E+05,	1.58E+04,	1.04E+04,	8.88E+03,	6.02E+03,	3.52E+03,	6.26E+02,
1993 ,	2.26E+05,	2.50E+05,	2.62E+05,	7.30E+04,	8.54E+03,	3.42E+03,	2.89E+03,	1.89E+03,	1.54E+03,
1994 ,	4.06E+05,	1.82E+05,	1.80E+05,	1.57E+05,	3.60E+04,	3.89E+03,	1.32E+03,	1.22E+03,	6.90E+02,
1995 ,	1.17E+05,	3.31E+05,	1.41E+05,	1.13E+05,	8.45E+04,	1.36E+04,	1.58E+03,	6.11E+02,	7.23E+02,
1996 ,	1.52E+05,	9.55E+04,	2.56E+05,	7.14E+04,	5.86E+04,	4.00E+04,	6.71E+03,	7.76E+02,	3.74E+02,
1997 ,	6.44E+04,	1.24E+05,	6.89E+04,	1.58E+05,	4.15E+04,	3.19E+04,	1.66E+04,	2.99E+03,	1.97E+02,
1998 ,	1.57E+05,	5.24E+04,	8.80E+04,	4.44E+04,	8.98E+04,	2.22E+04,	1.60E+04,	8.30E+03,	1.77E+03,
1999 ,	3.72E+04,	1.29E+05,	4.01E+04,	5.73E+04,	2.55E+04,	4.47E+04,	1.06E+04,	8.03E+03,	4.19E+03,

Table 5.6 continued

Estimated population abundance at 1st Jan 2000

0.00E+00, 3.04E+04, 9.70E+04, 2.29E+04, 2.82E+04, 1.18E+04, 1.85E+04, 4.78E+03, 3.40E+03,

Taper weighted geometric mean of the VPA populations:

1.54E+05, 1.38E+05, 9.16E+04, 5.35E+04, 2.66E+04, 1.17E+04, 4.27E+03, 1.73E+03, 6.98E+02,

Standard error of the weighted Log(VPA populations) :

.7566, .6455, .7342, .7942, .8272, .9114, .9173, .9270, .8569,

Log catchability residuals.

Fleet : FLT02: Norway Purse

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	No data for this fleet at this age									
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.33
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.25
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	1.53
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.73
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-1.58
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	No data for this fleet at this age									
3	1.36	1.29	.38	-.33	-.36	-.68	-.17	.33	-.77	-.70
4	.43	-.53	-.83	.14	.00	.57	.43	-.09	-.31	-.04
5	.82	-1.02	-2.37	-.96	.08	.12	.39	.61	.28	.70
6	1.46	-1.27	-1.77	-1.65	.29	-.10	.42	.31	.95	.68
7	1.36	-.88	-1.27	-.68	.44	-.32	-.06	.79	.74	.91
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	3	4	5	6	7
Mean Log q	-7.2334	-6.5542	-7.0106	-7.6502	-8.1610
S.E(Log q)	.7360	.4272	1.0448	1.0704	.9357

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.04	-.111	7.03	.45	11	.81	-7.23
4	.87	.798	7.21	.82	11	.38	-6.55
5	.58	1.792	8.68	.70	11	.54	-7.01
6	.52	2.734	8.96	.80	11	.42	-7.65
7	.64	1.856	8.65	.77	11	.53	-8.16

Table 5.6 continued

Fleet : FLT03: Norway Ac Sur

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.30	.10
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-.94	-.29
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-1.37	-.73
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-1.39	-.53
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-2.21	-.36
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	.22	-.40	.61	.51	-1.21	.15	-.16	-1.28	-.03	1.75
3	-.06	-.18	.05	.25	-.44	-.41	.56	-.86	.90	.90
4	-.41	-1.41	-.36	-.54	-.13	.03	.18	1.32	1.14	1.02
5	-.78	-.56	.07	-.68	-.38	.15	.14	.28	1.41	1.16
6	-.41	-.24	.84	-.24	-.39	-.73	-.51	1.01	.74	1.35
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									

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

Age	2	3	4	5	6
Mean Log q	-7.9974	-6.9860	-6.8791	-7.4160	-7.0192
S.E(Log q)	.8538	.6227	.8976	.7948	.9210

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.53	-1.011	5.89	.30	12	1.31	-8.00
3	1.26	-.678	5.72	.44	12	.81	-6.99
4	1.05	-.118	6.64	.38	12	1.00	-6.88
5	1.00	-.004	7.41	.48	12	.84	-7.42
6	.91	.261	7.32	.49	12	.88	-7.02

Fleet : FLT05: Norway Trawl

Age	1976	1977	1978	1979
2	No data for this fleet at this age			
3	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99
10	99.99	99.99	99.99	99.99

Table 5.6 continued

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	No data for this fleet at this age									
3	1.44	-.31	-.44	.30	1.77	1.55	-.03	-1.56	-.18	.95
4	.24	.82	-.11	.67	1.31	.71	1.22	.10	-1.37	.58
5	-.47	.35	1.23	.69	.18	.03	.83	.51	.33	.15
6	-.07	-.09	.39	.33	.28	.33	.52	.41	.52	.18
7	-.17	-.72	-.87	-.16	-.73	.34	.70	.87	.96	.02
8	-.07	.80	-.85	.37	-.43	.08	.71	-.26	.97	.05
9	-2.02	-1.12	.10	-.77	-.15	.29	.29	.32	.68	-.23
10	-1.03	-.16	.22	-.42	-.47	.07	.39	.22	.61	.73

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	No data for this fleet at this age									
3	1.81	1.52	.08	.34	-1.52	-.77	.13	.49	-1.34	-.61
4	.90	1.11	.21	-.05	-.32	.23	-.77	-.14	-1.11	-.27
5	-.13	.12	.32	.43	-.07	-.15	-.44	.01	-.75	-.34
6	-.16	-.15	.34	.08	.26	-.28	-.46	.03	-.44	-.26
7	.19	-.33	.54	-.14	.02	-.72	.03	-.17	-.37	-.14
8	.22	.10	.97	.20	-.59	-.32	-.53	.03	-.42	-.19
9	-.50	-.14	.54	-.47	-1.42	-2.37	.25	-.70	-1.31	-.35
10	.19	-.14	.88	-.11	-.53	-1.20	-3.05	-.12	-.63	-1.01

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

Age	3	4	5	6	7	8	9	10
Mean Log q	-7.5435	-6.2234	-5.7162	-5.4052	-5.2865	-5.5850	-5.5850	-5.5850
S.E(Log q)	1.0747	.7448	.4032	.3269	.4611	.4936	.9968	1.1159

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.26	-.397	6.43	.19	20	1.41	-7.54
4	2.19	-2.010	.05	.22	20	1.44	-6.22
5	1.17	-.954	4.83	.76	20	.47	-5.72
6	1.38	-3.099	3.58	.87	20	.34	-5.41
7	1.19	-1.041	4.52	.75	20	.55	-5.29
8	1.03	-.184	5.50	.76	20	.53	-5.58
9	.94	.210	6.15	.57	20	.85	-6.06
10	1.11	-.255	5.92	.36	20	1.20	-5.98

Terminal year survivor and F summaries :

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

Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT02: Norway Purse	1.	.000	.000	.00	0	.000	.000
FLT03: Norway Ac Sur	174462.	.893	.000	.00	1	.238	.000
FLT05: Norway Trawl	1.	.000	.000	.00	0	.000	.000
F shrinkage mean	17592.	.50				.762	.003

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
30381.	.44	2.00	2	4.590	.002

Table 5.6 continued

```
Age  3   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
 FLT02: Norway Purse ,     48189.,   .772,       .000,    .00,   1,  .161,     .159
 FLT03: Norway Ac Sur,    172792.,   .526,       .445,    .84,   2,  .346,     .047
 FLT05: Norway Trawl ,     52853.,  1.118,       .000,    .00,   1,  .077,     .146

   F shrinkage mean  ,     87987.,    .50,,,,                        .416,     .090

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     97004.,       .32,      .27,    5,    .868,   .082

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

 Year class = 1995

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT02: Norway Purse ,     18434.,   .388,       .312,    .80,   2,  .341,     .432
 FLT03: Norway Ac Sur,     33044.,   .460,       .689,   1.50,   3,  .234,     .263
 FLT05: Norway Trawl ,     12558.,   .637,       .498,    .78,   2,  .126,     .584

   F shrinkage mean  ,     28264.,    .50,,,,                        .299,     .302

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     22885.,       .24,      .24,    8,    .995,   .361

 Age  5   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
 FLT02: Norway Purse ,     26894.,   .368,       .275,    .75,   3,  .238,     .528
 FLT03: Norway Ac Sur,     35882.,   .408,       .530,   1.30,   4,  .193,     .420
 FLT05: Norway Trawl ,     18672.,   .353,       .273,    .77,   3,  .302,     .695

   F shrinkage mean  ,     39410.,    .50,,,,                        .267,     .389

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     28191.,       .21,      .19,   11,    .904,   .509

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

 Year class = 1993

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
      ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT02: Norway Purse ,     12616.,   .358,       .172,    .48,   4,  .162,     .541
 FLT03: Norway Ac Sur,     31999.,   .388,       .240,    .62,   5,  .146,     .249
 FLT05: Norway Trawl ,      8078.,   .250,       .141,    .56,   4,  .459,     .752

   F shrinkage mean  ,     12769.,    .50,,,,                        .233,     .536

 Weighted prediction :
 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     11816.,       .18,      .15,   14,    .818,   .569
```

Table 5.6 continued

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

Year class = 1992

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT02: Norway Purse ,	30426.,	.371,	.249,	.67,	5,	.144,	.466
FLT03: Norway Ac Sur,	18548.,	.390,	.316,	.81,	5,	.098,	.679
FLT05: Norway Trawl ,	14099.,	.232,	.109,	.47,	5,	.468,	.824
F shrinkage mean ,	22519.,	.50,,,,				.290,	.588

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
18535.,	.19,	.11,	16,	.576,	.680

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

Year class = 1991

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT02: Norway Purse ,	7557.,	.382,	.164,	.43,	5,	.098,	.414
FLT03: Norway Ac Sur,	6260.,	.404,	.267,	.66,	5,	.067,	.482
FLT05: Norway Trawl ,	3900.,	.230,	.102,	.44,	6,	.512,	.690
F shrinkage mean ,	5450.,	.50,,,,				.323,	.537

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
4785.,	.20,	.08,	17,	.409,	.594

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

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FLT02: Norway Purse ,	4324.,	.378,	.190,	.50,	5,	.079,	.551
FLT03: Norway Ac Sur,	3422.,	.407,	.186,	.46,	5,	.053,	.657
FLT05: Norway Trawl ,	2432.,	.235,	.057,	.24,	7,	.446,	.836
F shrinkage mean ,	4621.,	.50,,,,				.422,	.523

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3398.,	.24,	.10,	18,	.422,	.660

Age 10 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
FLT02: Norway Purse ,	1794.,	.399,	.071,	.18,	5,	.046,	.682
FLT03: Norway Ac Sur,	1116.,	.416,	.142,	.34,	5,	.029,	.944
FLT05: Norway Trawl ,	1184.,	.278,	.187,	.67,	8,	.351,	.909
F shrinkage mean ,	2097.,	.50,,,,				.575,	.608

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1674.,	.30,	.12,	19,	.393,	.717

Table 5.7 Fishing mortality (F) at age

Run title : Arctic Saithe (run: XSASME04/X04)

At 24/08/2000 9:14

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1960,	1961,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,
AGE										
2,	.0694,	.0259,	.0039,	.0259,	.0628,	.1742,	.0347,	.0409,	.0160,	.0131,
3,	.1412,	.2383,	.2772,	.1747,	.1080,	.1562,	.1876,	.1886,	.2041,	.3402,
4,	.1843,	.1755,	.2297,	.3606,	.4012,	.0805,	.3616,	.3278,	.1709,	.1406,
5,	.5007,	.2695,	.1204,	.1825,	.2760,	.3093,	.3131,	.4319,	.1024,	.2354,
6,	.2407,	.2519,	.2882,	.1797,	.1198,	.3557,	.2447,	.1522,	.1649,	.1307,
7,	.3847,	.0915,	.2530,	.2108,	.1978,	.1786,	.2736,	.1595,	.0391,	.1356,
8,	.4184,	.1206,	.0943,	.1734,	.2195,	.1772,	.1219,	.2757,	.0747,	.0721,
9,	.3585,	.1479,	.1645,	.1355,	.3055,	.3690,	.1106,	.1777,	.1274,	.0885,
10,	.3832,	.1770,	.1849,	.1771,	.2248,	.2795,	.2138,	.2406,	.1020,	.1330,
+gp,	.3832,	.1770,	.1849,	.1771,	.2248,	.2795,	.2138,	.2406,	.1020,	.1330,
FBAR 3- 6,	.2667,	.2338,	.2289,	.2244,	.2262,	.2254,	.2767,	.2751,	.1606,	.2117,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	.0785,	.1052,	.0472,	.1396,	.1204,	.2763,	.2181,	.2178,	.1964,	.2066,
3,	.1880,	.3511,	.5893,	.4906,	.6669,	.5962,	.9054,	.7864,	.6156,	.4445,
4,	.5146,	.4216,	.4300,	.4766,	.5911,	.4590,	.6942,	.6807,	.5245,	.6833,
5,	.2432,	.4348,	.3782,	.4110,	.6231,	.4557,	.6610,	.5207,	.5675,	.5614,
6,	.3709,	.2610,	.2894,	.3693,	.6370,	.3552,	.4705,	.3522,	.4670,	.3991,
7,	.2034,	.3929,	.2409,	.3374,	.5334,	.5380,	.5164,	.4539,	.4575,	.6257,
8,	.3480,	.1697,	.2451,	.2654,	.4017,	.6560,	.4432,	.4307,	.3557,	.6252,
9,	.2271,	.3262,	.1569,	.3211,	.3673,	.4563,	.5921,	.4163,	.5509,	.4827,
10,	.2801,	.3188,	.2635,	.3429,	.5166,	.4960,	.5410,	.4379,	.4834,	.5432,
+gp,	.2801,	.3188,	.2635,	.3429,	.5166,	.4960,	.5410,	.4379,	.4834,	.5432,
FBAR 3- 6,	.3292,	.3671,	.4217,	.4369,	.6295,	.4665,	.6828,	.5850,	.5436,	.5221,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	.0582,	.0788,	.1459,	.1144,	.1249,	.0091,	.0181,	.0425,	.0734,	.1498,
3,	.5169,	.4110,	.4037,	.2134,	.7500,	.7839,	.1176,	.1282,	.1180,	.2607,
4,	.5179,	.5837,	.6561,	.5373,	.8206,	.5008,	.4831,	.4206,	.4083,	.4700,
5,	.6401,	.6673,	.8660,	.8423,	.5817,	.4095,	.5140,	.2947,	.5461,	.8230,
6,	.5371,	.5627,	.5836,	.5371,	.8055,	.5477,	.4928,	.5485,	.5798,	.7069,
7,	.5721,	.4264,	.3130,	.4379,	.3646,	.7025,	.6411,	.9163,	1.0974,	.5243,
8,	.6731,	.8957,	.3837,	.6956,	.5030,	.4572,	.6263,	.3502,	1.0215,	.5023,
9,	.1767,	.3908,	.5214,	.4262,	.8770,	.5035,	.3866,	.6374,	1.0649,	.4157,
10,	.5241,	.5941,	.5382,	.5940,	.6457,	.5281,	.5334,	.5484,	.8256,	.5624,
+gp,	.5241,	.5941,	.5382,	.5940,	.6457,	.5281,	.5334,	.5484,	.8256,	.5624,
FBAR 3- 6,	.5530,	.5562,	.6274,	.5325,	.7394,	.5605,	.4019,	.3480,	.4130,	.5651,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97–99
AGE											
2,	.0451,	.0147,	.0506,	.0167,	.0039,	.0007,	.0070,	.0056,	[.0002]	[.0020]	[.0026]
3,	.4645,	.4470,	.1587,	.1268,	.0586,	.0564,	.1260,	.1419,	.0676,	[.0823]	[.0973]
4,	.5035,	.5100,	.2853,	.3119,	.2692,	.4782,	.2851,	.2398,	.2285,	.3613,	.2766,
5,	.4020,	.3862,	.4158,	.5065,	.4190,	.4544,	.3413,	.3620,	.3543,	.5094,	.4086,
6,	.5752,	.4160,	.9087,	.5863,	.7777,	.5478,	.4090,	.4258,	.4986,	.5690,	.4978,
7,	.7294,	.3711,	.9246,	.7531,	.7003,	.5024,	.6803,	.4925,	.5416,	.6798,	.5713,
8,	.6711,	.4165,	.9566,	.6611,	.5686,	.5108,	.6073,	.4926,	.4861,	.5936,	.5241,
9,	.3939,	.3315,	.6252,	.8089,	.3235,	.2896,	1.1722,	.3267,	.4841,	.6602,	.4903,
10,	.5089,	.3713,	.7209,	.6273,	.5805,	.5591,	.9071,	.4364,	.6104,	.7168,	.5878,
+gp,	.5089,	.3713,	.7209,	.6273,	.5805,	.5591,	.9071,	.4364,	.6104,	.7168,	
FBAR 3- 6,	.4863,	.4398,	.4421,	.3829,	.3811,	.3842,	.2903,	.2924,	.2873,	[.3805]	

Table 5.8 Stock number at age

Run title : Arctic Saithe (run: XSASME04/X04)

At 24/08/2000 9:14

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	1969
AGE										
2	121649	213268	355504	121814	368898	210353	241201	191871	367841	347429
3	88173	92920	170143	289934	97186	283653	144688	190738	150800	296370
4	85921	62681	59948	105582	199330	71425	198652	98200	129322	100666
5	38001	58508	43057	39010	60271	109268	53953	113296	57926	89245
6	26165	18857	36586	31252	26611	37443	65664	32298	60224	42811
7	16897	16840	12001	22453	21379	19328	21479	42090	22711	41814
8	7761	9416	12582	7630	14890	14362	13235	13376	29379	17882
9	4823	4181	6833	9375	5252	9788	9850	9593	8313	22322
10	2580	2759	2953	4746	6703	3168	5541	7220	6576	5992
+gp	5253	8334	11260	12044	19432	16183	16565	17951	13243	4518
TOTAL	397223	487764	710868	643839	819951	774971	770828	716630	846335	969049

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
2	379813	219522	278459	117296	206219	373547	305388	178787	283663	167755
3	280750	287482	161776	217480	83521	149692	231999	201032	117730	190840
4	172673	190462	165681	73475	109022	35099	67515	76813	74968	52080
5	71607	84508	102298	88245	37349	49422	18159	27610	31838	36328
6	57741	45971	44794	57382	47899	16399	25655	7676	13430	14778
7	30755	32626	28991	27457	32475	20740	9413	13122	4419	6893
8	29893	20546	18032	18654	16043	15597	9916	4598	6823	2290
9	13621	17281	14196	11554	11712	8790	6626	5212	2447	3914
10	16728	8887	10210	9935	6862	6641	4560	3001	2814	1155
+gp	12585	22072	14934	14828	10361	11585	7537	3503	6139	3110
TOTAL	1066166	929356	839372	636307	561462	687513	686766	521354	544271	479142

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	356393	152722	140186	118950	137684	271558	204082	102803	78362	88634
3	111708	275298	115567	99189	86858	99493	220328	164093	80669	59618
4	100180	54545	149430	63191	65606	33593	37196	160379	118179	58694
5	21531	48864	24913	63482	30230	23643	16669	18786	86220	64321
6	16965	9294	20527	8580	22386	13834	12852	8162	11455	40888
7	8118	8118	4335	9375	4105	8191	6550	6428	3862	5252
8	3019	3751	4339	2595	4954	2334	3322	2824	2105	1055
9	1003	1261	1254	2420	1060	2453	1210	1454	1629	621
10	1978	688	698	609	1294	361	1214	673	629	460
+gp	4368	1534	1177	1854	2058	1869	754	2064	198	379
TOTAL	625263	556075	462426	370245	356235	457329	504177	467667	383308	319921

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST 60–97	AMST 60–97
AGE													
2	289438	464409	321173	226115	405596	116667	152304	64393	[157164]	[37182]	[0]	204410	230046
3	62472	226527	374674	249985	182070	330778	95455	123827	52426	[128644]	[30381]	156651	175935
4	37611	32144	118617	261742	180301	140589	255977	68900	87965	40117	[97004]	91200	107010
5	30035	18611	15804	73011	156883	112782	71355	157595	44381	57306	22885	48566	59069
6	23125	16450	10356	8537	36021	84482	58617	41530	89840	25495	28191	24564	30360
7	16509	10652	8884	3417	3889	13551	39996	31881	22212	44674	11816	12884	16763
8	2546	6518	6018	2886	1317	1581	6713	16585	15950	10581	18535	6552	9404
9	523	1065	3519	1893	1220	611	776	2994	8297	8032	4785	3409	5596
10	335	289	626	1542	690	723	374	197	1768	4186	3398	1872	3484
+gp	694	467	567	248	1730	779	808	496	949	808	1997		
TOTAL	463287	777132	860239	829376	969716	802541	682375	508397	[480953]	[357025]	[218992]		

Table 5.9 Stock biomass at age with SOP

Run title : Arctic Saithe (run: XSASME04/X04)

At 24/08/2000 9:14

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,	1969,
AGE										
2,	52914,	104084,	150962,	49810,	146547,	76678,	89902,	65172,	141800,	115247,
3,	80090,	94699,	150875,	247569,	80622,	215917,	112617,	135290,	121393,	205295,
4,	122013,	99871,	83108,	140945,	258515,	84999,	241729,	108894,	162753,	109017,
5,	79245,	136893,	87654,	76471,	114785,	190951,	96408,	184489,	107053,	141924,
6,	77994,	63067,	106467,	87573,	72444,	93534,	167724,	75179,	159097,	97318,
7,	68310,	76385,	47365,	85330,	78935,	65480,	74407,	132872,	81367,	128911,
8,	40011,	54469,	63329,	36979,	70109,	62054,	58473,	53853,	134237,	70307,
9,	30051,	29229,	41562,	54907,	29886,	51106,	52585,	46672,	45901,	106060,
10,	18581,	22298,	20763,	32134,	44091,	19123,	34198,	40608,	41974,	32911,
+gp,	53962,	96172,	111439,	113717,	176662,	138087,	147199,	143355,	115857,	32970,
TOTALBIO,	623172,	777167,	863524,	925436,	1072597,	997929,	1075242,	986383,	1111433,	1039959,

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
2,	123644,	59361,	77751,	32571,	67968,	128977,	104037,	61159,	99126,	64953,
3,	190854,	162337,	94327,	126107,	57484,	107931,	165044,	143604,	85911,	154301,
4,	183515,	168143,	151029,	66608,	117309,	39565,	75089,	85782,	85527,	65832,
5,	111755,	109555,	136937,	117473,	59015,	81809,	29657,	45279,	53337,	67433,
6,	128813,	85189,	85711,	109194,	108187,	38803,	59894,	17995,	32162,	39211,
7,	93053,	81996,	75234,	70861,	99480,	66556,	29802,	41717,	14352,	24805,
8,	115344,	65852,	59679,	61397,	62674,	63830,	40039,	18644,	28262,	10508,
9,	63515,	66932,	56777,	45955,	55293,	43472,	32335,	25537,	12249,	21708,
10,	90171,	39791,	47208,	45684,	37450,	37970,	25723,	17000,	16283,	7405,
+gp,	89214,	123797,	91699,	89433,	72484,	83847,	55281,	26057,	47493,	27655,
TOTALBIO,	1189878,	962953,	876351,	765282,	737345,	692760,	616901,	482774,	474702,	483811,

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
2,	160227,	65508,	71217,	71305,	72954,	102469,	64842,	35491,	25607,	39796,
3,	88167,	200472,	88641,	104054,	61653,	74097,	129070,	88307,	49526,	44019,
4,	127110,	76175,	166713,	83967,	82642,	45367,	45057,	136790,	101810,	56806,
5,	43668,	99923,	50128,	117969,	61049,	49068,	32605,	31664,	111843,	89207,
6,	43220,	25588,	53367,	24001,	60428,	36129,	29351,	19228,	27562,	73842,
7,	26682,	26723,	14119,	37467,	15925,	26677,	18664,	19386,	14798,	15826,
8,	13089,	16387,	16899,	10838,	22139,	9202,	12269,	11472,	11215,	3937,
9,	5162,	7483,	5858,	12889,	5679,	11033,	5165,	6967,	9406,	2873,
10,	11361,	4388,	3917,	3459,	7840,	1986,	5652,	3717,	3340,	2180,
+gp,	30273,	10470,	8862,	16049,	14796,	15198,	4938,	14472,	1457,	2834,
TOTALBIO,	548960,	533116,	479722,	481998,	405105,	371226,	347613,	367493,	356564,	331319,

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
2,	156313,	184138,	144527,	104096,	142497,	58330,	60919,	24496,	[55090]	[23787]
3,	47484,	161672,	262271,	157617,	95036,	185223,	56316,	76858,	35703,	[87444]
4,	40624,	37917,	130478,	267191,	133929,	109652,	209890,	63459,	88096,	41706,
5,	46859,	32838,	31292,	124218,	192124,	136458,	94183,	187746,	65782,	82488,
6,	49030,	36526,	24233,	21360,	78100,	146988,	107263,	69016,	168253,	49442,
7,	39627,	30199,	24965,	9850,	12453,	37939,	98785,	73726,	57394,	103605,
8,	9292,	21450,	19557,	8923,	5250,	5911,	24971,	51469,	49041,	31307,
9,	1882,	4784,	14285,	7009,	5656,	2688,	3486,	13010,	34234,	29947,
10,	2136,	1631,	3876,	9550,	3658,	3815,	1984,	1190,	9652,	19457,
+gp,	3328,	3296,	4180,	2032,	10543,	5801,	5666,	3781,	7654,	4911,
TOTALBIO,	396575,	514450,	659664,	711847,	679246,	692804,	663463,	564750,	[570899]	[474094]

Table 5.10 Spawning stock biomass with SOP

Run title : Arctic Saithe (run: XSASME04/X04)

At 24/08/2000 9:14

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	1969
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	1628	1090
5	43585	75291	48210	42059	63132	105023	53024	101469	58879	78058
6	66295	53607	90497	74437	61578	79504	142566	63902	135233	82720
7	66944	74857	46417	83624	77357	64170	72919	130214	79740	126333
8	40011	54469	63329	36979	70109	62054	58473	53853	134237	70307
9	30051	29229	41562	54907	29886	51106	52585	46672	45901	106060
10	18581	22298	20763	32134	44091	19123	34198	40608	41974	32911
+gp	53962	96172	111439	113717	176662	138087	147199	143355	115857	32970
TOTSPBIO	320649	406922	423048	439266	525400	519918	563381	581162	613448	530449

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	1835	1681	1510	666	1173	396	751	858	855	658
5	61465	60255	75315	64610	32458	44995	16311	24903	29336	37088
6	109491	72411	72854	92815	91959	32982	50910	15295	27337	33329
7	91191	80356	73729	69444	97491	65225	29206	40883	14065	24309
8	115344	65852	59679	61397	62674	63830	40039	18644	28262	10508
9	63515	66932	56777	45955	55293	43472	32335	25537	12249	21708
10	90171	39791	47208	45684	37450	37970	25723	17000	16283	7405
+gp	89214	123797	91699	89433	72484	83847	55281	26057	47493	27655
TOTSPBIO	622227	511076	478772	470003	450982	372717	250556	169178	175881	162660

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	1271	762	1667	840	826	454	451	1368	1018	568
5	24017	54958	27570	64883	33577	26987	17933	17415	61514	49064
6	36737	21750	45362	20401	51364	30710	24948	16344	23428	62765
7	26148	26188	13837	36718	15606	26143	18291	18998	14502	15510
8	13089	16387	16899	10838	22139	9202	12269	11472	11215	3937
9	5162	7483	5858	12889	5679	11033	5165	6967	9406	2873
10	11361	4388	3917	3459	7840	1986	5652	3717	3340	2180
+gp	30273	10470	8862	16049	14796	15198	4938	14472	1457	2834
TOTSPBIO	148059	142385	123972	166076	151827	121712	89647	90753	125880	139730

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	406	379	1305	2672	1339	1097	2099	635	881	417
5	25772	18061	17211	68320	105668	75052	51801	103260	36180	45369
6	41676	31047	20598	18156	66385	124940	91174	58663	143015	42025
7	38834	29595	24466	9653	12203	37180	96809	72252	56246	101532
8	9292	21450	19557	8923	5250	5911	24971	51469	49041	31307
9	1882	4784	14285	7009	5656	2688	3486	13010	34234	29947
10	2136	1631	3876	9550	3658	3815	1984	1190	9652	19457
+gp	3328	3296	4180	2032	10543	5801	5666	3781	7654	4911
TOTSPBIO	123327	110242	105478	126315	210703	256483	277990	304259	336904	274966

Table 5.11 Summary (with SOP correction)

Run title : Arctic Saithe (run: XSASME04/X04) ,

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Table 17 Summary (with SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 2	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	SOPCOFAC,	FBAR 3- 6,
1960,	121649,	623172,	320649,	136006,	.4242,	1.2793,	.2667,
1961,	213268,	777167,	406922,	109821,	.2699,	1.4354,	.2338,
1962,	355504,	863524,	423048,	122841,	.2904,	1.2489,	.2289,
1963,	121814,	925436,	439266,	148036,	.3370,	1.2026,	.2244,
1964,	368898,	1072597,	525400,	198110,	.3771,	1.1684,	.2262,
1965,	210353,	997929,	519918,	184548,	.3550,	1.0721,	.2254,
1966,	241201,	1075242,	563381,	201860,	.3583,	1.0963,	.2767,
1967,	191871,	986383,	581162,	191191,	.3290,	.9990,	.2751,
1968,	367841,	1111433,	613448,	107181,	.1747,	1.1338,	.1606,
1969,	347429,	1039959,	530449,	140379,	.2646,	.9756,	.2117,
1970,	379813,	1189878,	622227,	260404,	.4185,	.9575,	.3292,
1971,	219522,	962953,	511076,	244732,	.4789,	.7953,	.3671,
1972,	278459,	876351,	478772,	210508,	.4397,	.8212,	.4217,
1973,	117296,	765282,	470003,	215659,	.4588,	.8167,	.4369,
1974,	206219,	737345,	450982,	262301,	.5816,	.9694,	.6295,
1975,	373547,	692760,	372717,	233453,	.6264,	1.0155,	.4665,
1976,	305388,	616901,	250556,	242486,	.9678,	1.0020,	.6828,
1977,	178787,	482774,	169178,	182808,	1.0806,	1.0061,	.5850,
1978,	283663,	474702,	175881,	154465,	.8782,	1.0278,	.5436,
1979,	167755,	483811,	162660,	164234,	1.0097,	1.1388,	.5221,
1980,	356393,	548960,	148059,	154379,	1.0427,	.9991,	.5530,
1981,	152722,	533116,	142385,	175516,	1.2327,	.9975,	.5562,
1982,	140186,	479722,	123972,	170903,	1.3786,	.9961,	.6274,
1983,	118950,	481998,	166076,	155405,	.9357,	.9991,	.5325,
1984,	137684,	405105,	151827,	158796,	1.0459,	.9997,	.7394,
1985,	271558,	371226,	121712,	107147,	.8803,	.9930,	.5605,
1986,	204082,	347613,	89647,	70458,	.7860,	.9929,	.4019,
1987,	102803,	367493,	90753,	91679,	1.0102,	1.0154,	.3480,
1988,	78362,	356564,	125880,	114508,	.9097,	.9902,	.4130,
1989,	88634,	331319,	139730,	122664,	.8779,	.9978,	.5651,
1990,	289438,	396575,	123327,	95393,	.7735,	1.0001,	.4863,
1991,	464409,	514450,	110242,	107326,	.9735,	.9912,	.4398,
1992,	321173,	659664,	105478,	127606,	1.2098,	1.0000,	.4421,
1993,	226115,	711847,	126315,	153584,	1.2159,	1.0008,	.3829,
1994,	405596,	679246,	210703,	146544,	.6955,	1.0038,	.3811,
1995,	116667,	692804,	256483,	168174,	.6557,	.9999,	.3842,
1996,	152304,	663463,	277990,	171498,	.6169,	.9999,	.2903,
1997,	64393,	564750,	304259,	143760,	.4725,	1.0011,	.2924,
1998,	267526,	612836,	336904,	153822,	.4566,	1.0015,	.2873,
1999,	213000	646252	274966,	150272,	.5465,	.9996,	.3718,
Arith. Mean ,	230557,	678015,	300360,	161261,	.6959		.4092,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

Table 5.12 RCT3-estimate of 2 year-olds

```
NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds
1,12,2               (No. of surveys, No. of years, VPA Column No.)
1986,  78, 15.7
1987,  89, 24.8
1988,  289,   99.6
1989,  464,   87.8
1990,  321,   163.5
1991,  226,   106.9
1992,  406,   34.4
1993,  117,   38.7
1994,  152,   37.0
1995,   64,    5.1
1996,  -11,   43,6
1997,  -11,   61.1


 Analysis by RCT3 ver3.1 of data from file :

 c:\rct32in.txt

 NORTHEAST ARCTIC SAITHE : recruits as 2 year-olds

 Data for    1 surveys over   12 years :  1986 - 1997

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

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

 Forecast/Hindcast variance correction used.


 Yearclass =   1997

          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

            .89   1.84    .60   .621     10   4.13    5.52     .718     .496

                                         VPA Mean =    5.20     .713     .504



 Year     Weighted      Log     Int     Ext     Var     VPA      Log
 Class     Average      WAP     Std     Std    Ratio             VPA
          Prediction           Error   Error

 1995         112      4.72     .57    1.12     3.85     65     4.17
 1996         182      5.21     .50     .00      .00
 1997         213      5.36     .51     .16      .10
```

Table 5.13 RCT3-estimate of 3 year-olds

```
NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds
1,12,2                (No. of surveys, No. of years, VPA Column No.)
1985,   81,    22.5
1986,   60,    28.4
1987,   62,    31.9
1988,  226,   104.0
1989,  375,   273.6
1990,  250,   227.7
1991,  182,    87.8
1992,  331,   165.2
1993,   95,   118.9
1994,  123,    36.7
1995    52,    96.5
1996   -11,   233.8
```

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

 c:\rct33in.txt

 NORTHEAST ARCTIC SAITHE : recruits as 3 year-olds

 Data for    1 surveys over   12 years :  1985 - 1996

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

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

 Forecast/Hindcast variance correction used.



 Yearclass =   1996

          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series           cept   Error          Pts  Value   Value    Error   Weights

           1.18   -.32    .71   .532     11   5.46    6.11     .893     .390

                                        VPA Mean =    4.93     .714     .610



 Year     Weighted      Log     Int     Ext     Var     VPA      Log
 Class     Average      WAP     Std     Std    Ratio             VPA
          Prediction           Error   Error

 1995        166       5.11     .40     .06      .03     52      3.97
 1996        219       5.39     .56     .58     1.07
```

Table 5.14

The SAS System 11:31 Wednesday, September 6, 2000
North-East Arctic saithe (Sub-areas I and II)

Prediction with management option table: Input data

Year: 2000								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.460	0.0024	0.460
3	174328.00	0.2000	0.0000	0.0000	0.0000	0.660	0.1004	0.660
4	171002.00	0.2000	0.0100	0.0000	0.0000	0.990	0.3242	0.990
5	22885.000	0.2000	0.5500	0.0000	0.0000	1.370	0.4790	1.370
6	28191.000	0.2000	0.8500	0.0000	0.0000	1.820	0.5836	1.820
7	11816.000	0.2000	0.9800	0.0000	0.0000	2.400	0.6697	2.400
8	18535.000	0.2000	1.0000	0.0000	0.0000	3.040	0.6144	3.040
9	4785.000	0.2000	1.0000	0.0000	0.0000	4.060	0.5748	4.060
10	3398.000	0.2000	1.0000	0.0000	0.0000	5.380	0.6892	5.380
11+	1997.000	0.2000	1.0000	0.0000	0.0000	7.250	0.6892	7.250
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2001								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.460	0.0024	0.460
3	.	0.2000	0.0000	0.0000	0.0000	0.660	0.1004	0.660
4	.	0.2000	0.0100	0.0000	0.0000	0.990	0.3242	0.990
5	.	0.2000	0.5500	0.0000	0.0000	1.370	0.4790	1.370
6	.	0.2000	0.8500	0.0000	0.0000	1.820	0.5836	1.820
7	.	0.2000	0.9800	0.0000	0.0000	2.400	0.6697	2.400
8	.	0.2000	1.0000	0.0000	0.0000	3.040	0.6144	3.040
9	.	0.2000	1.0000	0.0000	0.0000	4.060	0.5748	4.060
10	.	0.2000	1.0000	0.0000	0.0000	5.380	0.6892	5.380
11+	.	0.2000	1.0000	0.0000	0.0000	7.250	0.6892	7.250
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 2002								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
2	210000.00	0.2000	0.0000	0.0000	0.0000	0.460	0.0024	0.460
3	.	0.2000	0.0000	0.0000	0.0000	0.660	0.1004	0.660
4	.	0.2000	0.0100	0.0000	0.0000	0.990	0.3242	0.990
5	.	0.2000	0.5500	0.0000	0.0000	1.370	0.4790	1.370
6	.	0.2000	0.8500	0.0000	0.0000	1.820	0.5836	1.820
7	.	0.2000	0.9800	0.0000	0.0000	2.400	0.6697	2.400
8	.	0.2000	1.0000	0.0000	0.0000	3.040	0.6144	3.040
9	.	0.2000	1.0000	0.0000	0.0000	4.060	0.5748	4.060
10	.	0.2000	1.0000	0.0000	0.0000	5.380	0.6892	5.380
11+	.	0.2000	1.0000	0.0000	0.0000	7.250	0.6892	7.250
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : MANSME03
Date and time: 25AUG00:11:43

Table 5.15

The SAS System 11:31 Wednesday, September 6, 2000

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

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	5.517	13730.811	2.713	11594.801	2.713	11594.801
0.0500	0.0186	0.085	289.874	5.096	11295.569	2.304	9176.839	2.304	9176.839
0.1000	0.0372	0.148	468.087	4.777	9552.808	1.997	7450.859	1.997	7450.859
0.1500	0.0558	0.199	579.468	4.527	8258.087	1.759	6172.439	1.759	6172.439
0.2000	0.0744	0.240	649.322	4.325	7267.799	1.568	5197.992	1.568	5197.992
0.2500	0.0930	0.274	692.693	4.157	6492.358	1.411	4437.950	1.411	4437.950
0.3000	0.1115	0.302	718.874	4.015	5873.196	1.280	3833.765	1.280	3833.765
0.3500	0.1301	0.327	733.774	3.893	5370.566	1.169	3345.703	1.169	3345.703
0.4000	0.1487	0.348	741.230	3.787	4956.646	1.073	2945.961	1.073	2945.961
0.4500	0.1673	0.367	743.779	3.695	4611.461	0.991	2614.578	0.991	2614.578
0.5000	0.1859	0.384	743.116	3.612	4320.353	0.918	2336.910	0.918	2336.910
0.5500	0.2045	0.399	740.384	3.539	4072.362	0.854	2102.013	0.854	2102.013
0.6000	0.2231	0.412	736.359	3.472	3859.164	0.797	1901.573	0.797	1901.573
0.6500	0.2417	0.424	731.564	3.412	3674.339	0.746	1729.184	0.746	1729.184
0.7000	0.2603	0.436	726.356	3.357	3512.879	0.701	1579.850	0.701	1579.850
0.7500	0.2789	0.446	720.974	3.307	3370.829	0.659	1449.628	0.659	1449.628
0.8000	0.2974	0.455	715.576	3.261	3245.035	0.622	1335.374	0.622	1335.374
0.8500	0.3160	0.464	710.265	3.218	3132.957	0.588	1234.559	0.588	1234.559
0.9000	0.3346	0.472	705.108	3.178	3032.536	0.556	1145.133	0.556	1145.133
0.9500	0.3532	0.480	700.141	3.141	2942.083	0.527	1065.417	0.527	1065.417
1.0000	0.3718	0.487	695.386	3.106	2860.207	0.501	994.030	0.501	994.030
1.0500	0.3904	0.494	690.852	3.074	2785.755	0.476	929.826	0.476	929.826
1.1000	0.4090	0.500	686.538	3.044	2717.763	0.454	871.851	0.454	871.851
1.1500	0.4276	0.506	682.439	3.015	2655.421	0.433	819.301	0.433	819.301
1.2000	0.4462	0.511	678.548	2.988	2598.044	0.413	771.501	0.413	771.501
1.2500	0.4648	0.517	674.853	2.962	2545.051	0.395	727.875	0.395	727.875
1.3000	0.4833	0.522	671.345	2.938	2495.946	0.378	687.936	0.378	687.936
1.3500	0.5019	0.527	668.010	2.915	2450.304	0.362	651.263	0.362	651.263
1.4000	0.5205	0.531	664.839	2.893	2407.756	0.346	617.496	0.346	617.496
1.4500	0.5391	0.535	661.819	2.872	2367.986	0.332	586.324	0.332	586.324
1.5000	0.5577	0.540	658.941	2.852	2330.717	0.319	557.477	0.319	557.477
1.5500	0.5763	0.544	656.194	2.833	2295.709	0.307	530.718	0.307	530.718
1.6000	0.5949	0.547	653.569	2.815	2262.751	0.295	505.843	0.295	505.843
1.6500	0.6135	0.551	651.058	2.797	2231.656	0.284	482.672	0.284	482.672
1.7000	0.6321	0.555	648.652	2.780	2202.262	0.273	461.044	0.273	461.044
1.7500	0.6507	0.558	646.345	2.764	2174.422	0.263	440.821	0.263	440.821
1.8000	0.6692	0.561	644.130	2.748	2148.009	0.253	421.878	0.253	421.878
1.8500	0.6878	0.564	642.001	2.733	2122.907	0.244	404.104	0.244	404.104
1.9000	0.7064	0.567	639.951	2.719	2099.015	0.236	387.402	0.236	387.402
1.9500	0.7250	0.570	637.977	2.705	2076.239	0.228	371.683	0.228	371.683
2.0000	0.7436	0.573	636.073	2.692	2054.497	0.220	356.868	0.220	356.868
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : YLDSME04
Date and time : 25AUG00:14:57
Computation of ref. F: Simple mean, age 3 - 6
F-0.1 factor : 0.2405
F-max factor : 0.4619
F-0.1 reference F : 0.0894
F-max reference F : 0.1717
Recruitment : Single recruit

Table 5.16

The SAS System 11:31 Wednesday, September 6, 2000

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

Prediction with management option table

Year: 2000					Year: 2001					Year: 2002	
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
0.8408	0.3126	600500	198872	125000	0.0000	0.0000	626907	218678	0	802137	363843
.	.	.	.	.	0.0500	0.0186	.	218678	9513	790768	354821
.	.	.	.	.	0.1000	0.0372	.	218678	18803	779671	346035
.	.	.	.	.	0.1500	0.0558	.	218678	27876	768838	337480
.	.	.	.	.	0.2000	0.0744	.	218678	36737	758262	329149
.	.	.	.	.	0.2500	0.0930	.	218678	45393	747936	321035
.	.	.	.	.	0.3000	0.1115	.	218678	53848	737854	313133
.	.	.	.	.	0.3500	0.1301	.	218678	62108	728010	305437
.	.	.	.	.	0.4000	0.1487	.	218678	70178	718396	297942
.	.	.	.	.	0.4500	0.1673	.	218678	78062	709008	290641
.	.	.	.	.	0.5000	0.1859	.	218678	85766	699839	283531
.	.	.	.	.	0.5500	0.2045	.	218678	93294	690884	276604
.	.	.	.	.	0.6000	0.2231	.	218678	100651	682137	269857
.	.	.	.	.	0.6500	0.2417	.	218678	107840	673592	263285
.	.	.	.	.	0.7000	0.2603	.	218678	114867	665245	256883
.	.	.	.	.	0.7500	0.2789	.	218678	121736	657091	250646
.	.	.	.	.	0.8000	0.2974	.	218678	128450	649124	244569
.	.	.	.	.	0.8500	0.3160	.	218678	135013	641339	238649
.	.	.	.	.	0.9000	0.3346	.	218678	141430	633733	232882
.	.	.	.	.	0.9500	0.3532	.	218678	147703	626300	227262
.	.	.	.	.	1.0000	0.3718	.	218678	153837	619036	221786
.	.	.	.	.	1.0500	0.3904	.	218678	159836	611936	216451
.	.	.	.	.	1.1000	0.4090	.	218678	165702	604997	211252
.	.	.	.	.	1.1500	0.4276	.	218678	171439	598214	206186
.	.	.	.	.	1.2000	0.4462	.	218678	177050	591584	201249
.	.	.	.	.	1.2500	0.4648	.	218678	182538	585102	196438
.	.	.	.	.	1.3000	0.4833	.	218678	187907	578765	191749
.	.	.	.	.	1.3500	0.5019	.	218678	193159	572569	187180
.	.	.	.	.	1.4000	0.5205	.	218678	198298	566511	182726
.	.	.	.	.	1.4500	0.5391	.	218678	203325	560587	178385
.	.	.	.	.	1.5000	0.5577	.	218678	208245	554793	174154
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : MANSME03
Date and time : 25AUG00:11:43
Computation of ref. F: Simple mean, age 3 - 6
Basis for 2000 : TAC constraints

Table 5.17

Single option prediction: Summary table

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2000	0.8408	0.3126	82587	125006	646937	600500	78554	198872	78554	198872
2001	0.6994	0.2600	77602	114782	665469	626900	103888	218673	103888	218673
2002	0.6994	0.2600	84476	128017	685068	665339	125751	256954	125751	256954
2003	0.6994	0.2600	88330	137859	694952	691653	136955	285364	136955	285364
2004	0.6994	0.2600	89674	141688	699594	704848	141730	298885	141730	298885
2005	0.6994	0.2600	90333	144686	702187	716601	144322	310635	144322	310635
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : SPRSME01
Date and time : 25AUG00:15:09
Computation of ref. F: Simple mean, age 3 - 6
Prediction basis : F factors

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2000	0.8408	0.3126	82587	125006	646937	600500	78554	198872	78554	198872
2001	0.8408	0.3126	90904	133814	665469	626900	103888	218673	103888	218673
2002	0.8408	0.3126	95032	141364	673184	642753	118103	239723	118103	239723
2003	0.8408	0.3126	96770	146040	675811	651500	122887	251870	122887	251870
2004	0.8408	0.3126	96838	146067	676412	652846	123730	253734	123730	253734
2005	0.8408	0.3126	96848	146579	676842	656051	124168	256957	124168	256957
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	1 January Sp.stock size	1 January Sp.stock biomass	Spawning time Sp.stock size	Spawning time Sp.stock biomass
2000	0.8408	0.3126	82587	125006	646937	600500	78554	198872	78554	198872
2001	1.0000	0.3718	105057	153835	665469	626900	103888	218673	103888	218673
2002	1.0000	0.3718	105111	153135	660567	619031	110083	221782	110083	221782
2003	1.0000	0.3718	104244	151590	656522	611950	109003	219345	109003	219345
2004	1.0000	0.3718	103019	147877	653995	604362	106808	212433	106808	212433
2005	1.0000	0.3718	102483	146331	653019	602038	105845	210140	105845	210140
Unit	-	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

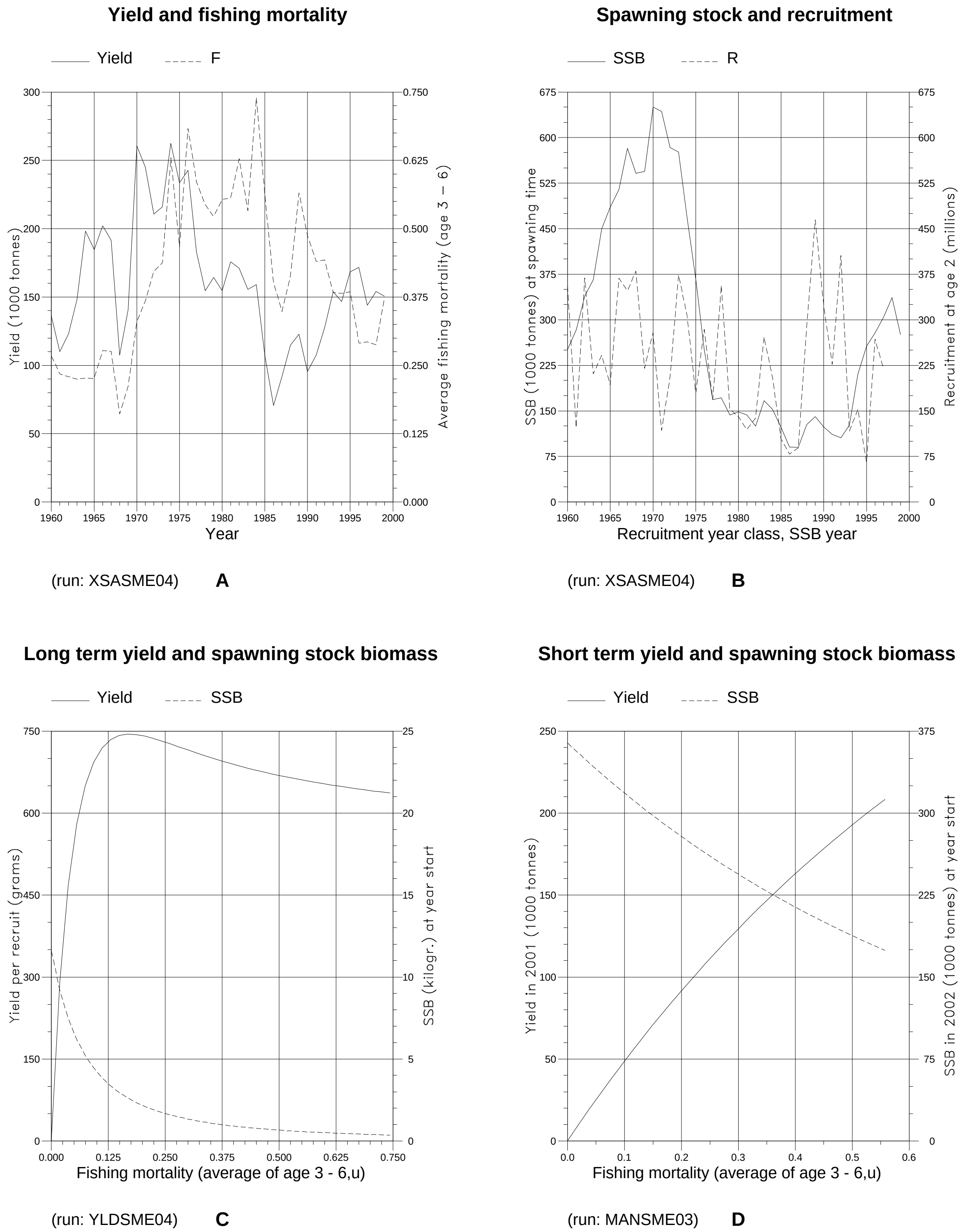

Figure 5.1A-D Northeast Arctic saithe

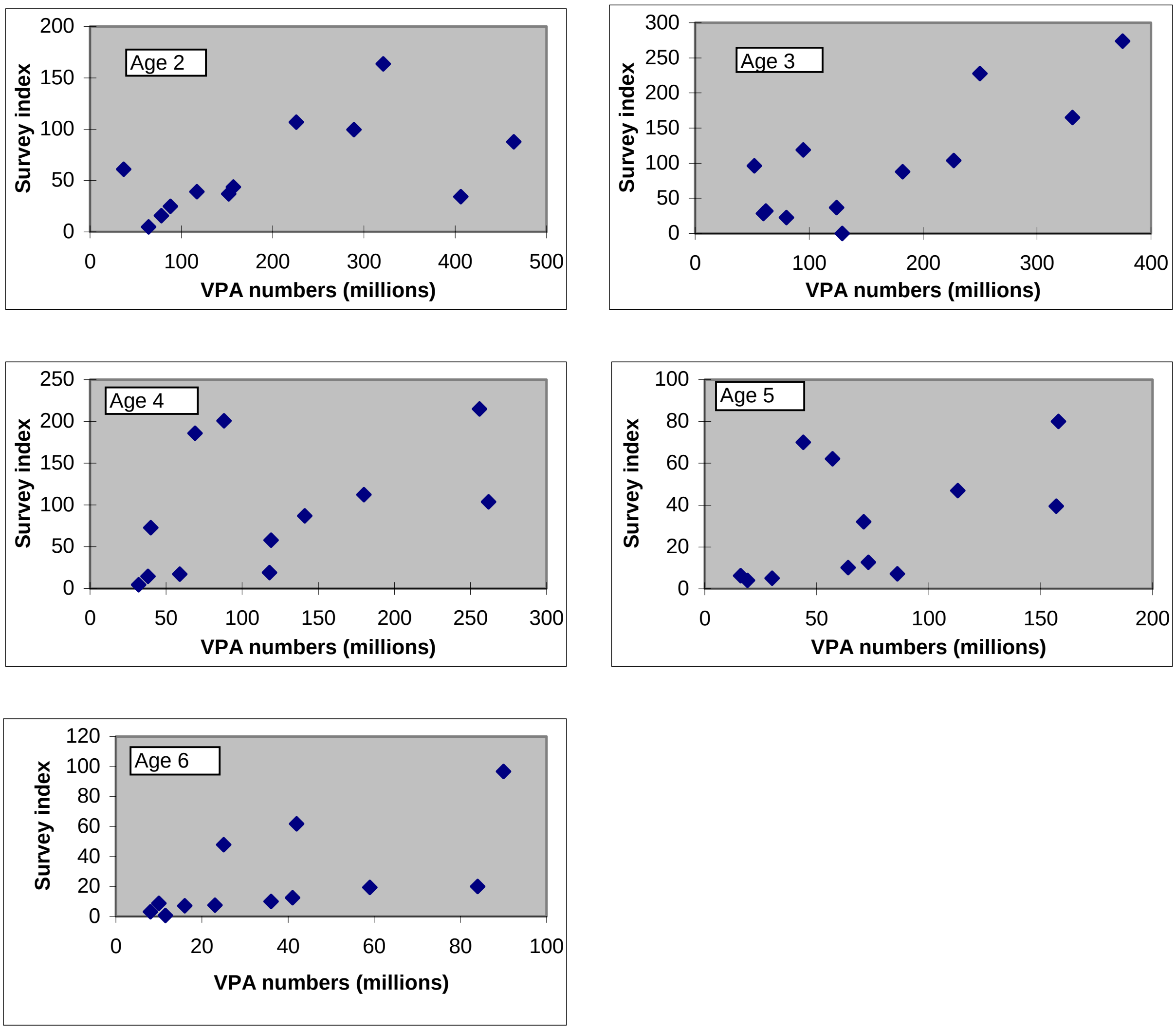

Figure 5.2A. North-East Arctic Saithe - Acoustic survey vs VPA

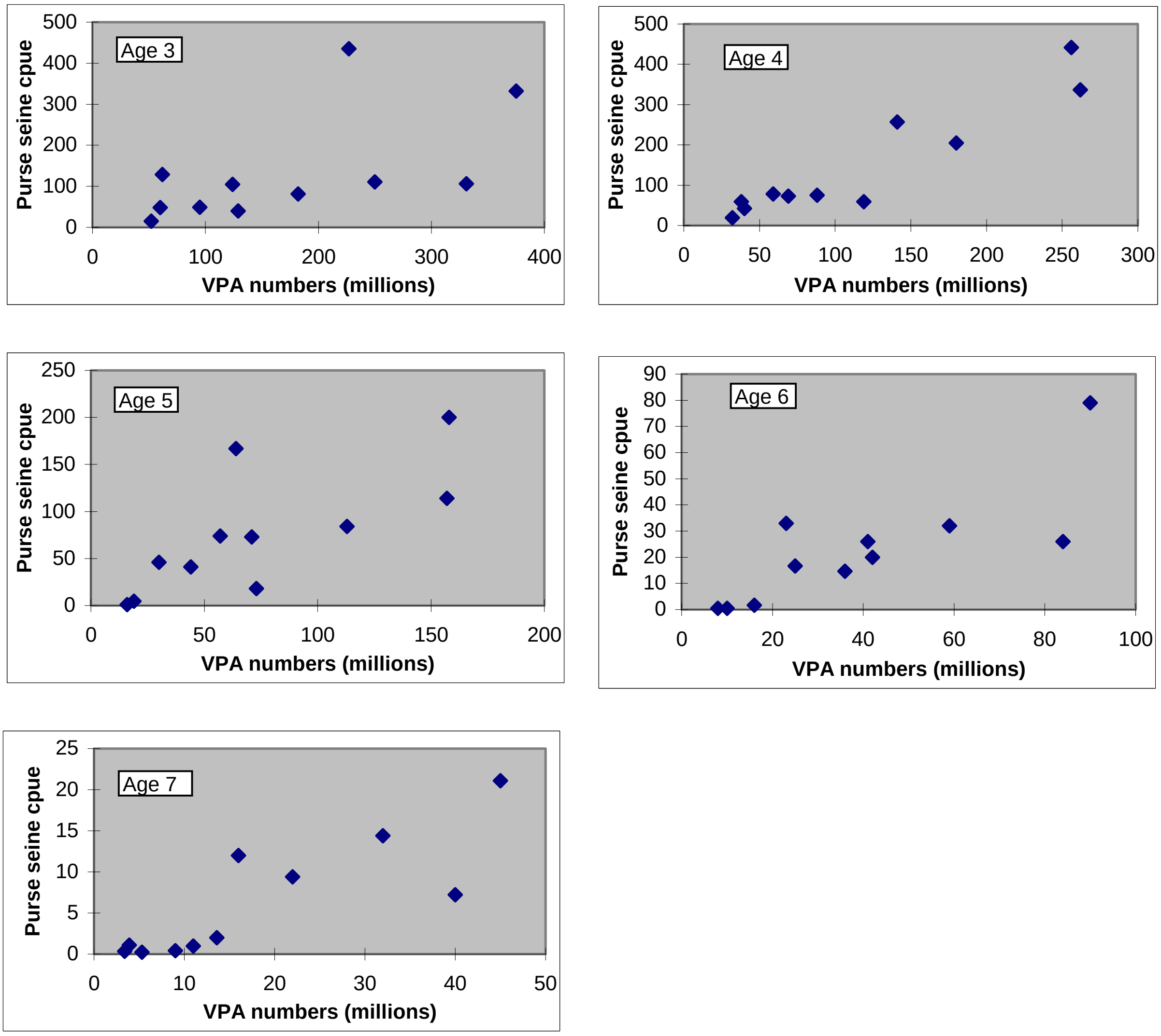

Figure 5.2B. North-East Arctic Saithe - Norwegian purse seine vs VPA

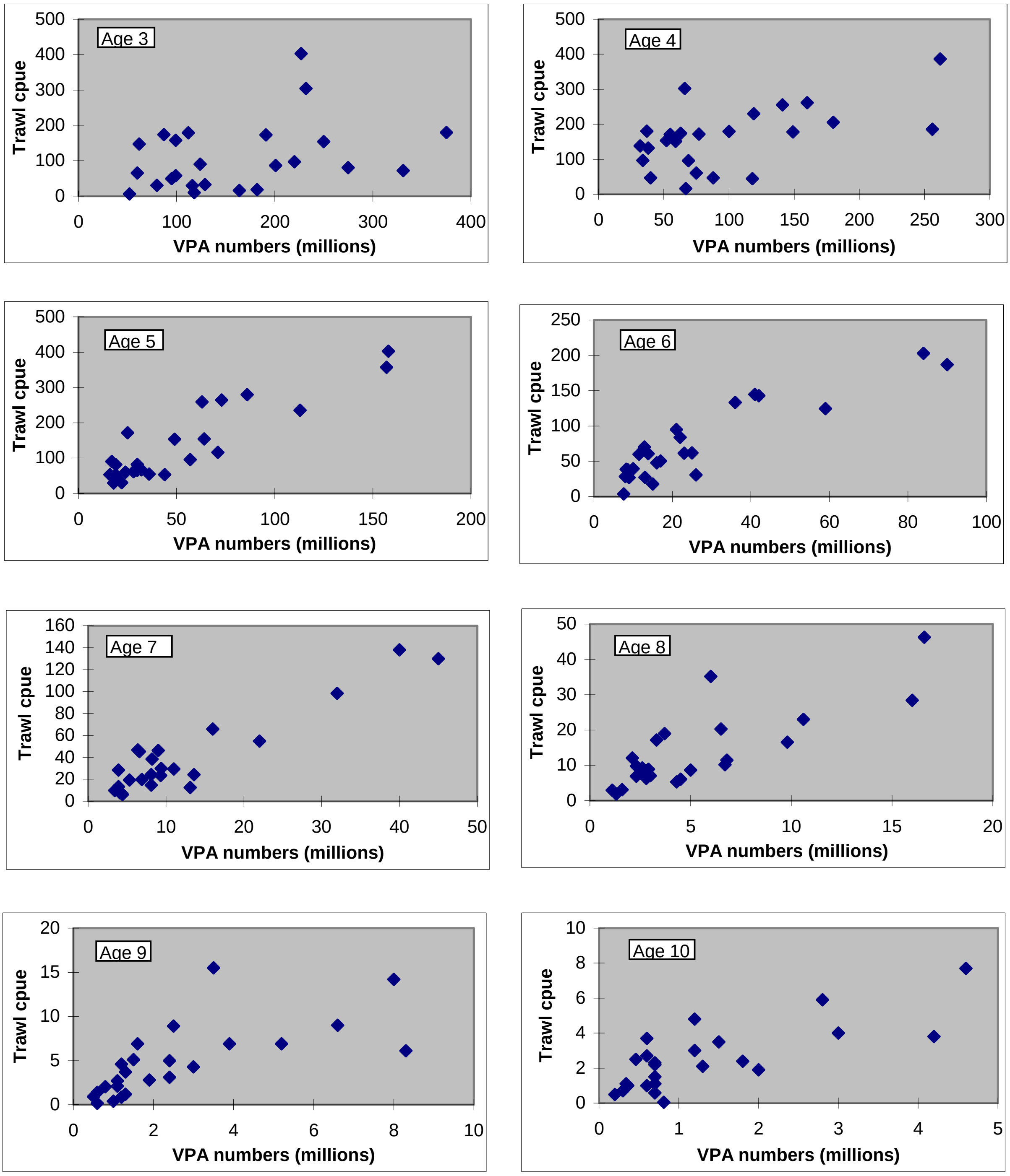

Figure 5.2C. North-East Arctic Saithe - Norwegian trawl vs VPA

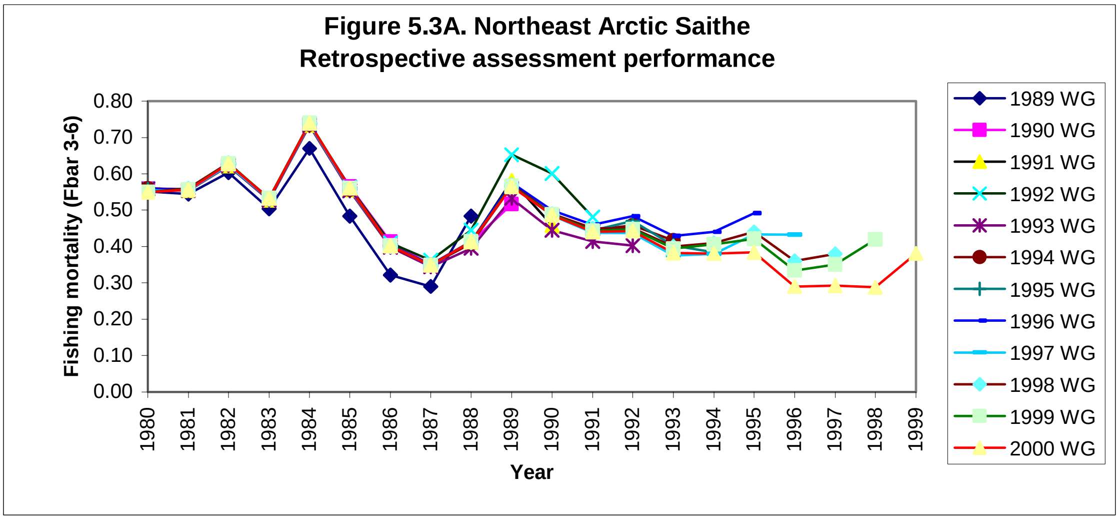
Figure 5.3A. Northeast Arctic Saithe
Retrospective assessment performance
Fishing mortality (Fbar 3-6)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
Year
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG
1999 WG
2000 WG

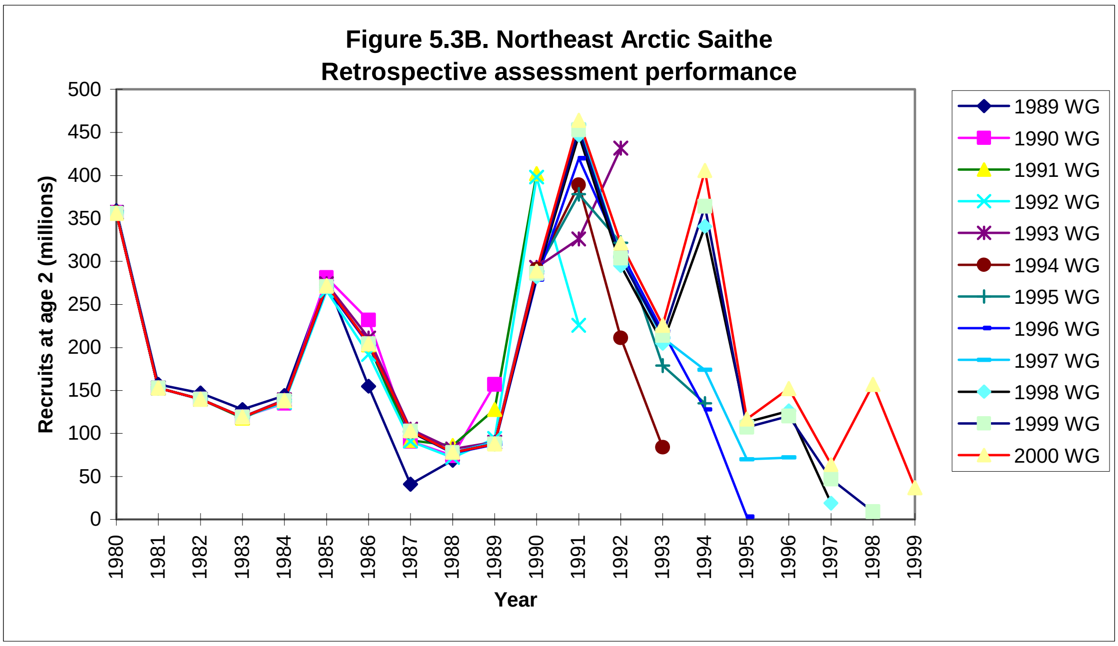
Figure 5.3B. Northeast Arctic Saithe
Retrospective assessment performance
Recruits at age 2 (millions)
500
450
400
350
300
250
200
150
100
50
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
Year
1989 WG
1990 WG
1991 WG
1992 WG
1993 WG
1994 WG
1995 WG
1996 WG
1997 WG
1998 WG
1999 WG
2000 WG

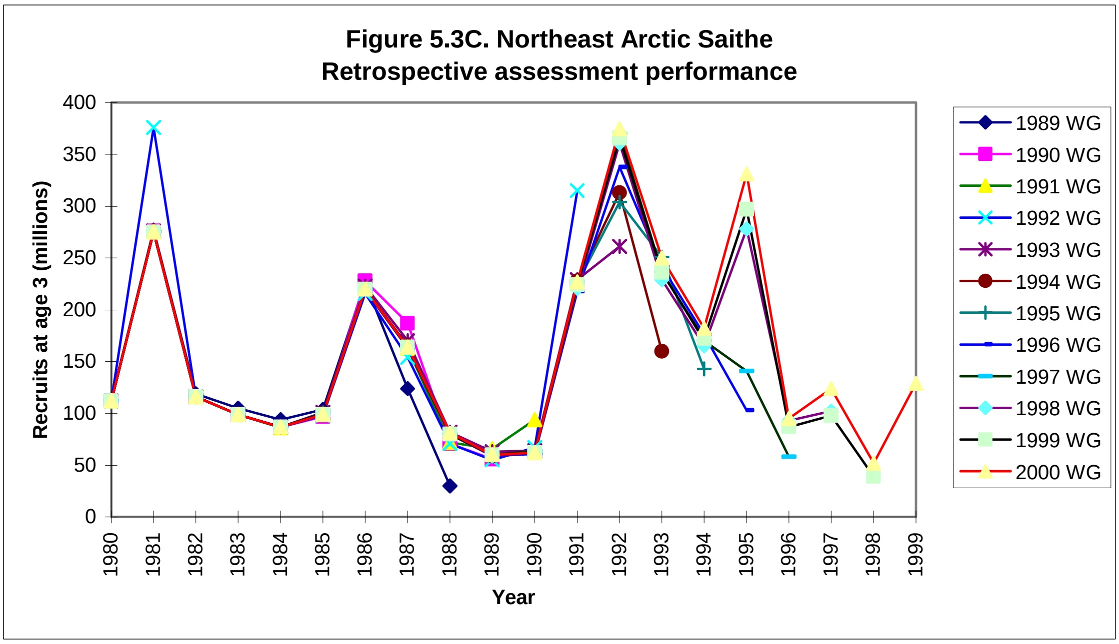
Figure 5.3C. Northeast Arctic Saithe
Retrospective assessment performance
Recruits at age 3 (millions)
400
350
300
250
200
150
100
50
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
Year
1989 WG
1990 WG
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1997 WG
1998 WG
1999 WG
2000 WG

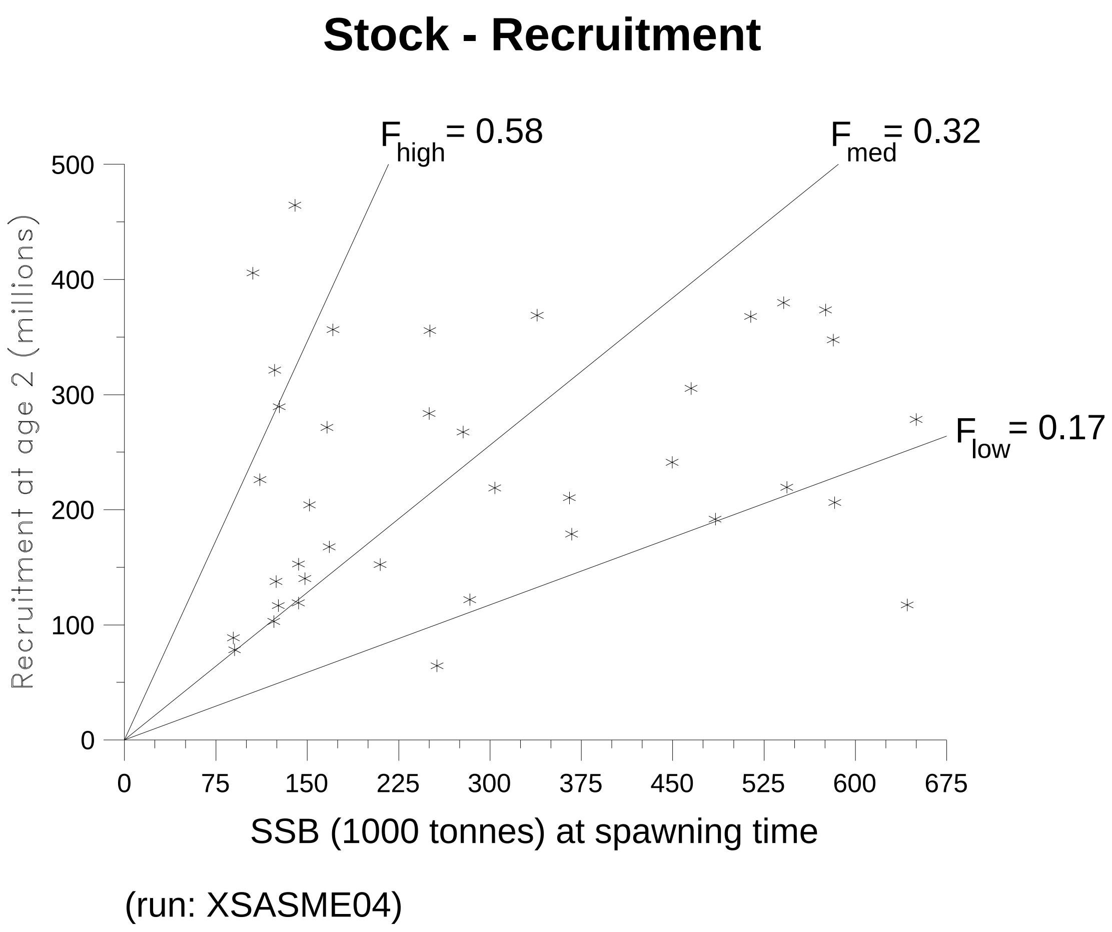


Figure 5.4 Northeast Arctic saithe

Figure 5.5 A Quantiles of the SSB distribution, Fpa=0.26

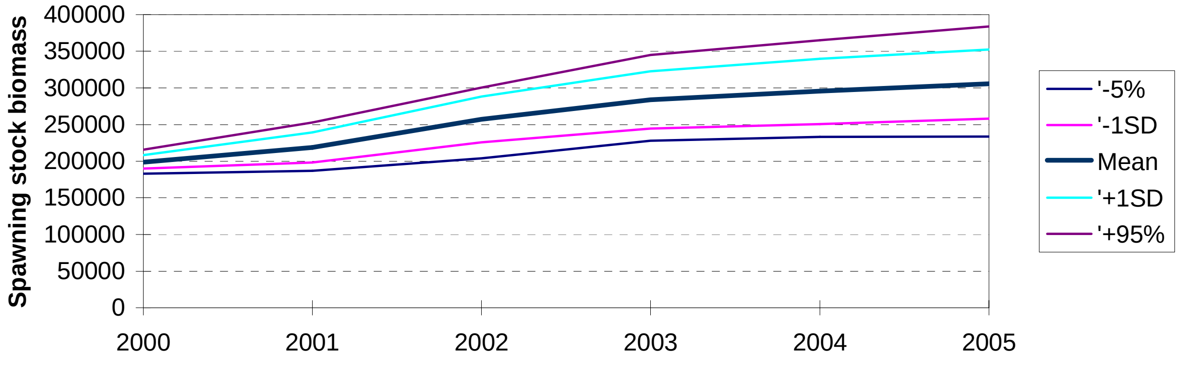


Figure 5.5 B Quantiles of the SSB distribution, F2000=0,31

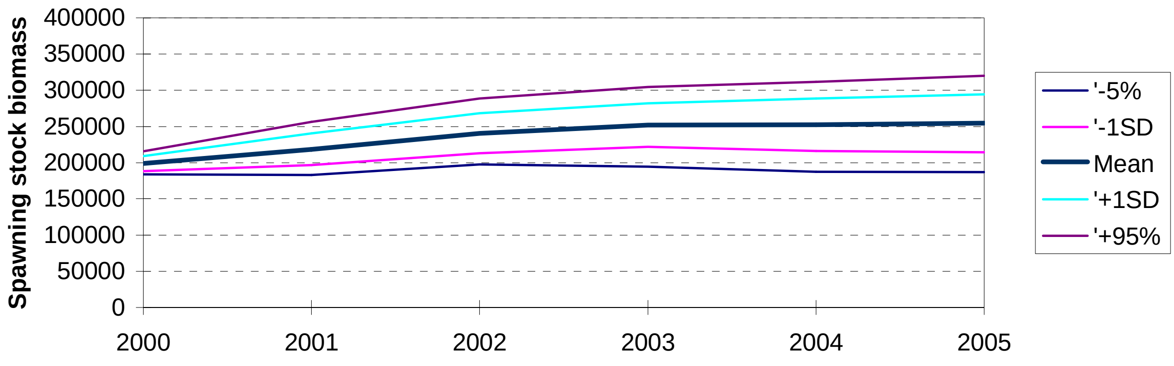
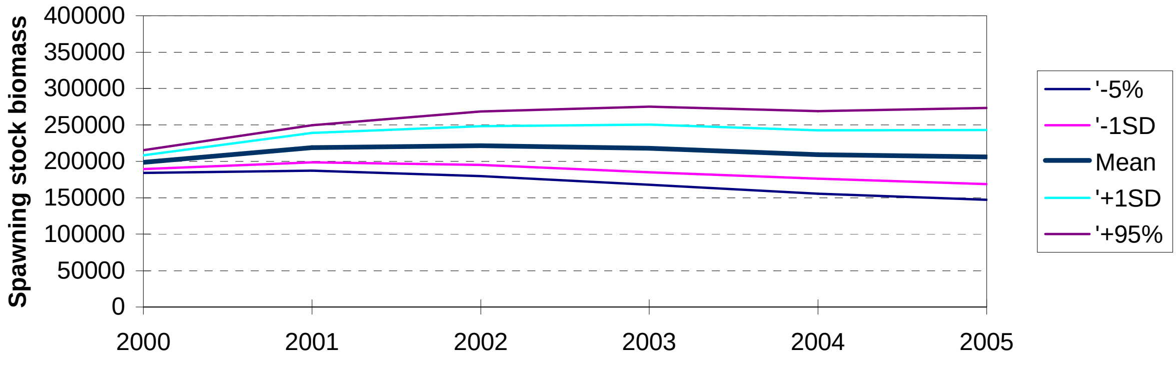


Figure 5.5 C Quantiles of the SSB distribution, Fsq=0.37



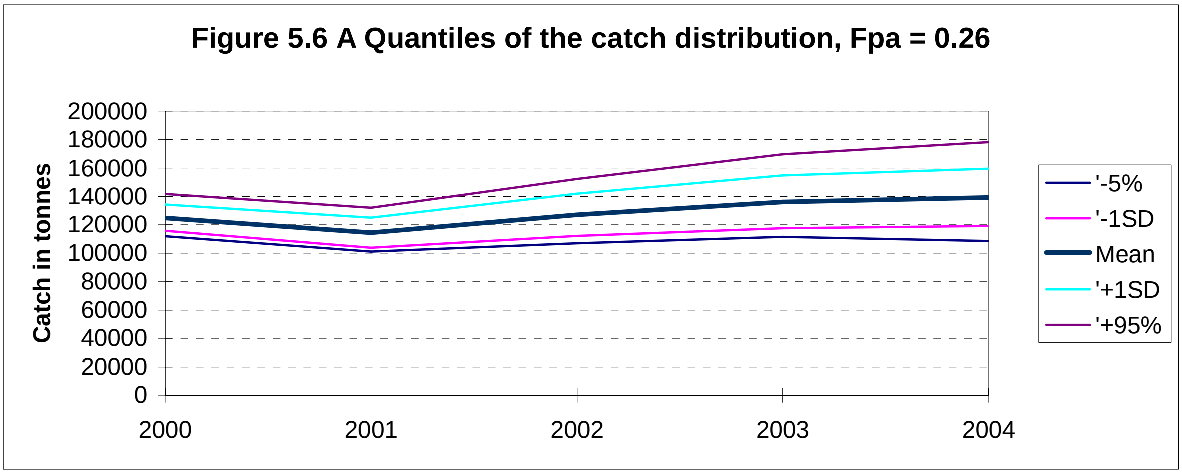


Figure 5.6 A Quantiles of the catch distribution, Fpa = 0.26
Catch in tonnes
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
2000
2001
2002
2003
2004
'-5%
'-1SD
Mean
'+1SD
'+95%

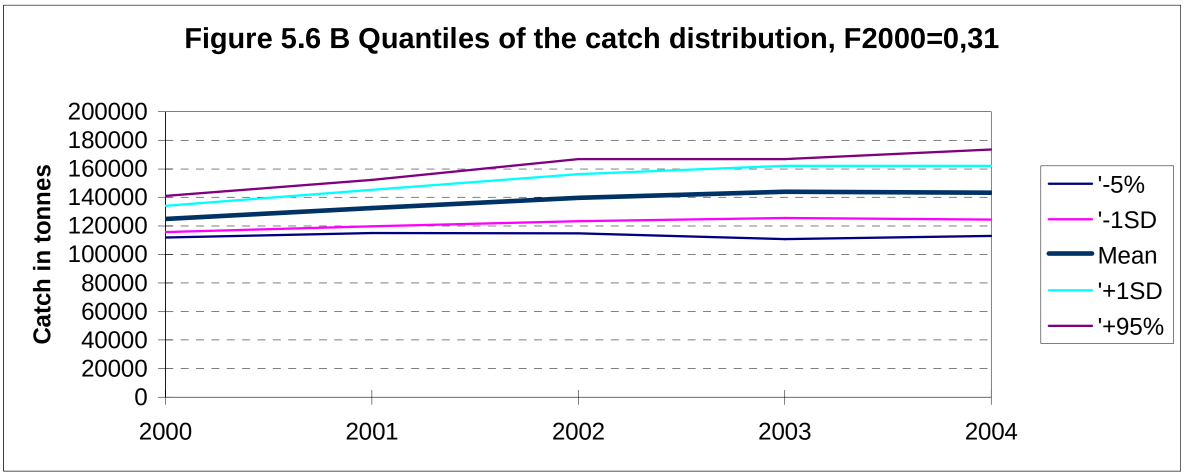


Figure 5.6 B Quantiles of the catch distribution, F2000=0,31
Catch in tonnes
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
2000
2001
2002
2003
2004
'-5%
'-1SD
Mean
'+1SD
'+95%

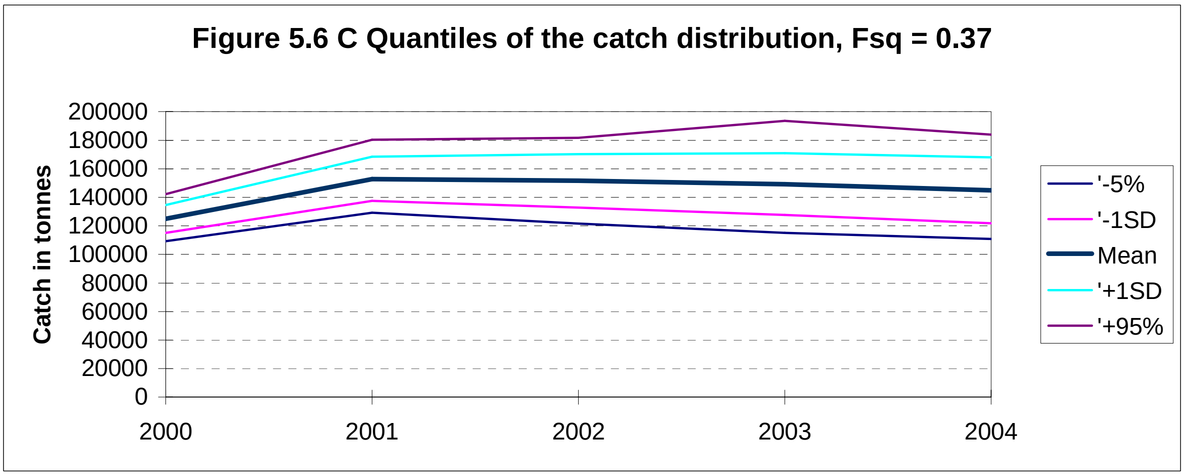


Figure 5.6 C Quantiles of the catch distribution, Fsq = 0.37
Catch in tonnes
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
2000
2001
2002
2003
2004
'-5%
'-1SD
Mean
'+1SD
'+95%

Table C.1.a Northeast Arctic saithe. Norwegian purse seiners taking part in the saithe fishery.
Data given are: number of vessels, catch in tonnes, catch per vessel.

	Vessel length (m)								
	< 19,9			20.0-24.9			> 25.0		
Year	Number	Catch	C/V	Number	Catch	C/V	Number	Catch	C/V
1977	208	21,398	103	66	25,324	384	19	5,655	298
1978	184	16,288	89	72	21,224	295	19	6,094	321
1979	250	21,224	85	72	27,057	376	25	9,122	365
1980	269	21,243	79	96	27,551	287	39	10,234	262
1981	312	25,984	83	89	29,108	327	23	7,354	320
1982	308	30,228	98	98	35,969	367	23	9,303	404
1983	222	19,925	90	80	28,348	354	12	5,524	460
1984	168	8,834	53	69	20,668	300	15	6,713	448
1985	90	4,150	46	57	18,328	322	16	8,391	524
1986	55	1,281	23	43	3,581	83	21	2,643	126
1987	106	9,084	86	46	16,766	364	15	8,185	546
1988	120	13,111	109	48	20,413	425	13	8,981	691
1989	195	14,993	77	61	23,000	377	13	10,466	805
1990	89	2,533	28	53	13,360	252	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	445	21	17,931	854
1997	87	10,153	117	48	20,135	419	32	14,012	438
1998 [1]	125	10,274	82	82	19,216	234	102	14,871	146
1999 [2]	113	9,983	88	76	14,135	186	112	13,902	124

[1] Provisional figures.
[2] Preliminary data per 24.10.99.

Table C.1.b. Northeast Arctic saithe. Catches splitted on vessels with catch < 100 t and > 100 t, and number of vessels with catch > 100 t scaled by total purse seine catch

	No. of vessels with catch		Total catch (t) from vessels with catch			Catch in % from vessels with		No. vessels with > 100 t, scaled to	C/V for scaled no.
Year	< 100 t	> 100 t	< 100 t	> 100 t	Total	< 100 t	> 100 t	total catch	vessels
1989	160	109	4165	44309	48474	9	91	119	407
1990	110	51	2341	22278	24618	10	90	56	440
1991	105	92	2569	36329	38898	7	93	99	393
1992	89	80	2671	24206	26877	10	90	89	302
1993	41	69	1319	31832	33151	4	96	72	460
1994	56	75	1601	27746	29348	5	95	79	371
1995	72	48	1762	20138	21900	8	92	52	421
1996	83	79	1654	45195	46848	4	96	82	571
1997	69	88	1943	42358	44301	4	96	92	482
1998	193	118	4142	40234	44376	9	91	130	341
1999 [1]	212	115	5263	33792	39055	13	87	133	294

[1] Provisional figures.

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	18,607	25,046	743
1999 [2]	18,498	25,233	733

[1] Including only days with more than 50% saithe on trips with more than 50% saithe in the catches.
[2] Provisional figures.

Table C.3 Northeast Arctic saithe. Norwegian effort indices.

Year	Purse seine[1]	Trawl[2]	Combined
1976		36.8	
1977		52.7	
1978		51.3	
1979		42.7	
1980		57.4	
1981		71.0	
1982		58.2	
1983		57.7	
1984		85.5	
1985		63.7	
1986		45.2	
1987		30.1	
1988		50.4	
1989	119	59.8	179
1990	56	60.4	116
1991	99	51.5	151
1992	89	57.6	147
1993	72	68.0	140
1994	79	78.7	158
1995	52	106.4	158
1996	82	74.7	157
1997	92	41.4	133
1998	130	65.8	196
1999 [3]	133	69.7	203

[1] No. of vessels with > 100 t. total catch in Table C.1, scaled by total purse seine catch.
[2] Hours trawling ('000). Effort in Table C-2 scaled by total Norwegian trawl catch.
[3] Provisional figures.

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					
	2	3	4	5	6+	Total
1985	3.1	4.9	2.4	0.5	0.0	10.9
1986	19.5	40.8	3.6	1.8	1.8	67.5
1987	1.8	22.0	48.4	1.8	1.7	75.7
1988	15.7	22.5	19.0	7.1	0.6	64.9
1989	24.8	28.4	17.0	10.1	12.4	92.7
1990	99.6	31.9	14.7	5.1	7.4	158.7
1991	87.8	104.0	4.6	4.0	7.1	207.5
1992	163.5	273.6	57.5	6.2	8.8	509.6
1993	106.9	227.7	103.9	12.7	3.2	454.4
1994	34.4	87.8	112.4	39.5	10.0	284.1
1995	38.7	165.2	87.0	46.8	20.0	357.7
1996	37.0	118.9	214.7	32.1	19.3	422.0
1997	5.1	36.7	185.8	79.8	61.7	369.1
1998	43.6	96.5	200.6	70.0	96.7	507.4
1999	61.1	233.8	72.9	62.2	47.8	477.8

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.

	agegroup											
Year	1	2	3	4	5	6	7	8	9	10	6+	Total
1995	680	13686	33703	9365	5695	2404	1342	708	110	171	4735	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
1999	305	1166	14044	1869	4916	1790	3098	4414	991	511	10804	33104

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 fishery and as juveniles in the shrimp trawl fisheries. 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. This was 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, except in 1996–1997 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 to the lowest possible level.

Strong regulations were enforced in the fishery in 1997. Since then it has been 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.

To provide additional protection of the adult *S. mentella* stock, two areas south of Lofoten have been closed for all trawl fishing since 1 March 2000. The two areas are delineated by straight lines between the following positions:

1. N 6630’ E 0659’
2. N 6621’ E 0644’
3. N 6543’ E 0600’
4. N 6520’ E 0600’
5. N 6520’ E 0530’
6. N 6600’ E 0530’
7. N 6630’ E 0634.27’

1. N 6236’ E 0300’
2. N 6210’ E 0115’
3. N 6240’ E 0052’
4. N 6300’ E 0300’

Since 1 January 2000 a maximum legal by-catch criterion of 10 juvenile redfish (both *S.marinus*, *S. mentella*, and *S. viviparus*) per 10 kg shrimp has been enforced in the shrimp fishery.

6.1.2 Landings prior to 2000 (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 increased to 13,791 t in 1998. Provisional statistics for 1999 show 11,115 t, which is about 2,800 t less than the 14,000 t expected by last year's Working Group. The regulations enforced in the fishery in 1997 (see chapter 6.1.1) have, however, not been sufficient to reduce the catches. Therefore, stronger regulations were introduced in 2000.

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 2000

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 2000. In addition to this, and based on reports from the eight first months in 2000, a by-catch of approx. 1,500 t in other fisheries and areas should give an expected total Russian catch in 2000 of about 3,500 t.

Based on the landings of *S. mentella* from the seven first months of the year, Norwegian landings in 2000 are expected to be around 4,000 t. On this basis, and assuming unchanged catch level for other countries, the total landings of *S. mentella* for 2000 is expected to be 8,000 t.

6.2 Data Used in the Assessment

All input data sets were updated up to and including 1999. Maturity ogives and some of the XSA tuning series were updated to 2000. A new Russian trawl/acoustic tuning series was included in a trial XSA run, and for reasons mentioned in Section 6.2.1 the commercial trawl CPUE data for 1997–1999 were excluded.

6.2.1 Fishing effort and catch-per-unit-effort (Table D3, Figure 6.7)

Catch-per-hour-trawling data for the *S. mentella* fishery were available from one or two Russian BMRT trawlers fishing in ICES Division IIa in April-May 1998–2000, representative for the directed Russian fishery accounting for 60–70% of the total Russian catch (Table D3). In order to extend the historical PST-trawler series, the BMRT CPUE was converted to PST-units. However, the new BMRT 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 by one or two vessels on a localised spawning concentration. Because of this, the CPUEs have been plotted in Figure 6.7 only for the period before 1997. 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 1999.

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 1993–1998 was revised according to new catch data. Data on age for 1999 for *S. mentella* were only available from Russia in Division IIa and Norway. For Division IIa, a German length distribution was available, and was converted to age using the Norwegian age-length key from the same Division. The landings from other countries were distributed on age according to the Norwegian age distribution.

6.2.3 Weight-at-age (Table 6.6)

Catch weight-at-age data for 1999 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 stock 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 1997–2000 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) were 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 material for the subsequent years were taken as representative for these years.

6.2.5 Survey results (Tables A14, D4–D7, Figures 6.1–6.6)

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 1978–1999 in fishing depths of 100–900 m (Table D4, Figure 6.2).

3) Norwegian Svalbard (Division IIb) bottom trawl survey (August–September) from 1986–1999 in fishing depths of 100–500 m. Data disaggregated on age only for the years 1992–1999 (Table D5a,b and Figure 6.3a,b).

4) Norwegian Barents Sea bottom trawl survey (February) from 1986–2000 in fishing depths of 100–500 m. Data disaggregated on age only for the years 1992–2000 (Tables D6a,b and Figures 6.4a,b).

5) Russian acoustic survey in April–May from 1992–2000 (except 1994 and 1996) on spawning grounds in the western Barents Sea (Table D7, Figure 6.6).

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 1996–1999 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.

Since 1981, a stratified 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 1986–2000 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 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 1997–2000. 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 (Figure 6.6). 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 1988–1990 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*. 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 1987–1990 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 1987–1990 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 previously defined 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 1987–1990 year classes (approx. 27–34 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 taken 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.

A trial XSA was run with the same settings as used in the last (1997) analytical assessment of this stock. A new Russian trawl/acoustic tuning series was included, and of reasons mentioned in section 6.2.1 the commercial trawl CPUE data for 1997–1999 were excluded in this trial run. Due to low fishing mortalities, high sensitivity for including the commercial CPUE-series or not, and poor diagnostics for some ages and series, the Working Group decided to explore the input and tuning settings more thoroughly before a reliable assessment could be presented. Nevertheless, the results from this trial assessment are in line with the previous analytical assessment.

Possible alternative methods to conventional catch-at-age analyses, such as the BORMICON model used by the ICES North-Western WG, were discussed also for this redfish stock. Preparatory work should be done in order to explore these possibilities.

6.4 Biological Reference Points

No biological reference points with respect to the precautionary approach could be derived from the available data at this time.

6.5 Management Advice

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, while a temporary increase of the SSB is expected if the catches are kept low. Therefore the same advice should be maintained for 2001. 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*.
Nominal catch (t) by countries in Sub-area I, Divisions IIa and IIb combined.

Year	Canada	Denmark	Faroe Islands	France	Germany[3]	Greenland	Ireland
1986	-	-	-	-	1,252	-	-
1987	-	-	200	63	1,321	-	-
1988	No species specific data available by country.						
1989	-	-	335	1,093	3,833	-	-
1990	-	-	108	142	6,354	36	-
1991	-	-	487	85	-	23	-
1992	-	-	23	12	-	-	-
1993	8	4	13	50	35	1	-
1994	-	28	4	74	18	1	3
1995	-	-	3	16	176	2	4
1996	-	-	4	75	119	3	2
1997	-	-	17	37	80	16	6
1998	-	-	20	73	100	14	9
1999[1]	-	-	76	26	202	50	3

Year	Norway	Poland	Portugal	Russia[4]	Spain	UK (Eng. & Wales)	UK (Scotland)	Total
1986	1,274	-	1,273	17,815	-	84	-	23,112[2]
1987	1,488	-	1,175	6,196	25	49	1	10,518
1988	No species specific data available by country.							15,586
1989	4,633	-	340	13,080	5	174	1	23,494
1990	10,173	-	830	17,355	-	72	-	35,070
1991	33,592	-	166	14,302	1	68	3	48,727
1992	10,751	-	972	3,577	14	238	3	15,590
1993	5,182	-	963	6,260	57	293	-	12,866
1994	6,511	-	895	5,021	30	124	12	12,721
1995	2,646	-	927	6,346	67	93	4	10,284
1996	6,053	-	467	925	328	76	23	8,075
1997	4,570	1	474	2,972	272	71	7	8,523
1998	9,532	13	125	3,646	125	93	41	13,791
1999[1]	7,781	6	65	2,731	35	112	28	11,115

[1] Provisional figures.
[2] Including 1,414 tonnes in Division IIb not split on countries.
[3] Includes former GDR prior to 1991.
[4] USSR prior to 1991.

Table 6.2 *Sebastes mentella*.
Nominal catch (t) by countries in Sub-area I.

Year	Faroe Islands	Germany[4]	Greenland	Norway	Russia[5]	UK(Eng.& 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	-	-	-	26	378	-	404
1999[1]	-	-	-	65	489	-	554

[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*.
Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Norway
1986[3]	-	-	1,252	-	-	-
1987[3]	200	63	970	-	-	149
1988	No species specific data presently available					
1989	312[2]	1,065[2]	3,200	-	-	4,573
1990	98[2]	137[2]	1,673	-	-	8,842
1991	487[2]	72[2]	-	-	-	32,810
1992	23[2]	7[2]	-	-	-	9,816
1993	11[2]	15[2]	35	1[2]	-	5,029
1994	2[2]	33[2]	16[2]	1[2]	2[2]	6,119
1995	1[2]	16[2]	176[2]	2[2]	2[2]	2,251
1996	-	75[2]	119[2]	3[2]	-	5,895
1997	13[2]	37[2]	77	12[2]	2[2]	4,366
1998	20[2]	73[2]	58[2]	14[2]	6[2]	9,363
1999[1]	72[2]	16[2]	160[2]	50[2]	3[2]	7,490

Year	Portugal	Russia[5]	Spain	UK(Eng.& Wales)	UK (Scotland)	Total
1986[3]	1,273	16,904	-	84	-	19,513
1987[3]	1,156	4,469	-	34	1	7,042
1988	No species specific data presently available					
1989	251	9,749	-	158[2]	1[2]	19,309
1990	824	6,492	-	9	-	18,075
1991	159[2]	7,596	-	23[2]	-	41,147
1992	824[2]	1,096	-	27[2]	-	11,793
1993	648[2]	5,328	-	2[2]	-	11,069
1994	687[2]	4,692	8[2]	4[2]	-	11,564
1995	715[2]	5,916	65[2]	41[2]	2[2]	9,187
1996	429[2]	677	5[2]	42[2]	19[2]	7,264
1997	410[2]	2,341	9[2]	48[2]	7[2]	7,322
1998	118[2]	2,626	40[2]	65[2]	41[2]	12,424
1999[1]	56[2]	1,340	15[2]	94[2]	26[2]	9,322

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 6.4 *Sebastes mentella*.
Nominal catch (t) by countries in Division IIb.

Year	Canada	Denmark	Faroe Islands	France	Germany[5]	Greenland	Ireland
1986[4]	Data not available on countries						
1987[4]	-	-	-	-	349	-	-
1988	No species specific data presently available						
1989	-	-	10	28	633	-	-
1990	-	-	8[2]	5[2]	4,681	36[2]	-
1991	-	-	-	13[2]	-	23	-
1992	-	-	-	5[2]	-	-	-
1993	8[2]	4[2]	-	35[2]	-	-	-
1994	-	28[2]	-	41[2]	-	-	1[2]
1995	-	-	-	-	-	-	2[2]
1996	-	-	4[2]	-	-	-	2[2]
1997	-	-	4[2]	-	3	1[2]	4[2]
1998	-	-	-	-	42[2]	-	3[2]
1999[1]			4[2]	10[2]	42[2]	-	-

Year	Norway	Poland	Portugal	Russia[6]	Spain	UK(Eng. & Wales)	UK Scotland	Total
1986[4]	Data not available on countries							1,414
1987[4]	173	-	19	1,493	25	12	-	2,071
1988	No species specific data presently available							
1989	-	-	89	2,847	5	7[2]	-	3,619
1990	1,331	-	6	10,763	-	63[2]	-	16,893
1991	774	-	7	6,286	1	45[2]	3[2]	7,152
1992	374	-	148[2]	2,073	14	211[2]	3[2]	2,826
1993	137	-	315[2]	344	57[3]	291[2]	-	1,191
1994	356	-	208[2]	21	22[3]	120[2]	12[2]	809
1995	375	-	212[2]	227	2[3]	52[2]	2[2]	872
1996	153	-	38[2]	147	323[2]	34[2]	4[2]	705
1997	191	1[2]	64[2]	457	263[2]	22[2]	-	1,010
1998	143	13[2]	7[2]	642	85[2]	28[2]	1[2]	964
1999[1]	226	6[2]	9[2]	902	20[2]	18[2]	2[2]	1,239

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.

Table 6.5.

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 29/08/2000 19:17

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

	YEAR	1965	1966	1967	1968	1969
	AGE					
	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0
	5	0	0	0	0	0
	6	48	0	0	7	31
	7	285	0	0	0	94
	8	1592	27	7	15	409
	9	2163	279	15	89	524
	10	1141	532	182	192	838
	11	1545	465	285	355	933
	12	1972	731	343	436	954
	13	2471	1223	394	554	849
	14	2804	1927	489	864	618
	15	1996	2007	496	768	482
	16	2067	1741	628	931	807
	17	1592	1422	613	694	451
	18	1473	944	540	665	849
	+gp	2589	1980	3254	1802	2536
0	TOTALNUM	23738	13278	7246	7372	10375
	TONSLAND	15662	10143	6239	5413	6836
	SOPCOF %	104	102	100	94	95

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

	YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	AGE										
	1	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0
	6	0	0	466	172	606	5834	18891	0	2905	3633
	7	0	0	792	1660	4847	19417	29815	2418	30158	20497
	8	33	114	5728	4865	15451	42425	59395	17175	65162	43553
	9	131	284	3586	9729	28781	82480	78241	33454	53391	46996
	10	620	681	2049	4636	30144	108462	110712	52102	33569	37469
	11	2122	1590	1770	2633	19843	119075	112524	49617	19909	26298
	12	3428	4429	3865	3148	10603	57231	93144	53938	17242	20717
	13	3983	4884	4564	5208	8634	29651	49550	33287	9270	16341
	14	3526	5451	4704	5666	8634	20894	26134	19095	7410	6059
	15	2808	4940	4098	4578	6514	16499	13881	12605	5456	3589
	16	3983	7496	4704	5380	5908	13465	9839	5796	4134	3465
	17	2743	4486	3632	3777	3332	13668	6300	4874	2134	2465
	18	3559	7382	3167	2747	2878	12207	7233	5499	1545	1964
	+gp	5714	14934	3447	3053	5300	22366	11439	13906	2917	6579
0	TOTALNUM	32650	56671	46572	57252	151475	563674	627098	303766	255202	239625
	TONSLAND	22916	45063	28862	38380	69372	239070	269022	146365	92611	87145
	SOPCOF %	94	98	101	118	99	91	98	95	101	100

Table 6.5 continued.

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 29/08/2000 19:17

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

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
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	1065	932	5	20	0	98	29	0	0	48
7	7412	3000	854	86	34	571	117	0	0	475
8	26296	8620	4775	1987	525	2009	215	109	0	1933
9	44131	26716	12554	4576	2106	4949	1049	1055	379	3972
10	40441	48290	47348	16695	7969	17096	3079	3145	1838	4432
11	27089	39206	57134	31310	22092	31564	5921	2679	3512	4303
12	19950	33394	46529	51099	36763	41511	10701	3580	4084	4667
13	11172	21178	37731	48307	47096	33190	15930	6213	6958	7062
14	6400	11853	15506	29973	25468	10519	7051	3702	7313	6068
15	5607	6038	9492	17132	12002	4243	2495	1459	4022	4412
16	6801	2697	5780	8347	4336	1971	704	656	1960	3282
17	3441	2172	3368	5238	1499	658	390	210	983	2399
18	3001	1344	2160	2055	517	343	81	66	328	1733
+gp	2546	1910	4184	673	472	52	67	0	106	2220
0 TOTALNUM	205352	207350	247420	217498	160879	148774	47829	22874	31483	47006
TONSLAND	79354	81546	115383	105273	72934	63068	23112	10518	15586	23494
SOPCOF %	97	95	100	99	104	101	100	100	100	99

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

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	5	0	0	0	0	0
3	0	0	0	0	62	0	0	0	0	0
4	0	0	1108	569	63	0	0	0	0	1
5	0	2044	957	298	88	119	155	73	1	3
6	1	1653	1873	159	738	662	223	122	34	7
7	748	5453	2498	159	730	941	634	523	741	59
8	4036	7994	1898	174	722	1279	1699	1281	2574	435
9	6797	6781	1622	512	992	719	1554	1237	4003	1479
10	7297	8226	1780	2094	2561	740	1236	1295	3963	2245
11	6038	5344	1531	3139	2734	1230	1078	1234	2730	3320
12	8568	6227	2108	2631	3060	2013	1146	872	1879	1826
13	11600	9880	2288	2308	1535	4297	1413	1410	1383	1410
14	7499	10824	2258	2987	2253	3300	1865	1784	1264	1439
15	3174	4049	2506	1875	2182	2162	880	1214	1574	1531
16	1698	2105	2137	1514	3336	1454	621	534	1111	1384
17	1419	9603	1512	1053	1284	757	498	1165	769	1291
18	1093	6522	677	527	734	794	700	339	793	651
+gp	15595	19299	9258	6022	3257	2404	2247	3512	6175	3933
0 TOTALNUM	75563	106004	36011	26021	26336	22871	15949	16595	28994	21014
TONSLAND	35070	48727	15590	12866	12721	10284	8075	8523	13791	11115
SOPCOF %	97	100	103	100	104	100	94	101	101	102

Table 6.6.

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 29/08/2000 19:17

Table 2 Catch weights at age (kg)

YEAR		1965	1966	1967	1968	1969
AGE						
	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0
	5	0	0	0	0	0
	6	0.168	0.168	0.168	0.168	0.168
	7	0.183	0.183	0.183	0.183	0.183
	8	0.225	0.225	0.225	0.225	0.225
	9	0.311	0.311	0.311	0.311	0.311
	10	0.367	0.367	0.367	0.367	0.367
	11	0.432	0.432	0.432	0.432	0.432
	12	0.508	0.508	0.508	0.508	0.508
	13	0.611	0.611	0.611	0.611	0.611
	14	0.679	0.679	0.679	0.679	0.679
	15	0.753	0.753	0.753	0.753	0.753
	16	0.821	0.821	0.821	0.821	0.821
	17	0.872	0.872	0.872	0.872	0.872
	18	0.91	0.91	0.91	0.91	0.91
+gp		0.999	0.993	1.032	1.01	1.026
0 SOPCOFAC		1.0367	1.0223	1.0037	0.9372	0.9489

Table 2 Catch weights at age (kg)

YEAR		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE											
	1	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0
	6	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.107
	7	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.183	0.155
	8	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.2
	9	0.311	0.311	0.311	0.311	0.311	0.311	0.311	0.311	0.311	0.252
	10	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.31
	11	0.432	0.432	0.432	0.432	0.432	0.432	0.432	0.432	0.432	0.374
	12	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.472
	13	0.611	0.611	0.611	0.611	0.611	0.611	0.611	0.611	0.611	0.568
	14	0.679	0.679	0.679	0.679	0.679	0.679	0.679	0.679	0.679	0.715
	15	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.898
	16	0.821	0.821	0.821	0.821	0.821	0.821	0.821	0.821	0.821	0.934
	17	0.872	0.872	0.872	0.872	0.872	0.872	0.872	0.872	0.872	1.024
	18	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	1.05
+gp		1	1.022	0.977	0.98	1	1.007	1.021	1.032	1.03	1.13
0 SOPCOFAC		0.9357	0.9849	1.0143	1.1784	0.9888	0.9146	0.9847	0.9515	1.013	0.9966

Table 6.6 continued.

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 29/08/2000 19:17

Table 2 Catch weights at age (kg)

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0.107	0.102	0.102	0.102	0.102	0.102	0.102	0.144	0.144	0.198
7	0.155	0.138	0.138	0.138	0.105	0.135	0.12	0.18	0.18	0.202
8	0.2	0.188	0.188	0.188	0.165	0.167	0.137	0.195	0.195	0.242
9	0.252	0.252	0.252	0.252	0.212	0.215	0.218	0.219	0.209	0.282
10	0.31	0.31	0.31	0.31	0.283	0.303	0.301	0.288	0.28	0.331
11	0.374	0.364	0.364	0.32	0.338	0.352	0.353	0.33	0.333	0.378
12	0.472	0.44	0.44	0.4	0.383	0.42	0.448	0.439	0.397	0.456
13	0.568	0.56	0.56	0.466	0.438	0.481	0.51	0.511	0.468	0.514
14	0.715	0.68	0.68	0.563	0.502	0.564	0.581	0.564	0.537	0.568
15	0.898	0.828	0.828	0.73	0.566	0.673	0.648	0.636	0.585	0.589
16	0.934	0.906	0.906	0.992	0.711	0.809	0.845	0.772	0.747	0.672
17	1.024	0.97	0.97	1.126	0.861	1.014	0.948	0.809	0.808	0.708
18	1.05	1.05	1.05	1.149	0.966	1.069	1.056	0.954	0.901	0.774
+gp	1.105	1.118	1.122	1.228	1.291	1.16	1.261	1.18	1.047	0.838
0 SOPCOFAC	0.9734	0.9503	1.0022	0.9891	1.0415	1.0066	1.0023	0.9976	1	0.9915

Table 2 Catch weights at age (kg)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0.02	0.02	0.02	0.02	0.02	0.02
3	0	0	0	0	0.06	0.06	0.06	0.06	0.06	0.06
4	0	0	0	0	0.05	0.05	0.05	0.05	0.06	0.07
5	0	0	0	0.13	0.09	0.1	0.19	0.14	0.09	0.11
6	0.14	0.13	0.19	0.17	0.16	0.14	0.2	0.18	0.14	0.16
7	0.146	0.18	0.22	0.23	0.22	0.16	0.2	0.21	0.19	0.22
8	0.158	0.21	0.26	0.25	0.24	0.19	0.25	0.25	0.23	0.22
9	0.206	0.27	0.28	0.28	0.3	0.21	0.31	0.29	0.29	0.28
10	0.28	0.34	0.31	0.33	0.34	0.28	0.42	0.33	0.33	0.33
11	0.355	0.35	0.33	0.38	0.37	0.32	0.44	0.38	0.38	0.37
12	0.471	0.42	0.38	0.44	0.4	0.37	0.47	0.46	0.43	0.44
13	0.543	0.46	0.46	0.47	0.44	0.41	0.59	0.48	0.48	0.49
14	0.611	0.51	0.43	0.5	0.45	0.47	0.67	0.51	0.54	0.53
15	0.625	0.58	0.43	0.57	0.49	0.53	0.69	0.55	0.59	0.56
16	0.722	0.59	0.45	0.58	0.55	0.58	0.71	0.6	0.61	0.61
17	0.576	0.58	0.52	0.62	0.58	0.66	0.74	0.66	0.64	0.66
18	0.659	0.59	0.57	0.65	0.67	0.71	0.74	0.65	0.66	0.67
+gp	0.659	0.7	0.67	0.662	0.79	0.806	0.847	0.787	0.753	0.805
0 SOPCOFAC	0.9668	1.0032	1.0291	1.0022	1.0365	0.9987	0.9433	1.0091	1.0089	1.0191

Table 6.7.

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 29/08/2000 19:17

Table 5 Proportion mature at age

YEAR	1965	1966	1967	1968	1969
AGE					
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0.03	0.03	0.03	0.03	0.03
9	0.06	0.06	0.06	0.06	0.06
10	0.08	0.08	0.08	0.08	0.08
11	0.22	0.22	0.22	0.22	0.22
12	0.36	0.36	0.36	0.36	0.36
13	0.55	0.55	0.55	0.55	0.55
14	0.72	0.72	0.72	0.72	0.72
15	0.85	0.85	0.85	0.85	0.85
16	0.88	0.88	0.88	0.88	0.88
17	0.95	0.95	0.95	0.95	0.95
18	0.97	0.97	0.97	0.97	0.97
+gp	1	1	1	1	1

Table 5 Proportion mature at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0.009	0.009	0.009	0.009
8	0.03	0.03	0.03	0.03	0.03	0.03	0.016	0.016	0.016	0.016
9	0.06	0.06	0.06	0.06	0.06	0.06	0.101	0.101	0.101	0.101
10	0.08	0.08	0.08	0.08	0.08	0.08	0.195	0.195	0.195	0.195
11	0.22	0.22	0.22	0.22	0.22	0.22	0.3	0.3	0.3	0.3
12	0.36	0.36	0.36	0.36	0.36	0.36	0.54	0.54	0.54	0.54
13	0.55	0.55	0.55	0.55	0.55	0.55	0.702	0.702	0.702	0.702
14	0.72	0.72	0.72	0.72	0.72	0.72	0.862	0.862	0.862	0.862
15	0.85	0.85	0.85	0.85	0.85	0.85	0.966	0.966	0.966	0.966
16	0.88	0.88	0.88	0.88	0.88	0.88	0.994	0.994	0.994	0.994
17	0.95	0.95	0.95	0.95	0.95	0.95	1	1	1	1
18	0.97	0.97	0.97	0.97	0.97	0.97	1	1	1	1
+gp	1	1	1	1	1	1	1	1	1	1

Table 6.7 continued.

Run title : Arctic S. mentella (run: XSAKHN06/X06)

At 29/08/2000 19:17

Table 5 Proportion mature at age

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0.009	0.009	0.009	0.009	0.005	0	0	0	0	0
8	0.016	0.016	0.016	0.016	0.008	0	0	0	0	0
9	0.101	0.101	0.101	0.101	0.057	0.01	0.034	0.045	0.083	0.004
10	0.195	0.195	0.195	0.195	0.168	0.079	0.113	0.076	0.095	0.078
11	0.3	0.3	0.3	0.3	0.302	0.218	0.238	0.178	0.194	0.201
12	0.54	0.54	0.54	0.54	0.534	0.453	0.507	0.43	0.462	0.486
13	0.702	0.702	0.702	0.702	0.721	0.781	0.794	0.735	0.689	0.653
14	0.862	0.862	0.862	0.862	0.879	0.846	0.872	0.827	0.801	0.767
15	0.966	0.966	0.966	0.966	0.952	0.9	0.912	0.885	0.862	0.832
16	0.994	0.994	0.994	0.994	0.985	0.925	0.95	0.958	1	1
17	1	1	1	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1	1	1	1
+gp	1	1	1	1	1	1	1	1	1	1

Table 5 Proportion mature at age

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0.018	0.021	0
8	0.015	0.015	0.015	0	0	0	0	0	0.014	0.016
9	0.05	0.055	0.062	0.023	0.023	0	0.014	0.027	0	0.059
10	0.126	0.132	0.133	0.113	0.113	0.055	0.093	0.13	0.074	0.11
11	0.205	0.202	0.224	0.267	0.267	0.111	0.212	0.312	0.171	0.333
12	0.506	0.481	0.411	0.438	0.438	0.368	0.325	0.281	0.276	0.579
13	0.623	0.545	0.539	0.574	0.574	0.587	0.577	0.566	0.622	0.689
14	0.726	0.741	0.774	0.843	0.843	0.696	0.716	0.736	0.714	0.788
15	0.801	0.85	0.888	0.951	0.951	0.729	0.78	0.831	0.871	0.813
16	1	0.962	0.946	0.92	0.92	0.789	0.874	0.958	0.919	0.903
17	1	1	0.992	0.989	0.989	1	0.975	0.95	1	0.923
18	1	1	1	1	1	1	1	1	1	1
+gp	1	1	1	1	1	1	1	1	1	1

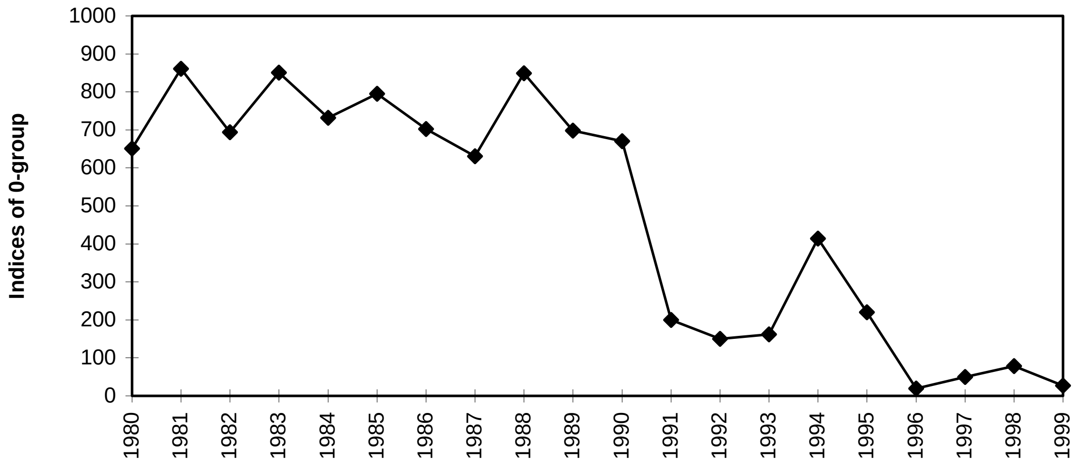


Figure 6.1. Abundance indices of 0-group redfish (believed to be mostly S.mentella) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-1999.

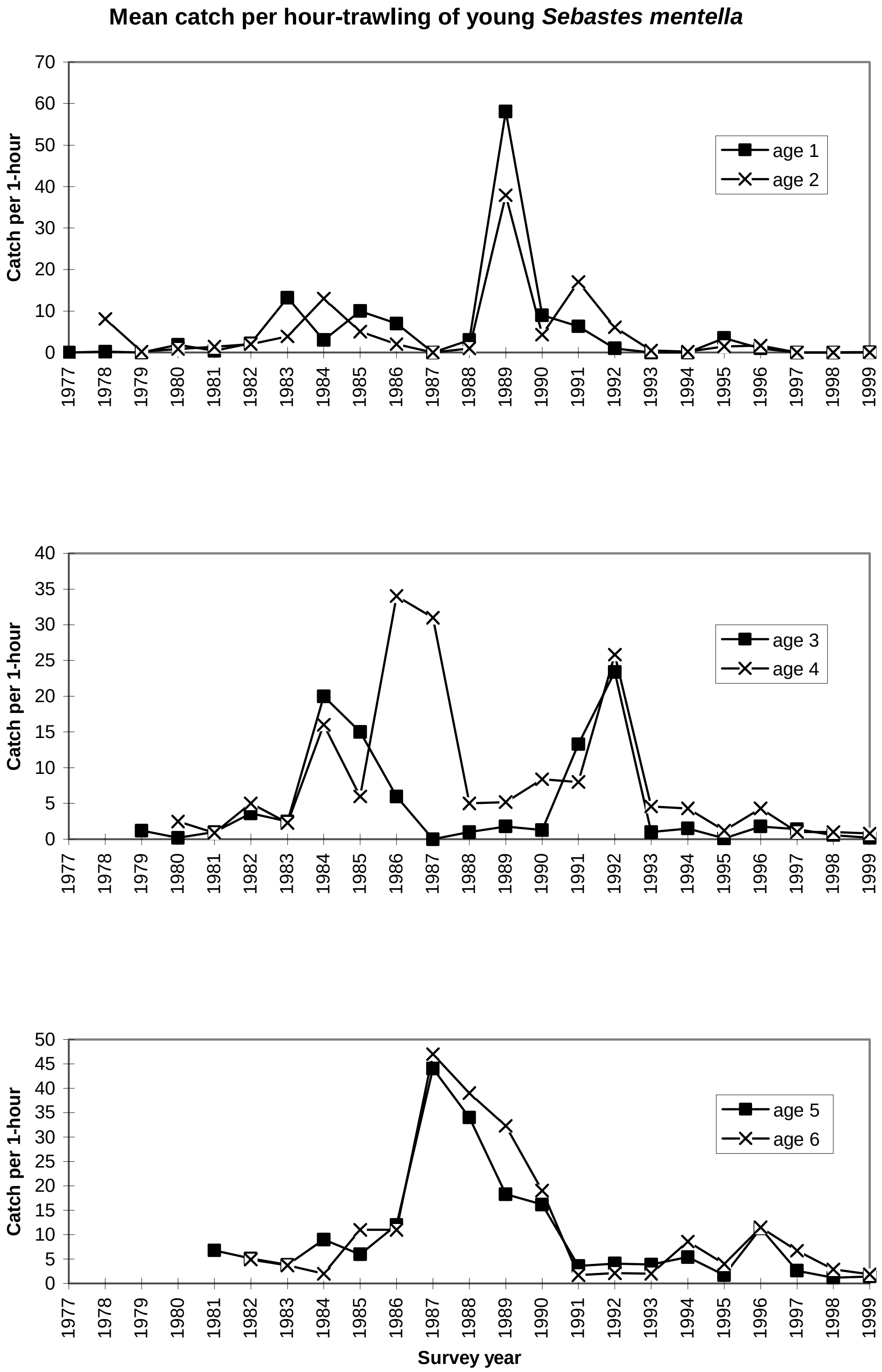
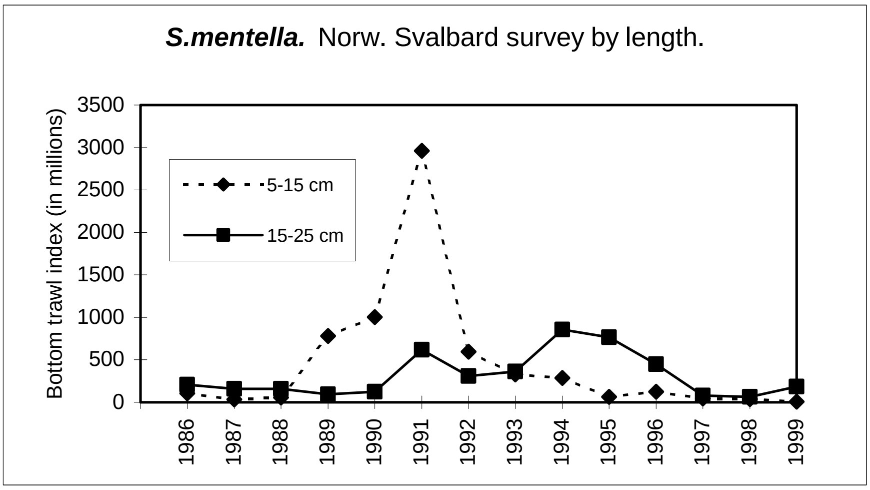


Figure 6.2. Catch (numbers of specimens) per hour trawling of different ages of Sebastes mentella in the Russian groundfish survey in the Barents Sea and Svalbard areas (ref. Table D4).



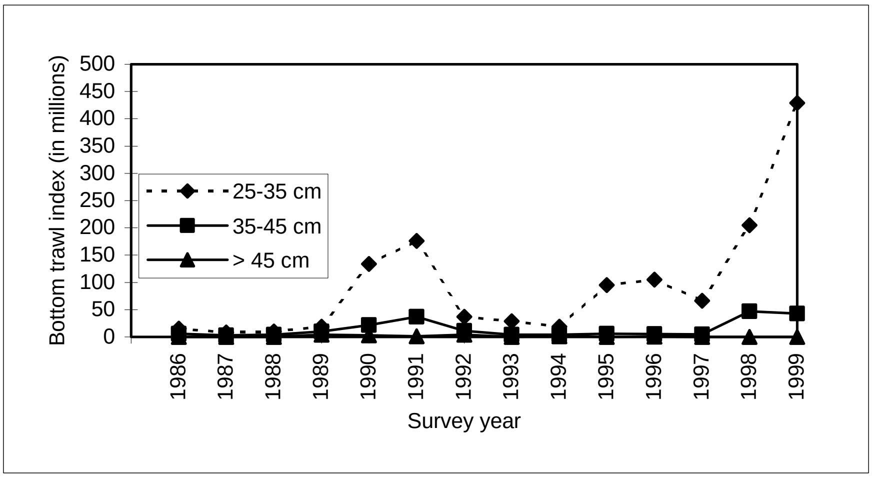


Figure 6.3a. *Sebastes mentella.* Abundance indices (on length) from the Norwegian bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1986-1999 (ref. Table D5a).

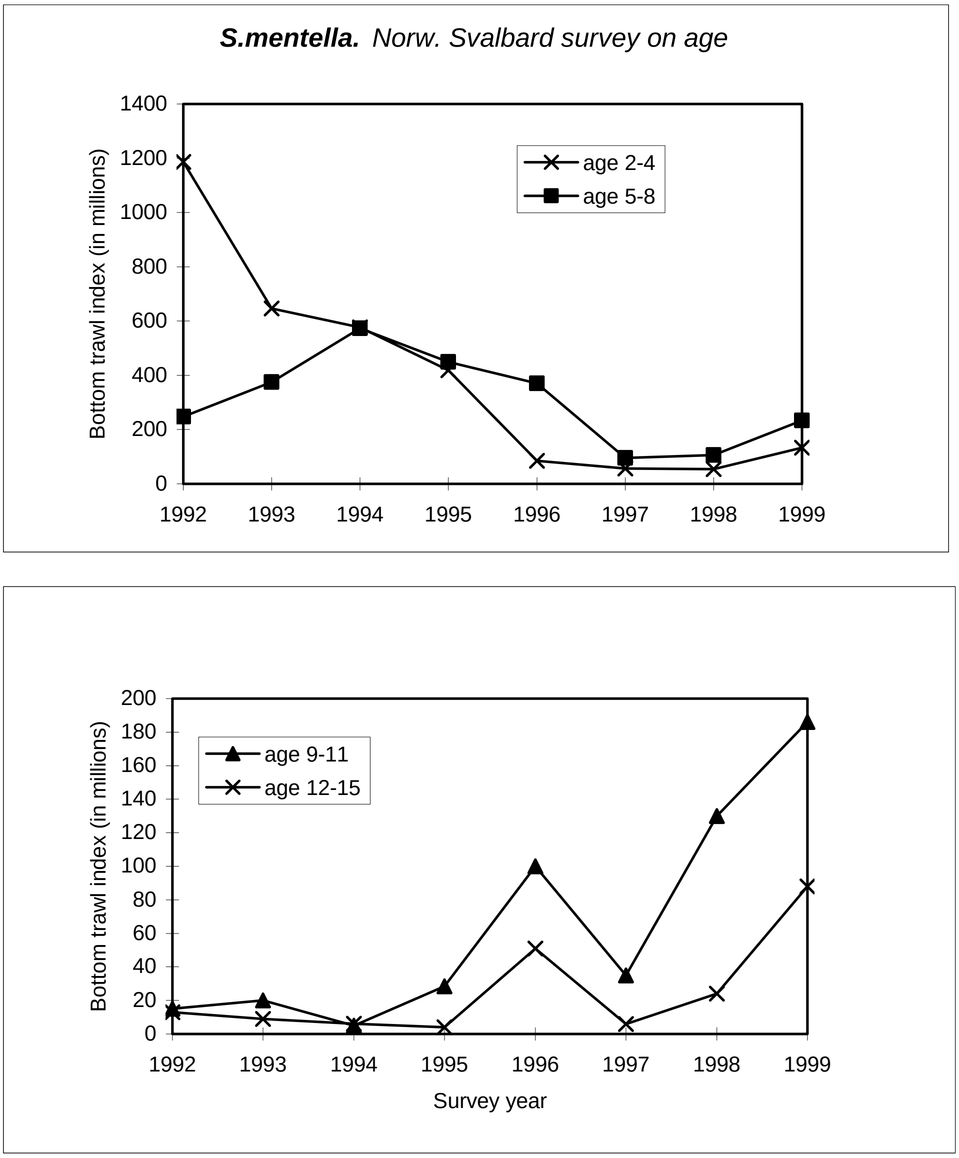
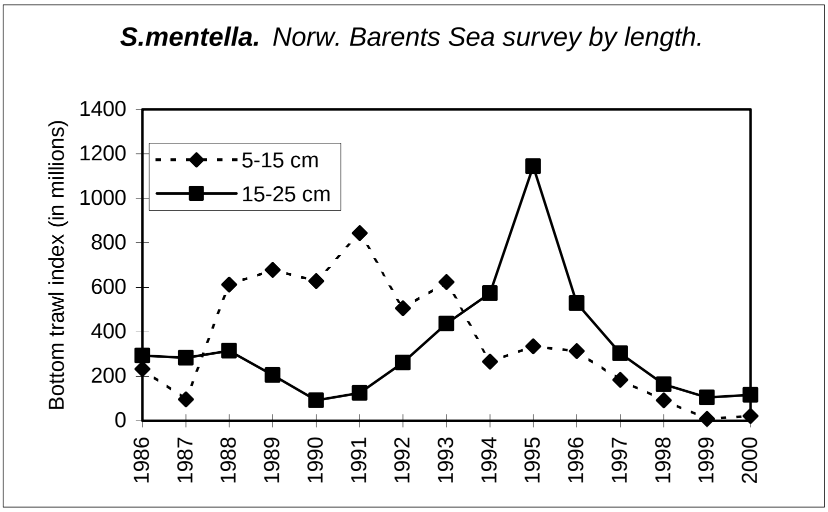


Figure 6.3b. *Sebastes mentella.* Abundance indices (on age) from the Norwegian bottom trawl survey in the Svalbard area (Division IIb) in summer/fall 1992-1999 (ref. Table D5b).



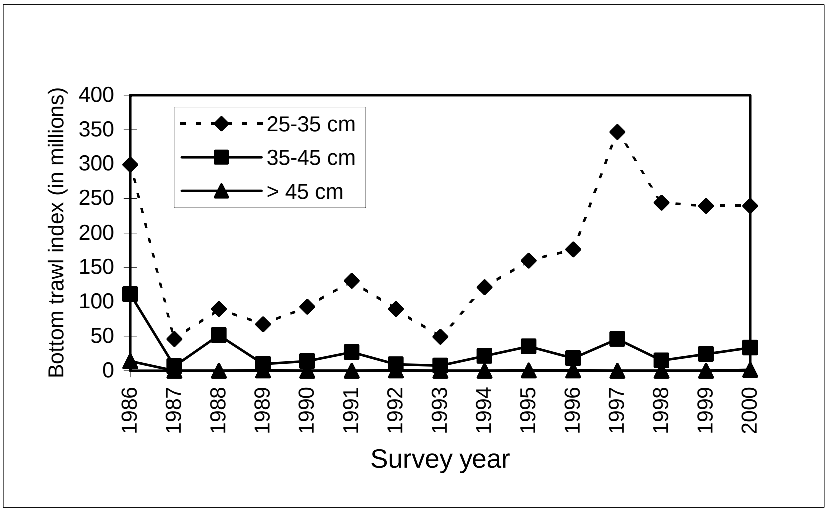
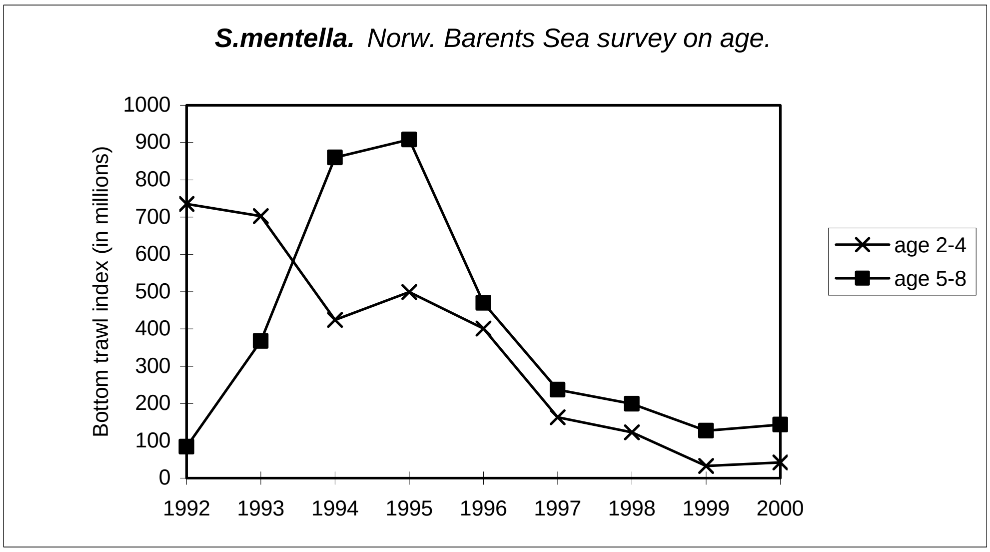


Figure 6.4a. *Sebastes mentella.* Abundance indices (**on length**) from the Norwegian bottom trawl survey in the Barents Sea in winter 1986-2000 (ref. Table D6a).



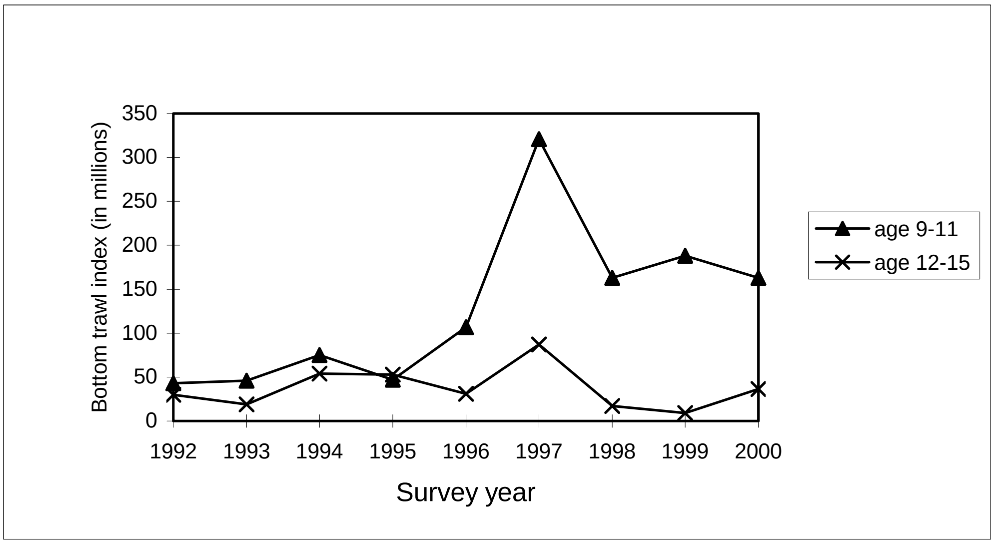
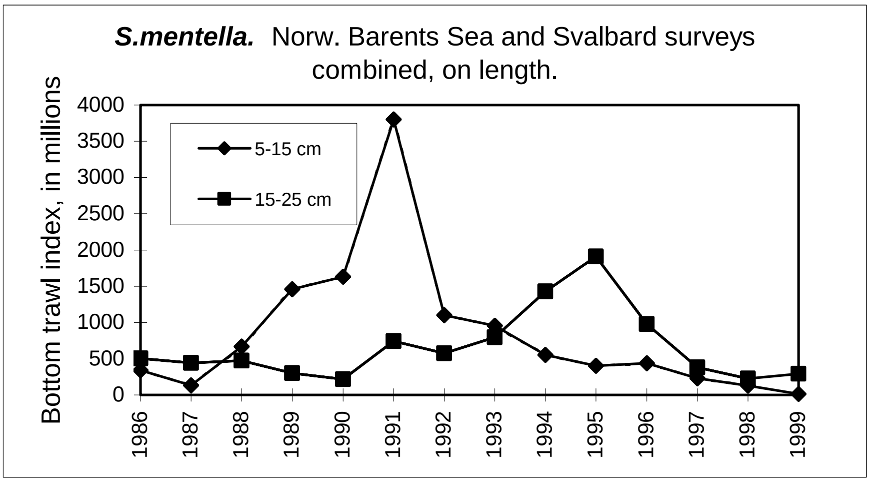


Figure 6.4b. *Sebastes mentella.* Abundance indices (**on age**) from the Norwegian bottom trawl survey in the Barents Sea in winter 1992-2000 (ref. Table D6b).



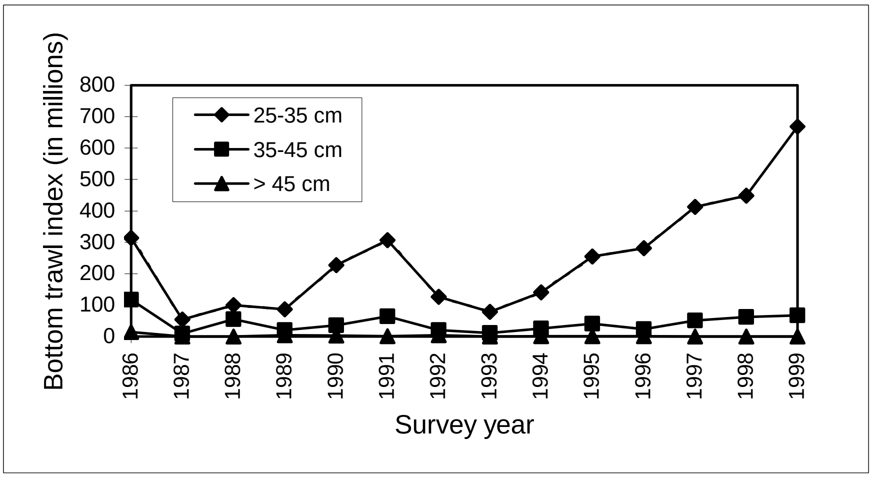
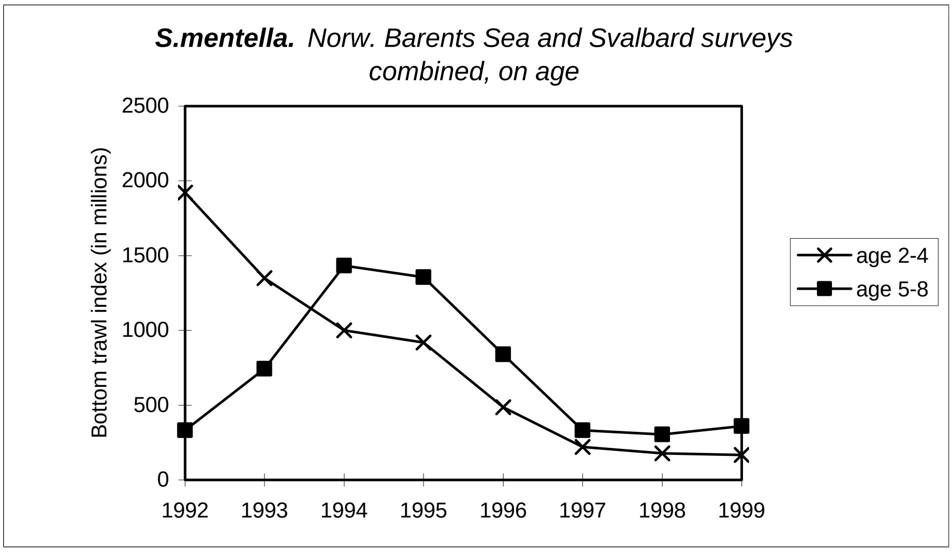


Figure 6.5a. *Sebastes mentella.* Abundance indices (**on length**) when combining the Norwegian bottom trawl surveys 1986-1999 at Svalbard (summer/fall) and in the Barents Sea (winter).



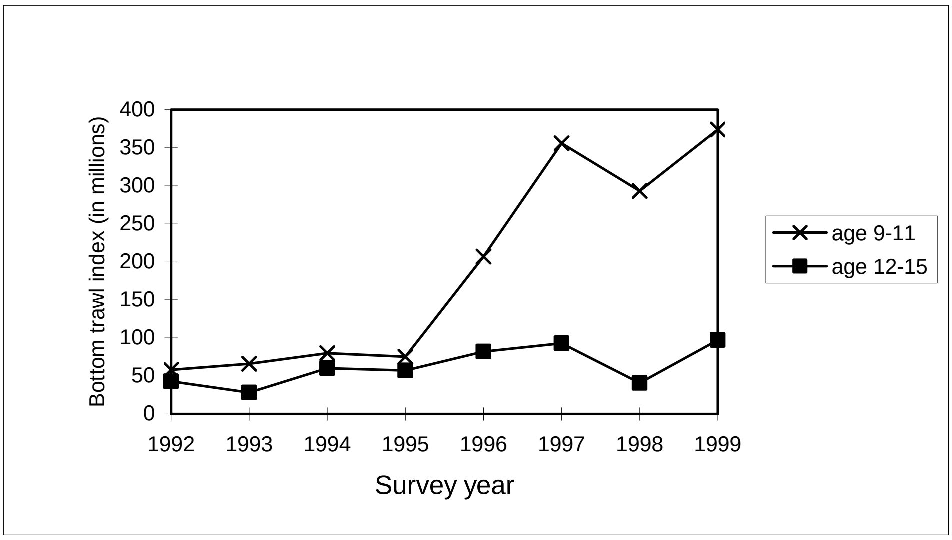


Figure 6.5b. *Sebastes mentella* . Abundance indices (**on age**) when combining the Norwegian bottom trawl surveys 1992-1999 at Svalbard (summer/fall) and in the Barents Sea (winter).

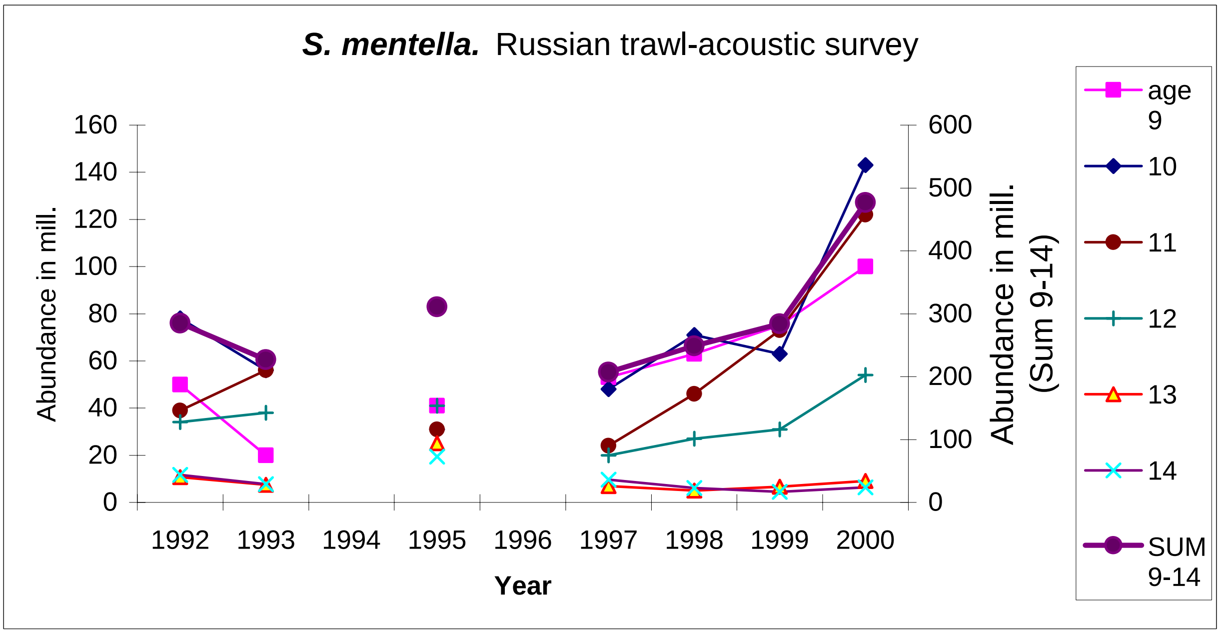


Figure 6.6. Results of the Russian trawl/acoustic redfish survey for ages 9-14 (ref. Table D7).

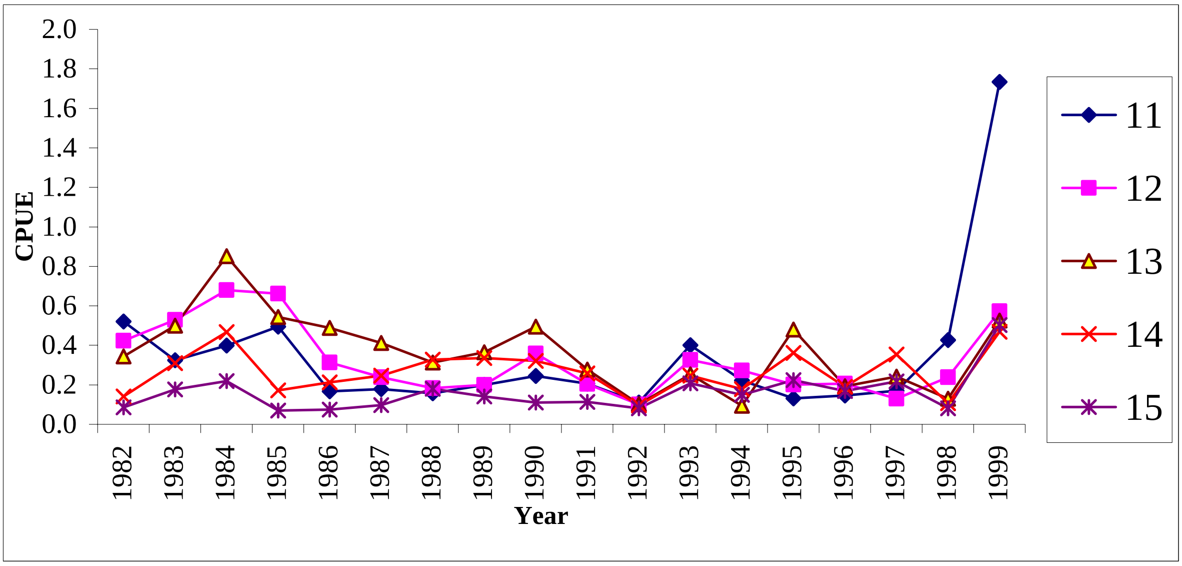


Figure 6.7. Russian trawl (PST) CPUE for ages 11-15.

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 (Scot.)	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	-	21,675	-	523	1,641	408	305	121	26,118
1997	-	-	28[3]	1,011	538	39[2]	-	11	-	18,808[2]	1	535	4,556	308	235	29	26,099
1998	-	-	98	567	231	47[3]	-	28	-	26,249[2]	13	131	5,278	162	211	94	33,109
1999[1]	-	-	113[3]	61[3]	430	97	14	11[3]		24,628[2]	6	68	4,422	42[2]	247	62	30,201

[1] Provisional figures.
[2] Working Group figure.
[3] As reported to Norwegian authorities.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

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	Ireland	Nether-lands	Norway	UK (England & Wales)	UK (Scotl)	Total
1986	-	24	-	578	183	-	-	1,048	35	1	1,869
1987	-	16	3	833	70	-	-	411	16	55	1,404
1988	-	32	90	915	188	-	-	696	125	9	2,055
1989	1	23	13	554	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	363	37	146	1,634
1997	16	23	-	1,049	45	-	53	612[1]	21	528	2,347
1998	2	27	12	570	370	4	21	1,113[1]	68	681	2,868
1999[1]	3	52	n.a.	n.a.	58	n.a.	16	868	67	465	1,533

[1] Provisional figures.
[2] Working Group figure.
n.a. = not available.

Table D3. *Sebastes mentella* in Divisions IIa and IIb. Catch per unit effort and calculated total international effort.

	USSR/Russia catch/hour trawling (t/hr)		German Dem.Rep. catch/day (t/day)		Total effort (USSR units)	
Year	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	BMRT[3]	0.80	-	-	-	10,094
1997	1.3	0.80	-	-	-	10,654
1998	0.8	1.00	-	-	-	13,791
1999	2.7	1.50	-	-	-	7,410

[1]Side trawlers, 800–1000 HP.
[2]Stern trawlers. Since 1986, data from spring fishery only.
[3]Stern trawlers, experimental fishery in spring.

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	0.3
1987	-	3.0	37.9	1.3	8.0	4.1	2.0	10.6	9.6	1.4	1.1	0.5
1988	4.0	58.1	4.3	13.3	25.8	3.9	8.6	11.2	2.8	2.0	1.4	1.1
1989	8.7	9.0	17.0	23.4	4.6	5.4	4.0	6.6	3.6	1.7	3.0	-
1990	2.5	6.3	6.1	1.0	4.3	1.7	11.5	6.6	2.5	3.3	-	-
1991	0.3	1.0	0.5	1.5	1.2	11.3	6.7	4.0	2.5	-	-	-
1992	0.6	+	0.2	0.1	4.3	2.6	2.9	1.5	-	-	-	-
1993[1]	-	+	1.5	1.8	1.0	1.2	1.9	-	-	-	-	-
1994	0.3	3.5	1.7	1.4	1.0	1.4	-	-	-	-	-	-
1995	2.8	1.0	0.7	0.6	0.8	-	-	-	-	-	-	-
1996[2]	+	+	+	0.2	-	-	-	-	-	-	-	-
1997[3]	+	+	+	-	-	-	-	-	-	-	-	-
1998	+	0.1	-	-	-	-	-	-	-	-	-	-
1999	+		-	-	-	-	-	-	-	-	-	-

[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 1986–1999 (numbers in millions).

	Length group (cm)								
Year	5.0–9.9	10.0–14.9	15.0–19.9	20.0–24.9	25.0–29.9	30.0–34.9	35.0–39.9	40.0–44.9	>45.0	Total
1986[2]	6	101	192	17	10	5	2	4	+	338
1987[2]	20	14	140	19	6	2	1	2	+	208
1988[2]	33	23	82	77	7	3	2	2	+	228
1989	566	225	24	72	17	2	2	8	4	921
1990	184	820	59	65	111	23	15	7	3	1,287
1991	1,533	1,426	563	55	138	38	30	7	1	3,791
1992	149	446	268	43	22	15	4	7	4	958
1993	9	320	272	89	16	13	3	1	+	722
1994	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
1999	3	3	124	62	260	169	42	1	0	664

[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 1992–1999 (numbers in millions).

	Age													
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1992	283	419	484	131	58	45	14	8	5	2	7	2	1	3	1,462
1993	2	527	117	202	142	8	23	6	13	1	7	1	1	+	1,050
1994	7	280	290	202	235	42	94	1	1	3	4	1	1	+	1,161
1995	4	50	365	237	132	61	19	17	11	+	1	3	0	0	900
1996	23	47	15	37	105	144	84	17	51	32	34	9	6	2	605
1997	8	43	6	6	40	20	30	25	7	3	1	2	2	1	194
1998	+	26	28	14	10	13	69	66	49	15	1	6	15	5	317
1999	3	16	114	27	36	53	117	78	67	41	45	11	19	13	640

[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 1986–2000 (numbers in millions). The area coverage was extended from 1993.

	Length group (cm)									
Year	5.0–9.9	10.0–14.9	15.0–19.9	20.0–24.9	25.0–29.9	30.0–34.9	35.0–39.9	40.0–44.9	>45.0	Total
1986	81.3	151.9	205.4	87.7	169.2	129.8	87.5	23.6	13.8	950.2
1987	71.8	25.1	227.4	56.1	34.6	11.4	5.3	1.1	0.1	432.9
1988	587.0	25.2	132.6	182.1	39.6	50.1	47.9	3.6	0.1	1068.2
1989	622.9	55.0	28.4	177.1	58.0	9.4	8.0	1.9	0.3	961.0
1990	323.6	304.5	36.4	55.9	80.2	12.9	12.5	1.5	0.2	827.7
1991	395.2	448.8	86.2	38.9	95.6	34.8	24.3	2.5	0.2	1126.5
1992	139.0	366.5	227.1	34.6	55.2	34.4	7.5	1.8	0.5	866.6
1993	30.8	592.7	320.2	116.3	24.2	25.0	6.3	1.0	+	1116.5
1994	6.9	258.6	289.4	284.3	51.4	69.8	19.9	1.4	0.1	981.8
1995	263.7	71.4	637.8	505.8	90.8	68.8	31.3	3.9	0.5	1674.0
1996	213.1	100.2	191.2	337.6	134.3	41.9	16.6	1.4	0.3	1036.6
1997[2]	62.8	121.1	24.7	277.9	274.4	72.3	40.7	5.1	0.2	879.0
1998[2]	1.3	90.6	62.8	100.8	203.1	40.7	13.0	1.7	0.2	514.0
1999	2.2	6.8	67.6	36.8	167.4	71.9	21.0	3.1	0.1	376.8
2000	9.0	12.9	39.3	76.8	141.9	97.2	26.6	6.9	1.5	412.1

[1] - Includes some unidentified *Sebastes* specimens, mostly less than 15 cm.
[2] - Adjusted indices to account for not covering the Russian EEZ in Subarea I.

Table D6b. *Sebastes mentella*[1] in Sub-areas I and II. Preliminary Norwegian bottom trawl indices (**on age**) from the annual Barents Sea survey in February (numbers in millions). The area coverage was extended from 1993 onwards.

	Age													
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1992	351	252	132	56	14	11	3	9	18	16	12	11	2	5	892
1993	38	473	192	242	62	45	19	22	13	11	10	4	2	3	1,136
1994	7	85	332	189	370	228	73	42	3	30	8	14	25	7	1,413
1995	308	45	146	264	364	211	69	23	7	17	23	9	11	10	1,507
1996	173	119	109	114	128	122	106	64	24	19	12	7	8	4	1,009
1997[2]	43	101	19	54	96	43	44	171	76	74	39	29	10	9	808
1998[2]	1	73	49	27	13	52	107	104	41	18	7	4	3	3	502
1999	1	+	32	43	30	24	30	81	79	28	2	1	6	+	357
2000[3]	9	12	21	17	9	39	77	73	50	41	14	10	7	6	385

[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.
[3] - Preliminary

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 1992–2000. Abundance indices in millions.

Year	Period of survey	Age																		Total				Area of survey
		1–4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	Numbers 10^6	Biomass t 10^3	SSN 10^6	SSB t 10^3	in n.m.^{2}
1992	April	29	27	27	37	36	50	78	39	34	40	44	43	28	17	13	4	7	3	566	218	191	114	25300
1993	April	31	15	13	6	6	20	56	56	38	28	29	27	19	12	7	3	1	2	396	150	151	90	23500
1994												No	Data											
1995	May	+	32	51	83	90	41	31	31	41	94	73	48	30	10	9	4	1	+	669	202	211	102	23300
1996												No	Data											
1997	Apr-May	86	6	24	102	150	53	48	24	20	26	36	28	11	9	4	2	1	+	630	170	111	58	22400
1998	April	1	+	8	47	77	63	71	46	27	19	23	23	25	6	3	2	1	+	442	153	106	57	22931
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
2000	Apr-May	2	2	14	15	62	100	143	122	54	34	24	29	12	11	7	2	1	1	635	208	114	53	22000

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	1987	1988	1989	1990	1991	1992	1993	1995	1997	1998	1999	2000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.021	0.000	0.000
8	0.000	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000	0.014	0.016	0.000
9	0.083	0.000	0.000	0.012	0.139	0.013	0.033	0.000	0.027	0.000	0.059	0.048
10	0.182	0.028	0.074	0.131	0.174	0.092	0.133	0.055	0.130	0.074	0.110	0.087
11	0.278	0.125	0.178	0.300	0.138	0.169	0.364	0.111	0.312	0.171	0.333	0.202
12	0.616	0.297	0.473	0.688	0.358	0.396	0.480	0.368	0.281	0.276	0.579	0.375
13	0.821	0.562	0.684	0.714	0.470	0.452	0.696	0.587	0.566	0.622	0.689	0.489
14	0.926	0.760	0.716	0.824	0.637	0.761	0.925	0.696	0.736	0.714	0.788	0.742
15	0.938	0.855	0.794	0.848	0.762	0.939	0.962	0.729	0.831	0.871	0.813	0.833
16	1.000	1.000	1.000	1.000	1.000	0.886	0.953	0.789	0.958	0.919	0.903	0.904
17	1.000	1.000	1.000	1.000	1.000	1.000	0.977	1.000	0.950	1.000	0.923	1.000
18	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

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 highest priced redfish species.

There are at present no regulations particular for the *S. marinus* fishery. The regulations aimed at *S. mentella* (see chapter 6.1.1) only have marginal effects on the *S. marinus* stock.

7.1.2 Landings prior to 2000 (Tables 7.1–7.5, D1 and D2 (Section 6))

Nominal catches of *S. marinus* by country for Sub-areas I and II combined are presented in Table 7.1 and the totals for both *S. marinus* and *S. mentella* in Tables D1 and D2. Landings of *S. marinus* showed a decrease in 1991–1992 from a level of 23,000–30,000 t in 1984–1990 to a stable level of about 16,000–19,000 t in the years 1991–1998. The provisional total landings figure for *S. marinus* in 1999 is 19,086 t. This is 1,586 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 long-term mean of 17,600 t.

7.1.3 Expected landings in 2000

On the basis of reports from the first half of the year, the Norwegian landings in 2000 are expected to be around 12,500 t. The Russian catch is expected to be 1,500 t. On this basis landings of 15,000 t are expected in 2000, which is less than the long-term mean. The expected decrease in landings may reflect a decrease of the stock since an increase in the landings would have been expected given that the fishermen would have targeted this species due to lower quotas of cod, haddock, and saithe.

7.2 Data Used in the Assessment

7.2.1 Fishing effort and catch-per-unit-effort (Tables D9–D10, Figure 7.1a,b)

Data for *S. marinus* were available for Norwegian freezer trawlers (ISSCFV-code 07, 250–499.9 GRT) since 1981 (Table D9–D10). The total international effort was estimated from these data. 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). Although typical *S. mentella* grounds have been excluded, 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 previous years. In 1998–1999 the effort increased to 80% of the 1981–1990 level. The year, area and month effects are all significant, but the differences in the standardized CPUEs from year to year were not significant. (Tables D9-D10, Figure 7.1a,b). A surplus production analysis was therefore considered to be of little value in the evaluation of stock parameters. The provisional figure for 1999 of 1.19 t/hour is less than the long-term average of 1.28 t/hour.

7.2.2 Catch-at-age (Table 7.8)

Catch at age data for 1996–1998 were revised. Age composition data for 1999 were only provided by Norway, accounting for 88% of the total landings. Russian catch-at-length from each Sub-area and German catch-at-length from Division IIa were converted to catch-at-age by using the Norwegian age-length key for trawlers in Division 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 were based on Norwegian otolith readings. In 1989–1990 it was 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 were available, while in the years prior to 1984 Russian scale readings exist.

7.2.3 Weight-at-Age (Table 7.9)

Weight-at-age data for ages 7–24+ were available from the Norwegian landings in 1999. 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 7.6 and 7.7, 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 1986–2000 in fishing depths of 100–500 m. Data on length for the years 1986–2000 are shown in Table D11a and Fig 7.2a. Data disaggregated on age for the years 1992–2000 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 1985–99 in fishing depths of 100–500 m. Data disaggregated on age only for the years 1992–99 (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 are 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 1995–99 from Finnmark to Møre (Tables 7.6–7.7).

Both the Barents Sea and the Svalbard bottom trawl surveys show that the abundance indices over the commercial size range (> 30 cm) appear to be relatively stable at least during the 1990's. An apparent lack of pre-recruit size groups may be a sign of poor recruitment although the Svalbard survey shows an increase in numbers of the smaller fish in 1998–1999. 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. An increase of 15–24 cm fish in the 1999 survey is partly caused by extra trawl stations taken in the southern part of the survey area (Table 7.6). The survey results show an almost absence of juveniles north of Lofoten.

7.3 Results of the Assessment

All newly available information confirm last year evaluation of the stock status.

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 have been relatively stable during the 1990's although a decrease is observed in 1998–1999. This stability may reflect the rather constant effort in the fishery during the 1990-ies and the 18% increase in effort in 1998–1999. The survey covering the near-coast and fjord resources showed an overall reduction in abundance from 1995 to 1998, irrespective of size. An increase for some length groups in 1999 is mainly caused by an increased number of trawl hauls which makes the comparison with the previous years more difficult. Concerns were again 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 BORMICON model used by the ICES North-Western WG, were discussed. Preparatory work in advance of the 2001 working group meeting needs to be done in order to explore these possibilities.

7.4 Biological Reference Points

No limit or precautionary reference points for the fishing mortality or the biomass are proposed.

7.5 Management Advice

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. Increased effort and expected reduced catches in 2000 despite the increased interest in the fishery due to reduced cod, haddock, and saithe quotas cause concern. In this regard, it is recommended that a management plan consistent with the precautionary approach be developed and implemented as a pre-requisite to continued fishing.

Table 7.1. *Sebastes marinus*. Nominal catch (t) by countries in Sub-area I and Divisions IIa and IIb combined.

Year	Faroe Islands	France	Germany[2]	Greenland	Iceland	Ireland	Netherlands
1986	29	2,719	3,369	-	-	-	-
1987	250	1,553	4,508	-	-	-	-
1988	No species specific data presently available on countries						
1989	3	784	412	-	-	-	-
1990	278	1,684	387	1	-	-	-
1991	152	706[1]	981	-	-	-	-
1992	35	1,289[1]	530	623	-	-	-
1993	139	871[1]	650	14	-	-	-
1994	22	697[1]	1,008	5	4	-	-
1995	27	732[1]	517	5	1	1	1
1996	38	671[1]	499	34	-	-	-
1997	11	974	457	23	-	5	-
1998	78	494	131	33	-	19	-
1999[1]	37	35	228	47	14	8	-

Year	Norway	Portugal	Russia[3]	Spain	UK (Eng. & Wales)	UK (Scotland)	Total
1986	21,680	-	2,350	-	42	14	30,203
1987	16,728	-	850	-	181	7	24,077
1988	No species specific data presently available on countries						25,908
1989	20,662	-	1,264	-	97	-	23,222
1990	23,917	-	1,549	-	261	-	28,077
1991	15,872	-	1.052	-	268	10	19.041
1992	12,700	5	758	2	241	2	16,185
1993	13,137	77	1,313	8	441	1	16,651
1994	14,955	90	1,199	4	135	1	18,120
1995	13,516	9	639	-	159	9	15,616
1996	15,622	55	716	81	229	98	18,043
1997	14,239	61	1,584	36	164	22	17,576
1998	16,717	6	1,632	37	118	53	19,318
1999[1]	16,848	3	1,691	7	135	34	19,087

[1] Provisional figures.
[2] Includes former GDR prior to 1991.
[3] USSR prior to 1991.

Table 7.2. *Sebastes marinus.*
Nominal catch (t) by countries in Sub-area I.

Year	Faroe Islands	Germany[4]	Greenland	Iceland	Norway	Russia[5]	UK(Eng. & 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	-	5[2]	-	-	2,085	308	30[2]	-	2,428
1999[1]	-	18[2]	9[2]	14[2]	1,972	360	11[2]	-	2,384

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 7.3. *Sebastes marinus*.
Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Netherlands	Norway	Portugal	Russia[5]	Spain	UK (Eng. & 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]	-	-	13,329	51[2]	449	5[2]	223[2]	98[2]	15,335
1997	8[2]	974[2]	438	18[2]	5[2]	-	11,558	61[2]	1,199	36[2]	162[2]	22[2]	14,481
1998	78[2]	494[2]	116[2]	33[2]	19[2]	-	14,603	6[2]	1,078	37[2]	85[2]	52[2]	16,601
1999[1]	37[2]	35[2]	210[2]	38[2]	8[2]	-	14,856	3[2]	976	7[2]	122[2]	34[2]	16,326

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 7.4. *Sebastes marinus*.
Nominal catch (t) by countries in Division IIb.

Year	Faroe Islands	Germany[5]	Greenland	Norway	Portugal	Russia[6]	Spain	UK(Eng. & Wales)	UK (Scotland)	Total
1986	-									+
1987[4]	-	1533	-	-	-	-	-	-	-	1533
1988	No species specific data presently available									
1989	-	-	-	66	-	242	-	-	-	308
1990	-	-	1[2]	210	-	1157	-	-	-	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]	-	27	5	136	76[2]	3[2]	-	302
1997	-	20	-	37	-	225	-	-	-	282
1998	-	10[2]	-	29	-	246	-	3[2]	-	288
1999[1]	-	-	-	20	-	355	-	2[2]	-	377

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.

Table 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	18.04
1948	20.00	1997	17.58
1949	22.36	1998	19.32
1950	25.56	1999	19.09
1951	45.30	Average	17.6
1952	56.17		
1953	34.83		
1954	35.78		
1955	35.47		
1956	43.38		

Table 7.6. *Sebastes marinus* . Mean catch rates (N/nm^2) of *Sebastes marinus* from Norwegian Coastal Surveys in 1995-1999 within 100-350 m depth. Catch rates for the total area are area-weighted means of catch rates from the individual subareas.

	Area 3 - East Finnmark					Area 4 - W.Finnmark/Troms					Area 5 - Lofoten/Vesterålen				
Length range (cm)	**1995**	**1996**	**1997**	**1998**	**1999**	**1995**	**1996**	**1997**	**1998**	**1999**	**1995**	**1996**	**1997**	**1998**	**1999**
0-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-9	244	322	39	0	0	107	19	0	0	0	0	0	0	0	0
10-14	152	273	98	0	0	318	331	0	2	4	219	21	0	0	31
15-19	19	157	112	28	2	135	574	10	6	2	149	49	0	0	314
20-24	69	287	77	33	2	62	698	7	2	8	162	6	0	16	136
25-29	169	476	268	42	4	24	64	20	50	10	72	27	17	8	9
30-34	299	333	255	28	15	7	696	40	43	39	133	88	54	18	62
35-39	112	200	19	8	47	21	796	30	43	55	92	529	324	341	295
40-44	38	53	27	6	50	7	238	23	22	25	60	133	385	291	263
45-49	2	16	12	0	11	3	48	3	2	23	11	24	83	50	40
50-54	2	3	0	0	2	0	0	3	0	8	0	0	0	8	5
55-59	0	0	0	0	0	0	0	7	0	4	4	0	0	0	0
60-64	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Total	1106	2120	911	144	134	684	3463	142	170	178	903	878	864	731	1156
Measured	398	602	230	52	62	198	243	43	54	87	168	185	70	97	148
# trawls	23	17	19	16	25	15	16	20	21	25	13	14	17	15	22
# trawl with species	18	12	16	7	10	10	15	9	10	9	9	13	9	9	13
Area nm^2			4205					7303					9962		

	Area 0 - Vestfjord					Area 6 - Nordland					Area 7 - Møre				
Length range (cm)	**1995**	**1996**	**1997**	**1998**	**1999**	**1995**	**1996**	**1997**	**1998**	**1999**	**1995**	**1996**	**1997**	**1998**	**1999**
0-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-14	0	0	0	0	55	0	0	0	0	0	0	0	0	0	26
15-19	0	0	0	6	711	0	7	0	0	0	0	0	0	0	479
20-24	0	0	430	26	273	0	25	5	7	0	0	0	0	0	557
25-29	0	8	587	6	88	5	15	21	4	0	0	0	0	0	111
30-34	18	41	286	0	88	28	167	75	15	0	0	0	0	0	57
35-39	454	206	380	58	328	564	526	225	78	44	5	14	3	0	114
40-44	442	33	361	64	230	373	599	229	81	61	14	10	3	0	31
45-49	53	8	88	13	0	52	217	59	19	4	0	7	3	4	0
50-54	9	0	6	6	0	3	0	5	0	4	0	0	0	0	0
55-59	0	0	0	0	0	3	0	0	0	4	0	0	0	0	0
60-64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	976	296	2138	180	1772	1028	1556	620	204	118	19	31	10	4	1374
Measured	75	22	162	28	40	183	172	91	55	27	4	9	3	1	95
# trawls	10	6	11	7	5	22	16	12	15	13	11	15	16	13	12
# trawl with species	7	3	11	4	3	15	12	9	6	4	2	5	3	4	3
Area nm^2			5542					9316					7246		

	Total				
Length range (cm)	**1995**	**1996**	**1997**	**1998**	**1999**
0-4	0	0	0	0	0
5-9	41	34	4	0	0
10-14	118	87	9	0	19
15-19	59	124	12	4	242
20-24	54	151	64	12	160
25-29	38	67	112	16	34
30-34	69	210	96	17	43
35-39	214	415	178	110	151
40-44	157	209	190	96	117
45-49	21	64	45	18	15
50-54	2	0	2	3	4
55-59	1	0	1	0	2
60-64	0	0	0	0	0
Total	775	1361	715	277	786
Measured	1026	1233	599	287	459
# trawls	94	84	95	87	102
# trawl with species	61	60	57	40	42

Table 7.7 Acoustic index of *Sebastes marinus* from the Norwegian Coastal Surveys in 1995–99, within 5-cm length-groups, total for all areas.

Areas 00 and 03–07					
Length (cm)	**1995**	**1996**	**1997**	**1998**	**1999**
5–9	40519	1908	232	0	0
10–14	13627	7656	706	24	519
15–19	8161	11057	1207	96	6926
20–24	9396	7983	6171	1500	5679
25–29	4229	10275	12113	81	1183
30–34	3914	10504	7382	2090	2423
35–39	15711	34437	22440	9914	9082
40–44	13960	19171	28846	5477	7881
45–49	3431	4539	5653	499	1587
50–54	657	8	230	0	376
55–59	519	0	147	0	179
60–64	0	0	20	0	0

Table 7.8.

Run title : Arctic S. marinus (run: XSAKHN01/X01)
At 31/08/2000 12:56
Table 1 Catch numbers at age Numbers*10**-3

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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	1	0	0	0	0
6	0	0	2	0	0	4	0	0	0	0
7	0	0	5	0	46	60	9	9	28	78
8	0	142	22	24	7	85	119	98	51	591
9	0	88	78	193	292	230	313	157	203	862
10	0	520	114	359	640	672	361	322	464	558
11	266	321	394	406	816	908	879	689	716	989
12	1488	350	549	1036	1930	1610	1234	1069	959	1183
13	1708	1387	783	1022	2096	2038	1638	1788	1506	1578
14	1854	2062	1718	1523	2030	2295	2134	2284	1729	1435
15	1722	1258	3102	2353	1601	1783	1675	2180	1574	1571
16	1571	2497	2495	1410	2725	1406	1614	1855	1039	1184
17	1894	1695	2104	1655	2668	785	1390	1426	1275	1351
18	1895	2472	1837	1678	1409	563	952	854	967	1654
19	1921	1150	998	745	617	670	679	807	1018	1010
20	1808	1026	858	716	733	593	439	610	847	384
21	1935	617	688	534	514	419	560	513	442	194
22	1304	425	547	528	256	368	334	206	764	460
23	908	659	268	576	177	250	490	335	488	170
+gp	6346	3991	3110	3482	1508	3232	3135	2139	3399	2149
0 TOTALNUM	26620	20660	19672	18240	20065	17972	17955	17341	17469	17401
TONSLAND	28077	19041	16185	16651	18120	15616	18043	17576	19318	19087
SOPCOF %	102	101	97	104	100	100	105	100	100	104

Table 7.9.

Run title : Arctic S. marinus (run: XSAKHN01/X01)

At 31/08/2000 12:56
Table 2 Catch weights at age (kg)

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
2	0	0	0	0	0	0	0	0	0	0
3	0.02	0.02	0.02	0	0	0	0	0	0	0
4	0.03	0.03	0.03	0	0	0	0	0	0	0
5	0.053	0.053	0.053	0	0	0.16	0	0	0	0
6	0.078	0.078	0.08	0	0	0.24	0	0	0	0
7	0.133	0.133	0.18	0	0.25	0.33	0.22	0.23	0.37	0.14
8	0.39	0.37	0.29	0.33	0.37	0.43	0.49	0.51	0.21	0.34
9	0.41	0.51	0.48	0.36	0.38	0.64	0.56	0.53	0.47	0.44
10	0.51	0.46	0.42	0.43	0.49	0.61	0.65	0.74	0.62	0.56
11	0.55	0.53	0.5	0.51	0.51	0.59	0.71	0.72	0.67	0.69
12	0.71	0.61	0.59	0.51	0.64	0.65	0.81	0.78	0.77	0.78
13	0.72	0.64	0.58	0.64	0.74	0.74	0.84	0.8	0.77	0.86
14	0.78	0.71	0.65	0.64	0.76	0.79	0.88	0.86	0.85	1.04
15	0.85	0.76	0.65	0.76	0.86	0.84	0.96	0.91	1.05	1.06
16	0.83	0.83	0.71	0.86	0.95	0.92	1	0.99	0.96	1.12
17	0.91	0.84	0.82	0.89	1.03	1.12	1.02	1.16	1.25	1.18
18	0.9	1	0.84	0.98	1.07	1.01	1.01	1.18	1.29	1.8
19	0.93	0.96	0.94	1	1.11	1.01	1	1.21	1.3	1.08
20	1.04	1.04	1.02	1.03	1.16	1.21	1.03	1.34	1.23	1.17
21	1.13	1.03	1.03	1.21	1.15	1.14	1.04	1.28	1.87	1.03
22	1.06	1.08	1.15	1.03	1.13	1.09	1.14	1.54	1.46	1.37
23	1.23	1.02	1.27	1.2	1.02	1.3	1.09	1.19	1.73	1.18
+gp	1.445	1.216	1.27	1.14	1.36	1.01	1.16	1.29	1.29	1.35
0 SOPCOFAC	1.0174	1.0135	0.9702	1.0376	1.0038	0.9998	1.0482	1.004	1.002	1.0377

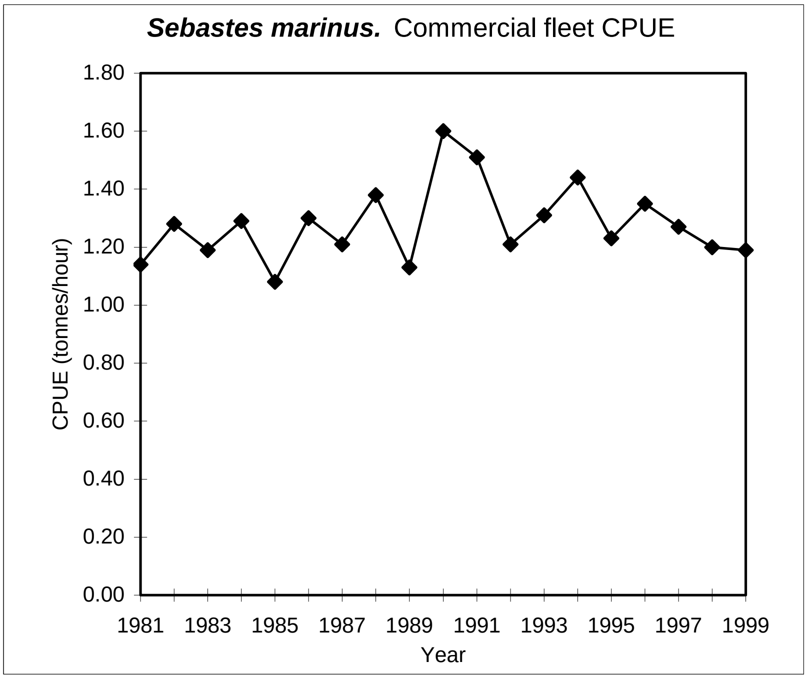


Figure 7.1a. Plot of CPUE based on logbook information from freezer trawlers and included in a GLM-analysis. Only days where *S.marinus* composed more than 50% of total catch were included in the analysis. The CPUEs have been standardized and scaled to a certain area (03) and month (2).

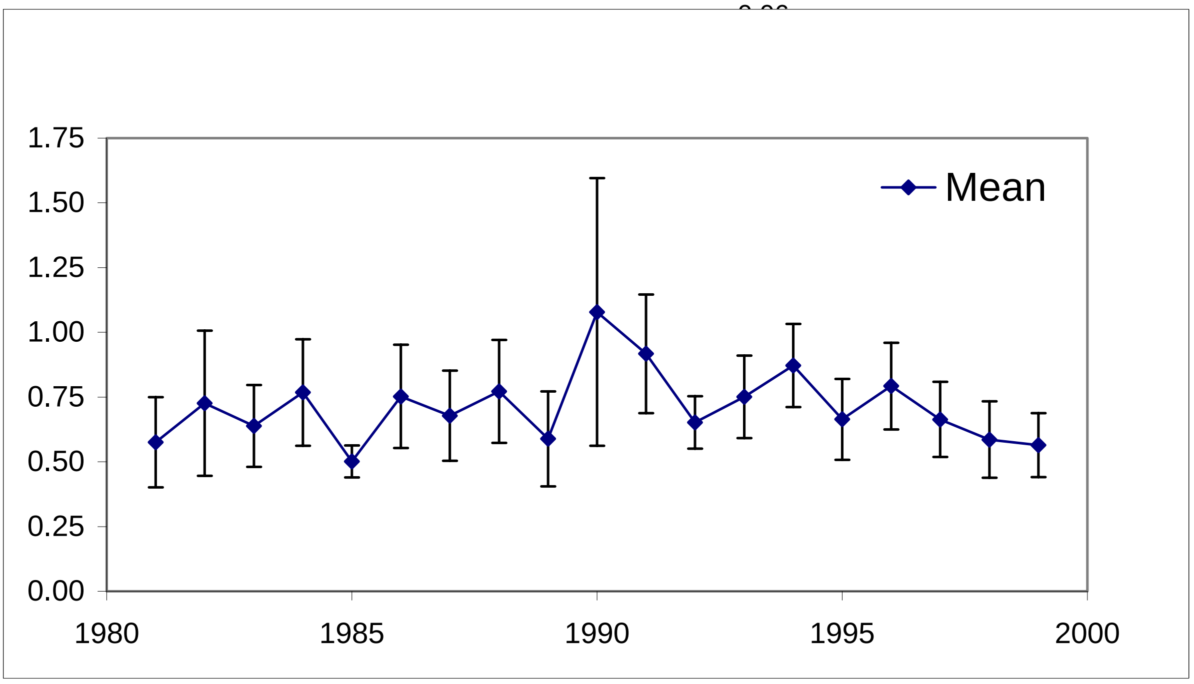
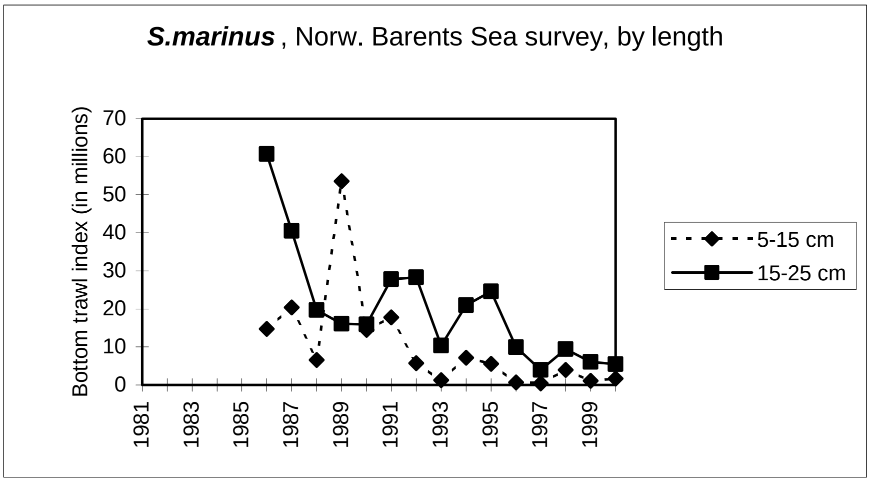


Figure 7.1b. Plot of simple mean CPUEs with 2 st.errors based on the same data as used in the GLM-analysis in Fig. 7.1a.



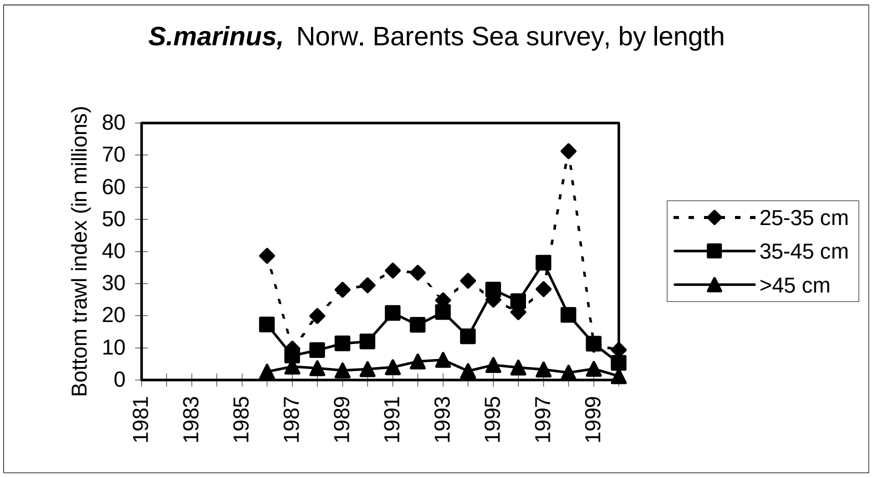
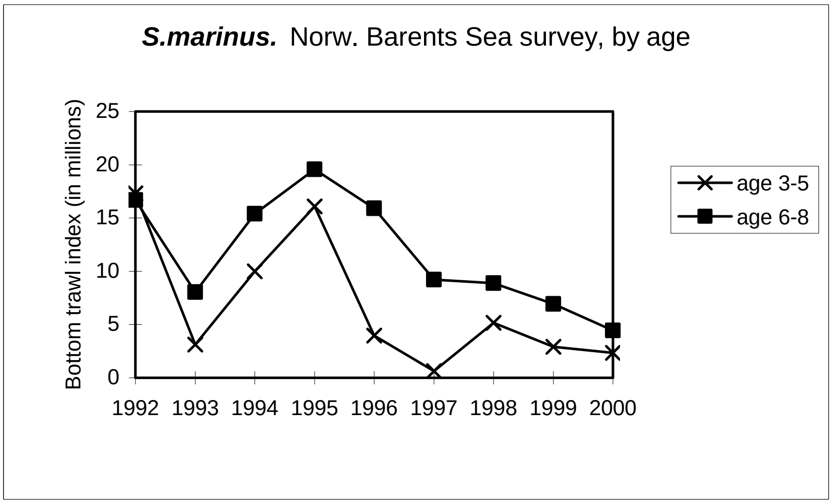


Figure 7.2a. *Sebastes marinus.* Abundance indices **(by length)** from the Norwegian bottom trawl survey in the Barents Sea in winter 1986-2000 (ref. Table D11a).



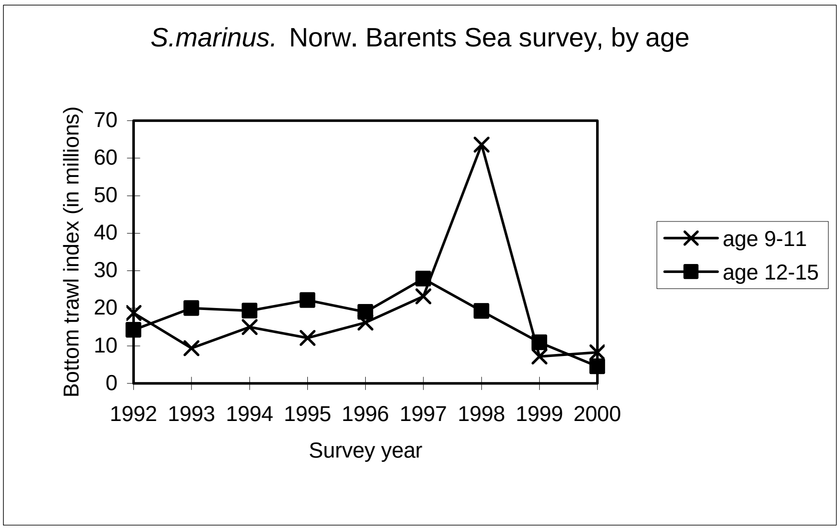
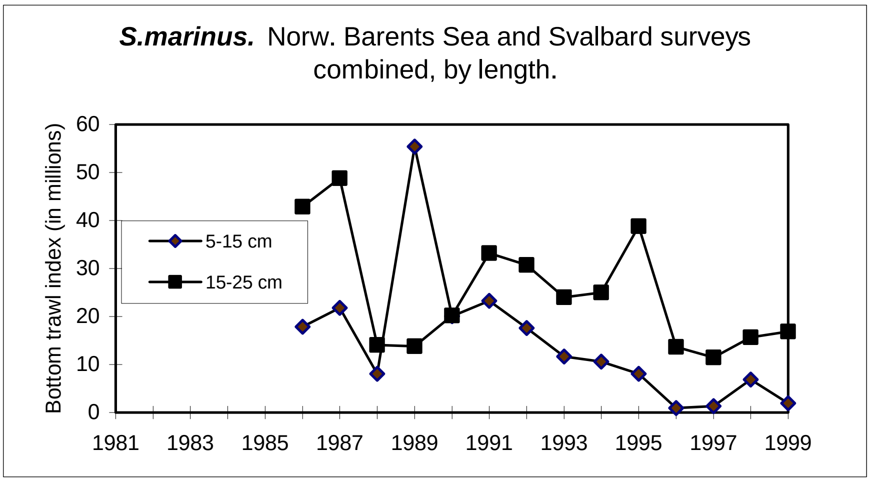


Figure 7.2b. *Sebastes marinus.* Abundance indices (by age) from the Norwegian bottom trawl surveys 1992-2000 in the Barents Sea (ref. Table D11b).



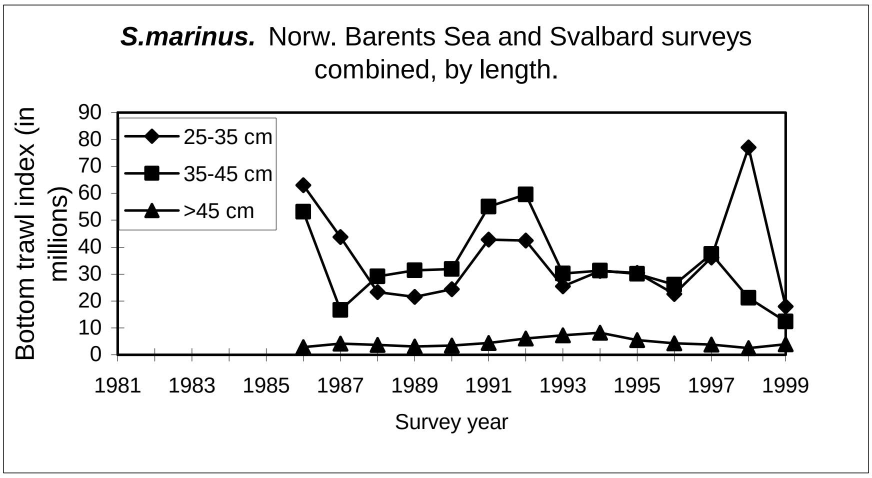
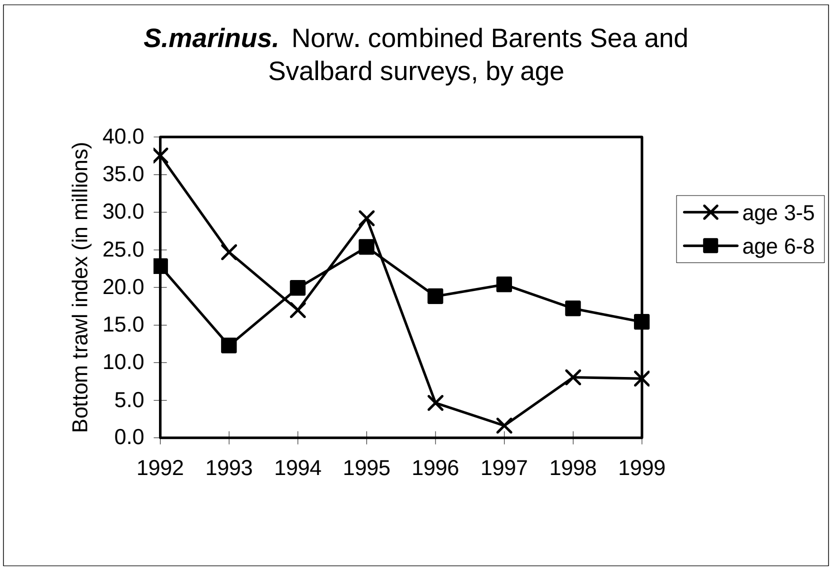


Figure 7.3a. *Sebastes marinus.* Abundance indices (**by length**) when combining the Norwegian bottom trawl surveys 1986-1999 in the Barents Sea (winter) and at Svalbard (summer/fall).



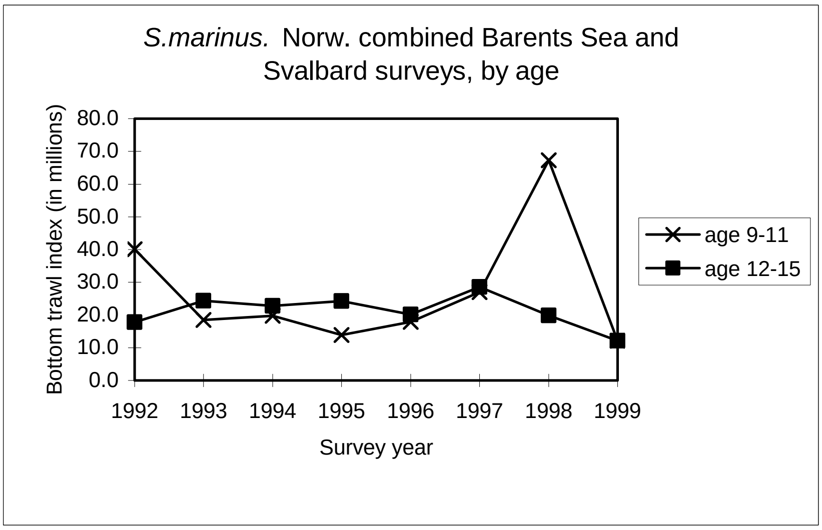


Figure 7.3b. *Sebastes marinus.* Abundance indices (**by age**) when combining the Norwegian bottom trawl surveys 1992-1999 in the Barents Sea (winter) and at Svalbard (summer/fall).

Table D9. Output statistics from the GLM-analysis of *S.marinus* CPUE.

```
                                              22:41 Saturday, August 19, 2000   1

                          General Linear Models Procedure
                              Class Level Information

Class    Levels    Values

YEAR         19    1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
                   1995 1996 1997 1998 1999

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 = 661

Dependent Variable: CPUE

Source                  DF          Sum of Squares          Mean Square  F Value    Pr > F

Model                   33             42.99771167           1.30296096     3.33    0.0001

Error                  627            245.16405777           0.39101126

Corrected Total        660            288.16176944

                  R-Square                    C.V.             Root MSE          CPUE Mean

                  0.149214                87.86573           0.62530893         0.71166415


Source                  DF               Type I SS          Mean Square  F Value    Pr > F

YEAR                    18             13.99829646           0.77768314     1.99    0.0088
AREA                     4             19.09492311           4.77373078    12.21    0.0001
MONTH                   11              9.90449210           0.90040837     2.30    0.0091

Source                  DF             Type III SS          Mean Square  F Value    Pr > F

YEAR                    18             12.10649888           0.67258327     1.72    0.0320
AREA                     4             21.09384147           5.27346037    13.49    0.0001
MONTH                   11              9.90449210           0.90040837     2.30    0.0091


                                                T for H0:        Pr > |T|       Std Error of
Parameter                         Estimate     Parameter=0                        Estimate
```

INTERCEPT		0.4374581226 B	2.86	0.0044	0.15314120
YEAR	1981	-.0462621043 B	-0.30	0.7671	0.15616402
	1982	0.0877526467 B	0.49	0.6222	0.17802072
	1983	0.0020809641 B	0.01	0.9898	0.16283435
	1984	0.1003372346 B	0.70	0.4812	0.14237016
	1985	-.1142561074 B	-0.84	0.3989	0.13535563
	1986	0.1066038462 B	0.78	0.4330	0.13588375
	1987	0.0228028633 B	0.16	0.8697	0.13897651
	1988	0.1900088174 B	0.63	0.5263	0.29967202

Table D9 (Continued)

	1989	-.0573526950 B	-0.39	0.6993	0.14842864
	1990	0.4139886393 B	2.90	0.0038	0.14266885
	1991	0.3194589274 B	2.25	0.0247	0.14193004
	1992	0.0185284959 B	0.13	0.9002	0.14775215
	1993	0.1233007610 B	0.80	0.4216	0.15332860
	1994	0.2486680442 B	1.64	0.1016	0.15168027
	1995	0.0451032284 B	0.28	0.7769	0.15913324
	1996	0.1624850026 B	1.08	0.2805	0.15042488
	1997	0.0775450204 B	0.54	0.5908	0.14414369
	1998	0.0070657133 B	0.05	0.9614	0.14580093
	1999	0.0000000000 B	.	.	.
AREA	3	0.5179503368 B	6.04	0.0001	0.08573726
	4	0.2567905253 B	3.15	0.0017	0.08155236
	5	0.1269960180 B	1.65	0.0995	0.07696964
	6	-.0205633341 B	-0.25	0.8055	0.08347039
	7	0.0000000000 B	.	.	.
MONTH	1	0.1399680187 B	0.98	0.3259	0.14234882
	2	0.2341351162 B	1.72	0.0857	0.13603115
	3	0.1931445614 B	1.47	0.1418	0.13131686
	4	0.1093223275 B	0.86	0.3894	0.12692787
	5	0.1226838831 B	0.96	0.3354	0.12725268
	6	-.0239212255 B	-0.18	0.8562	0.13193358
	7	-.1556147342 B	-1.14	0.2533	0.13610908
	8	-.0456933305 B	-0.34	0.7377	0.13638751
	9	-.0918963888 B	-0.73	0.4682	0.12661219
	10	-.0792849883 B	-0.62	0.5326	0.12698462
	11	-.1269541270 B	-0.96	0.3367	0.13205242
	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.

Level of		-------------CPUE------------	
YEAR	N	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	37	0.58567568	0.44933618
1999	37	0.56486486	0.37531928

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	1.14	18,272
1982	2,014	12.3	1.28	12,789
1983	1,588	8.3	1.19	16,185
1984	3,960	14.0	1.29	22,000
1985	3,086	10.5	1.08	27,296
1986	4,502	14.9	1.30	23,233
1987	2,168	9.0	1.21	19,898
1988	4,349	16.8	1.38	18,774
1989	3,044	13.1	1.13	20,550
1990	3,589	12.8	1.60	17,548
1991	4,943	26.0	1.51	12,610
1992	2,265	14.0	1.21	13,376
1993	1,426	8.6	1.31	12,711
1994	1,241	6.8	1.44	12,583
1995	928	5.9	1.23	12,696
1996	1,831	10,1	1.35	13,365
1997	1,313	7.4	1.27	13,839
1998	1,681	8,7	1.20	16,098
1999[2]	2,256	11.8	1.19	16,039

[1] Only including days with more than 50% *S. marinus* in the catches, and analysed by a GLM-analysis.
[2]Provisional figures.

Table D11a. *Sebastes marinus*. Abundance indices **(on length)** from the bottom trawl surveys in the Barents Sea in the winter 1986–2000 (numbers in millions). The area coverage was extended from 1993.

Year	Length group (cm)									
	5.0–9.9	10.0–14.9	15.0–19.9	20.0–24.9	25.0–29.9	30.0–34.9	35.0–39.9	40.0–44.9	>45.0	Total
1986	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
2000	0.6	1.1	1.4	4.1	4.6	4.8	3.5	1.8	1.2	23.1

[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.

	Age													
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
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
2000[2]	994	816	527	382	552	3,519	3,488	2,014	2,746	1,142	2,051	721	647	19,599

[2] Preliminary

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 1985–1999 (numbers in thousands).

	Length group (cm)									
Year	5.0–9.9	10.0–14.9	15.0–19.9	20.0–24.9	25.0–29.9	30.0–34.9	35.0–39.9	40.0–44.9	>45.0	Total
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
1999	0	794	7,057	3,698	4,563	2,449	467	619	369	20,017

[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 1992–1999 (numbers in thousands).

	Age														
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
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
1999	0	760	2,893	1,339	3,534	1,037	3,905	2,603	762	1,663	481	361	258	152	19,748

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 33,000 t. From 1992 to 1998 total landings varied between 9,000–14,000 t and in 1999 it increased to 19,000 t.

From 1992 this fishery has been regulated by allowing only the long line and gillnet fisheries by vessels smaller than 28 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 and until 1998 annual trawler landings have varied between 5,000 and 8,000 t without any clear trend attributable to changes in allowable bycatch. However, the increase of trawler landings in 1999 to 10,000 t may partly be attributable to the less strict bycatch regulations. Landings of Greenland halibut from the directed longline and gillnet fishery have also increased in recent years to levels well above the level of 2,500 t set by the Norwegian authorities. This is attributed to the increased difficulties of regulating a fishery that only lasts for a few weeks.

8.1.2 Landings prior to 2000 (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 1998 is 12,689 t, which is close to that used in the previous assessment. The preliminary estimate of total catch for 1999 is 19,389 t. This is almost equal to the projected catch of 19,000 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 2,010 t in 1996 (Table E8). In 1997 and 1998 landings were reduced to about 1,500 t, but in 1999 it increased to the historically highest level of 2,577 t. 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 1992–97 the reported annual catches were 56, 0, 140, 270, 59, and 54 respectively. In 1998 and 1999 no catches were reported from this area. Jan Mayen is within Sub-area IIa, but little is known about the relationship with the stock assessed by the Arctic Fisheries Working Group. Catches from this area have therefore not been included in the catches given for Sub-area II.

8.1.3 Expected landings in 2000

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 2000 the total Norwegian catch was 6,649 t. This is at the same level as at the same time in previous years before 1999 and only about half the level as in 1999. It is expected that the total Norwegian catch in 2000 will be approximately 9,700 t. In addition 4,000 t is expected to be caught by Russian vessels and 500 t by other countries. Expected total landings (officially) for 2000 are thus 14,200 t. It is believed that there may be additional landings that are not reported.

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 8.1–8.5)

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

1. Norwegian Svalbard bottom trawl surveys (autumn) from 1984–1999 in fishing depths of less than 100 m and down to 500 m (Table E1, Figure 8.1).

2. Norwegian Barents Sea bottom trawl survey (winter) from 1989–2000 in fishing depths of less than 100 m and down to 500 m. In order to utilise the 2000 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 1984–1999 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 1992–1999 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 1994–2000. The surveys cover the continental slope from 68 to 80ºN, in depths of 400–1500 m north of 70º30'N, and 400–1000 m south of this latitude. This series has in 2000 been revised to also include depths between 400 – 500 m in all years (Table E5, Figure 8.4).

6. Norwegian bottom trawl surveys east and north of Svalbard in autumn 1996–1999 (Table E6).

7. Norwegian pelagic 0-group surveys from 1970–1999. (Table A14).

8. Spanish bottom trawl survey in the slope of Svalbard area, ICES Division IIb: 1997 – 1999 (Figure 8.5).

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 trends (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 years there has been low but somewhat better representation of young fish in this survey (Figure 8.1 bottom). The 1995 – 1997 year classes were more abundant than any other year class since 1988, but the 1998 year class was down again to the 1990 level.

The Norwegian bottom trawl surveys during winter in the Barents Sea caught Greenland halibut older than 12 years, 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 1990–1993 year classes (Figure 8.2). From age 2–3 to age 6–8 the 1990–1993 year classes increased from only a few percentage to more than 50% of the mean for the 1983–1987 year classes. In this survey the 1995–1998 year classes were not as abundant as in the survey above.

The Russian Barents Sea bottom trawl survey series from 1984–1999 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 1990–1994 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 three surveys discussed above. 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 1995–1998 year classes were relatively abundant in this survey also.

The Norwegian Greenland halibut surveys along the deep continental slope south and west of Spitsbergen began in 1994. Although Greenland halibut older than 15 years were caught, few fish were represented in the catch over age 12 or less than age 5 (Table E5 and Figure 8.4). Most of the abundance indices were dominated by ages 5–8. Comparing the abundance at age for the different year classes it appeared that there was no major variation among those year classes included in Figure 8.4 (1985–1996). 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 now available for four years. 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 1997–1999 year classes are closer to the average.

The spawning stock biomass estimated from the Russian autumn bottom trawl survey shows an increasing trend from 1987 to 1999 (Smirnov, WD 25). This survey covers the Barents Sea including the continental slope of the Norwegian Sea. In recent years the continental slope has also been covered by the Norwegian Greenland halibut survey (Høines, WD 22) and a Spanish bottom trawl survey (Paz and Román, WD 39). Although the number of years in these surveys is limited, the trends are in accordance with that of the Russian survey (Figure 8.5).

All in all, the surveys seem to indicate that the catchability of the 1990–1994 year classes increase considerably as the fish becomes five years and older. Based on extremely low catch rates in the surveys, these year classes were considered very poor in previous assessments by the Working Group. The new results indicate that the 1990–1992 year classes may be at the same level as those prior to the previously assumed recruitment failure. 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 survey area.

The Norwegian survey series have been revised in 2000. This revision is done due to a standardisation of the areas covered in the surveys and to get a more appropriate and comparable swept area estimate from year to year. An XSA was run with the revised data using the same tuning fleets, years and settings as in the 1999 assessment. The revisions caused only minor changes in output from the XSA.

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. After 1996 the CPUE series has varied between 1200 and 1650 kg/h with the highest value in 2000.

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 1999 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. This year preliminary data were presented to the Working Group that indicate consistent differences in interpretation of otolith age by individual institutes. It may still be worthwhile to increase the effort to improve precision and accuracy of the ageing method.

8.3 Data Used in the Assessment

Based on the arguments in Section 8.2.1 the Working Group also this year considers the survey indices for ages below age 5 not appropriate for inclusion in the tuning data. Consequently, a standard XSA was run for age 5 and above. Although only age 5 and older was used in the assessment, input data for ages 3–4 is reported separately in Table 8.7.

8.3.1 Catch at age (Tables 8.7 – 8.8)

The catch-at-age data for 1998 were updated using revised catch figures and revised Norwegian age composition. Catch-at-age data for 1999 were available from both the Norwegian and Russian fisheries. The combined Norwegian and Russian catch-at-age were 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 noted that similar low numbers of age 9, as seen in some of the surveys, also was observed in the catches.

8.3.2 Weight at age (Table 8.7, 8.9)

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 1999 (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 WG assessments prior to 1999 these ages were only used for tuning and were not included in the stock biomass. In the present assessment and in the one from 1999 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 8.7, 8.10)

Annual ogives based on Russian survey data were given for the years 1984–1990 and 1992–1999. An average ogive derived from 1984–1987 was used for 1964–1983. For 1984 –1999 a three-year running average was used.

8.3.5 Tuning data

As in the previous assessment the following abundance indices were initially used for tuning the VPA:

Fleet 1: Norwegian Svalbard bottom trawl surveys (autumn) from 1984–1999 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 1989–2000 for ages 5–12.
Fleet 3: Norwegian Greenland halibut surveys using a commercial vessel along the continental slope from 1994–1999 for ages 5–14.
Fleet 4: Experimental commercial fishery CPUE from 1992–1999 for ages 5–14.
Fleet 5: Russian trawl survey from 1984–1999 for ages 5–14.
Fleet 6: Norwegian Svalbard shrimp trawl surveys from 1988–1999 for ages 5–8.

Based on the diagnostics for each fleet and age the Working Group decided to exclude fleets 1, 2, and 6. These tuning fleets were the ones that for all ages were given least weight in the XSA. The final illustrative VPA was thus run with only the three fleets that showed the best fit in the tuning.

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. The catchability was assumed to be independent on stock size for all ages and independent on age for age 10 and older. These are the same settings as used in last years assessment. Log catchability residuals for the three fleets used in the tuning are shown in Figures 8.6–8.7.

8.5 Results of the Assessment

As described in section 8.2.1 there are uncertainties in the tuning dataset caused by trends in catchability of the younger age groups. Excluding some of the formerly used tuning fleets improved the diagnostics of the assessment, but still the diagnostics show some unfavourable patterns. The younger age groups show trends in catchability residuals (Figure 8.6 – 8.7). In addition some age groups in most fleets show high catchability residuals. Due to the uncertainty in the tuning data the run should be regarded as an experimental run for illustrative purposes. The Working Group regards the absolute level of stock size to be uncertain, but believes that the trends in the converged part and the older ages of the VPA reflect true trends in the stock.

8.5.1 Results of the illustrative VPA (Tables 8.11–8.16)

The fishing mortality (F) matrix indicates that historically Greenland halibut were fully recruited to the fishery at approximately age 6–7. Since 1991 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 29,000 t and from 1993 to 1997 it increased gradually to around 50,000 t. It has remained at that level since. Prior to the reduction in the early 1990's the fishing mortality had increased continuously for more than a decade and peaked in 1991 at 0.66. After the reduction the fishing mortality has been stable around 0.2–0.3. The elevated catch in 1999 resulted in an increase in fishing mortality to 0.38.

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. The current spawning stock (mean of the last three years) is 29% of the level in 1970–1975 and 68% 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 17 and 43% respectively (Table 8.13). This is somewhat better than the results indicated in the previous assessments. Spawning stock biomass in 2000 was estimated from stock numbers at age from the VPA and the last years data for weight and maturity-at-age. The result of 46,325 t is an 8 % reduction since 1999. This may be a consequence of the elevated landings in 1999.

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 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 since 1990 lower than in most of the previous years. The reduction does not seem dramatic, though, and the present level in 1990–1999 is about 76% of the level in the 1980's. The result shows a sharp reduction in the most recent 2–3 years. However, previous assessments also showed reduced recruitment in the last few years included in the analyses. This may be attributed to the problems of survey coverage in relation to the distribution of the youngest age groups, and may not reflect the development of the stock.

8.5.2 Biological reference points

No limit or precautionary reference points for the fishing mortality or the spawning stock biomass are proposed.

8.5.3 Catch options for 2001

Based upon the evaluation of the stock, the spawning stock biomass has increased since its historically low level in 1992. The landings in 1999 of 19,000 t resulted in reduced stock size, while the stock increased during 1994–1998 with mean landing size of 11,000 t. The increase has been slow and it seems necessary to keep landings low in order to rebuild the stock to the same level as in the 1980's.

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.

The Working Group stated in it's 1999 meeting that the high landings in 1999 most likely would lead to substantial reduction in the spawning stock size. The present assessment shows a less severe response than expected.

Swept area estimates based on surveys along the continental slope (Figure 8.5), which is the main distribution area of the adult stock, are of the same magnitude as the analytical assessment and show similar trends.

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)	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	61	80	22	8	56	0	30	10 380	0	43	1 235	0	16	0	11 933
1994	4	0	18	55	296	3	15	5	4	8 428	0	36	283	1	76	2	9 226
1995	0	0	12	174	35	12	25	2	0	9 368	0	84	794	757	115	7	11 385
1996	0	0	2	219	81	123	70	0	0	11 725 [2]	0	79	1 576	137	317	57	14 386
1997	0	0	27	253	56	0	62	2	0	7 879 [2]	12	50	1 038	55 [2]	67	25	9 526
1998	0	0	57	67	34	0	23	2	0	9 236 [2]	31	99	2 659	254 [2]	182	45	12 689
1999 [1]	0	0	0	0	34	38	7	0	0	14 973 [2]	8	49	3 823	318 [2]	94	45	19 389

1 Provisional figures.
2 Working Group figures.
3 USSR prior to 1991.

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	Greenland	Iceland	Norway	Russia[3]	Spain	UK (England & Wales)	UK (Scotland)	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	-	32	-	-	56	1 754	867	-	-	-	2 709
1994	-	17	217	-	15	1 165	175	-	+	-	1 589
1995	-	12	-	-	25	1 352	270	57	-	-	1 716
1996	-	2	+	-	70	911	198	-	+	-	1 181
1997	-	15	-	-	62	606 [2]	170	-	+	-	853
1998	-	47	+	-	23	810 [2]	491	-	2	-	1 373
1999 [1]	-		-	13	7	1480	1203		+	-	2 703

[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.	Green-land	Ire-land	Norway	Portu-gal	Russia[5]	Spain	UK (Engl. & Wales)	UK (Scot-land)	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	104	-	-	8 050	-	4 964	-	6	-	13 222
1990		133	49	12	-	-	8 233	-	1 246 [2]	-	1	-	9 674
1991	1 400	314	119	21	-	-	11 189	-	305 [2]	-	+	1	13 349
1992	-	16	108	1	13 [4]	-	3 586	15 [3]	58	-	1	-	3 798
1993	-	29	78	14	8 [4]	-	7 977	17	210	-	2	-	8 335
1994	-	-	47	33	3 [4]	4	6 382	26	67	+	14	-	6 576
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	1	21	25	6 755
1998	-	-	67	16	- [4]	1	7 495 [2]	80	530	5	74	41	8 309
1999 [1]				20	25 [4]		12 641 [2]	33	734	1	63	45	13 562

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)	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	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	1	62	2	1 061
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	-	-	10	-	18	1	-	931 [2]	31	19	1638	249 [2]	106	4	3 007
1999 [1]	-	-		-	14		-	852	8	16	1886	317 [2]	31	-	3 124

[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	6 708	11 926
1999	2 565	6 804	10 019	19 388

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	-	-	-	-	-
2000	-	-	1.38	1.92	-	-	-	-	-

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. Input data for the youngest age groups, which were not used in the XSA.

Run title : Arctic Green.halibut (run: XSAAAG08/X08)

At 29/08/2000 9:34

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

YEAR, AGE	1964,	1965,	1966,	1967,	1968,	1969,
3,	18,	44,	54,	54,	12,	27,
4,	101,	91,	69,	121,	57,	233,

YEAR, AGE	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
3,	1,	1,	1,	1,	1,	22,	1,	62,	78,	88,
4,	34,	1,	461,	19,	276,	334,	98,	755,	532,	887,

YEAR, AGE	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
3,	64,	664,	48,	314,	0,	88,	141,	50,	5,	214,
4,	275,	1146,	551,	1212,	36,	461,	985,	435,	233,	924,

YEAR, AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
3,	155,	389,	98,	10,	0,	0,	3,	2,	1,	54,
4,	793,	2084,	437,	224,	73,	75,	48,	32,	79,	119,

Table 2 **Catch weights at age (kg)**

YEAR, AGE	1964,	1965,	1966,	1967,	1968,	1969,
3,	.1400,	.1400,	.1400,	.1400,	.1400,	.1400,
4,	.2600,	.2600,	.2600,	.2600,	.2600,	.2600,

YEAR, AGE	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
3,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.2000,	.3000,
4,	.4410,	.4410,	.4410,	.4410,	.4410,	.4410,	.4410,	.4410,	.4410,	.6000,

YEAR, AGE	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
3,	.2000,	.2000,	.2700,	.3100,	.3000,	.3000,	.3400,	.3070,	.4140,	.3100,
4,	.4820,	.5000,	.6200,	.4500,	.4800,	.3800,	.4700,	.5740,	.5540,	.6300,

YEAR, AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
3,	.2800,	.2900,	.2200,	.3400,	.2600,	.4400,	.1800,	.3000,	.3000,	.2000,
4,	.5500,	.6000,	.4600,	.5400,	.5200,	.5600,	.4700,	.5000,	.5200,	.4700,

Table 5 **Proportion mature at age**

YEAR, AGE	1964,	1965,	1966,	1967,	1968,	1969,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,

YEAR, AGE	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,

YEAR, AGE	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.1700,	.1700,	.1700,	.1700,	.1705,	.2405,	.1705,	.1300,	.0000,	.0300,

YEAR, AGE	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
3,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0200,	.0200,
4,	.0305,	.0405,	.2605,	.2410,	.2710,	.0910,	.1400,	.1400,	.1300,	.1000,

Table 8.8

Run title : Arctic Green.halibut (run: XSAAAG06/X06)

At 28/08/2000 10:17

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,
AGE						
5,	372,	253,	170,	156,	114,	1064,
6,	1480,	853,	563,	332,	283,	2420,
7,	2808,	1735,	1106,	623,	452,	3208,
8,	5674,	3868,	2715,	2006,	1976,	6288,
9,	4951,	4203,	4054,	3237,	3923,	4921,
10,	3981,	3799,	2499,	2409,	2950,	4431,
11,	1853,	1799,	1284,	1718,	2234,	2381,
12,	1018,	1002,	783,	871,	792,	812,
13,	364,	372,	246,	315,	146,	229,
14,	251,	282,	261,	155,	43,	100,
+gp,	76,	50,	28,	19,	7,	30,
0 TOTALNUM,	22828,	18216,	13709,	11841,	12920,	25884,
TONSLAND,	40391,	34751,	26321,	24267,	26168,	43789,
SOPCOF %,	100,	100,	101,	100,	100,	103,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
5,	526,	80,	1109,	212,	917,	840,	830,	2037,	1897,	2218,
6,	2792,	4486,	3521,	1117,	2519,	2337,	2982,	3255,	3589,	3155,
7,	10464,	12712,	9605,	3923,	6204,	6520,	5824,	4200,	4118,	2727,
8,	18562,	12283,	6438,	3515,	3838,	4118,	5002,	2524,	2365,	1234,
9,	10034,	6130,	2775,	2551,	1834,	2265,	3000,	1610,	1509,	495,
10,	6671,	4339,	1734,	1919,	1942,	1654,	1350,	1104,	946,	319,
11,	2517,	2703,	1368,	1536,	1622,	1857,	915,	1062,	934,	296,
12,	1250,	1660,	1234,	1127,	1338,	1536,	1212,	858,	438,	243,
13,	616,	1044,	675,	716,	734,	1122,	698,	595,	349,	103,
14,	1104,	300,	200,	251,	531,	600,	526,	384,	147,	45,
+gp,	281,	143,	80,	126,	216,	368,	358,	180,	112,	51,
0 TOTALNUM,	54817,	45880,	28739,	16993,	21695,	23217,	22697,	17809,	16404,	10886,
TONSLAND,	89484,	79034,	43055,	29938,	37763,	38172,	36074,	28827,	24617,	17312,
SOPCOF %,	94,	104,	98,	92,	98,	88,	93,	101,	105,	104,

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
5,	731,	1896,	1304,	1543,	915,	1219,	1672,	1212,	907,	2080,
6,	1138,	1917,	1494,	1864,	3698,	2874,	3335,	2972,	2540,	4453,
7,	1665,	1919,	1276,	1851,	3350,	2561,	2712,	3572,	3141,	3655,
8,	1341,	933,	1208,	2287,	1938,	1548,	1531,	1746,	2096,	1657,
9,	944,	484,	1493,	1491,	1064,	972,	1128,	752,	1182,	801,
10,	473,	448,	1258,	1228,	1191,	1037,	997,	828,	860,	318,
11,	511,	482,	838,	713,	602,	614,	530,	362,	481,	228,
12,	275,	380,	502,	488,	340,	363,	434,	202,	313,	126,
13,	242,	384,	324,	247,	171,	161,	314,	186,	133,	120,
14,	145,	150,	108,	201,	132,	120,	305,	63,	140,	140,
+gp,	78,	62,	46,	64,	71,	63,	239,	7,	47,	28,
0 TOTALNUM,	7543,	9055,	9851,	11977,	13472,	11532,	13197,	11902,	11840,	13606,
TONSLAND,	13284,	15018,	16789,	22147,	21883,	19945,	22875,	19112,	19587,	20138,
SOPCOF %,	109,	107,	100,	98,	100,	99,	98,	101,	100,	103,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	2139,	3312,	1098,	1140,	631,	846,	1034,	330,	359,	411,
6,	5163,	3889,	1195,	1088,	708,	992,	2083,	921,	1116,	1796,
7,	4642,	4716,	1069,	1608,	1252,	1719,	3795,	1822,	2466,	3829,
8,	1932,	2355,	778,	1118,	817,	990,	1426,	953,	1464,	1968,
9,	1221,	1031,	360,	140,	310,	405,	262,	342,	527,	903,
10,	499,	1284,	600,	976,	642,	726,	655,	822,	924,	1927,
11,	264,	774,	188,	444,	416,	461,	270,	231,	237,	417,
12,	314,	673,	150,	144,	330,	371,	132,	150,	122,	223,
13,	42,	177,	79,	36,	88,	154,	29,	18,	15,	70,
14,	96,	266,	89,	20,	39,	56,	22,	41,	29,	41,
+gp,	44,	517,	56,	4,	3,	8,	1,	1,	15,	4,
0 TOTALNUM,	16356,	18994,	5662,	6718,	5236,	6728,	9709,	5631,	7274,	11589,
TONSLAND,	23183,	33320,	8602,	12462,	9318,	11665,	14269,	9574,	11927,	19389,
SOPCOF %,	102,	105,	95,	106,	100,	100,	100,	100,	100,	101,

Table 8.9

Run title : Arctic Green.halibut (run: XSAAAG06/X06)

At 28/08/2000 10:17

Table 2 Catch weights at age (kg)

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,
AGE						
5,	.4200,	.4200,	.4200,	.4200,	.4200,	.4200,
6,	.6400,	.6400,	.6400,	.6500,	.6600,	.6400,
7,	.9000,	.9000,	.9100,	.9300,	.9600,	.9100,
8,	1.2000,	1.2200,	1.2400,	1.2700,	1.3100,	1.2500,
9,	1.6300,	1.6600,	1.7000,	1.7100,	1.7400,	1.6400,
10,	2.2600,	2.2300,	2.2200,	2.2000,	2.1900,	2.2500,
11,	3.1100,	3.0000,	2.9400,	2.8400,	2.7900,	2.9900,
12,	3.7400,	3.4900,	3.3900,	3.3000,	3.1900,	3.6300,
13,	4.5700,	4.4000,	4.3800,	4.2700,	4.2700,	4.6800,
14,	5.0100,	4.9100,	4.8400,	4.8800,	5.0000,	5.3800,
+gp,	5.9400,	5.8900,	5.8800,	5.8000,	5.9900,	5.9900,
0 SOPCOFAC,	.9986,	1.0046,	1.0054,	1.0024,	.9994,	1.0262,

Table 2 Catch weights at age (kg)

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
5,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.5670,	.9000,
6,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	.7370,	1.2000,
7,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.0790,	1.5000,
8,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.4210,	1.8000,
9,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	1.8480,	2.2000,
10,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.2810,	2.6000,
11,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	2.8870,	3.0000,
12,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.2470,	3.5000,
13,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.3030,	4.1000,
14,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.9310,	4.8000,
+gp,	5.7940,	5.8410,	6.0370,	6.0060,	5.9640,	5.9100,	5.9230,	6.0270,	5.9060,	6.1760,
0 SOPCOFAC,	.9436,	1.0434,	.9752,	.9231,	.9825,	.8805,	.9255,	1.0095,	1.0485,	1.0364,

Table 2 Catch weights at age (kg)

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
5,	.7020,	.6600,	.6900,	.7500,	.6300,	.6000,	.6200,	.7090,	.7400,	.7600,
6,	.8720,	.8400,	.8400,	1.0400,	.9600,	.8900,	.9200,	1.0030,	.9620,	1.0300,
7,	1.1410,	1.1500,	1.0300,	1.3400,	1.1800,	1.2000,	1.2800,	1.2660,	1.2490,	1.3200,
8,	1.4680,	1.5600,	1.3100,	1.5700,	1.5300,	1.8500,	1.9000,	1.6830,	1.6260,	1.8000,
9,	1.7780,	2.0400,	1.7400,	1.9700,	2.3100,	2.5900,	2.4800,	2.4820,	2.1640,	2.4200,
10,	2.3020,	2.5700,	2.2400,	2.7300,	2.8700,	3.1800,	3.1100,	2.9820,	2.8970,	3.1300,
11,	2.6640,	2.9800,	2.7700,	3.2900,	3.4600,	3.6200,	3.3500,	3.5470,	3.4060,	3.3700,
12,	3.0460,	3.4300,	3.3700,	4.2200,	3.7700,	3.9500,	3.7200,	3.8000,	3.6610,	4.0500,
13,	3.3680,	4.1300,	4.3200,	4.7100,	3.9900,	4.4800,	4.0000,	4.5600,	4.2470,	4.2900,
14,	4.2850,	4.6800,	5.3500,	6.0800,	4.3500,	4.2500,	4.1800,	5.0020,	4.1870,	4.5000,
+gp,	5.3460,	5.9990,	5.8330,	6.1220,	4.5250,	4.8250,	4.5260,	5.9530,	4.4630,	4.7200,
0 SOPCOFAC,	1.0894,	1.0680,	1.0038,	.9783,	1.0009,	.9858,	.9782,	1.0116,	.9973,	1.0346,

Table 2 Catch weights at age (kg)

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	.7100,	.7700,	.6800,	.7900,	.7200,	.7300,	.7700,	.7700,	.7300,	.6900,
6,	1.0600,	1.0500,	.9700,	1.0200,	.9400,	.9400,	.9700,	.9400,	.9300,	.9500,
7,	1.2900,	1.3800,	1.2700,	1.3500,	1.2700,	1.2500,	1.3100,	1.2800,	1.3000,	1.2600,
8,	1.7000,	1.7500,	1.7600,	1.8800,	1.7200,	1.7400,	1.7400,	1.6400,	1.6100,	1.5500,
9,	2.1000,	2.2000,	2.2100,	2.4600,	2.1900,	2.0900,	2.2400,	2.0700,	2.1200,	2.0000,
10,	2.6100,	2.6000,	2.5600,	2.6700,	2.5200,	2.5100,	2.5900,	2.5900,	2.5700,	2.4700,
11,	2.8700,	2.7900,	3.1100,	3.4300,	2.9700,	2.9500,	3.2900,	3.3000,	3.2500,	3.3000,
12,	3.4500,	3.2800,	3.5900,	4.2900,	3.2900,	3.3400,	4.0200,	4.0100,	3.9100,	3.8100,
13,	3.7200,	3.8900,	3.8300,	5.0800,	3.8400,	3.8300,	4.7500,	4.8300,	4.9000,	4.6000,
14,	4.0900,	4.3800,	4.2500,	6.3300,	4.9500,	4.9800,	6.2400,	5.9500,	5.6600,	5.8800,
+gp,	4.5200,	5.2900,	4.8000,	8.9100,	6.6800,	8.1500,	6.0900,	6.2600,	4.9100,	6.6300,
0 SOPCOFAC,	1.0204,	1.0470,	.9519,	1.0634,	1.0037,	1.0036,	1.0011,	1.0022,	1.0012,	1.0074,

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Table 8.10

Run title : Arctic Green.halibut (run: XSAAAG06/X06)

At 28/08/2000 10:17

Table 5 Proportion mature at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,
AGE						
5,	.3600,	.3600,	.3600,	.3600,	.3600,	.3600,
6,	.7200,	.7200,	.7200,	.7200,	.7200,	.7200,
7,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,
8,	.8400,	.8400,	.8400,	.8400,	.8400,	.8400,
9,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,
10,	.9500,	.9500,	.9500,	.9500,	.9500,	.9500,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,
12,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,
13,	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,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
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,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
5,	.3600,	.3600,	.3600,	.3600,	.4500,	.4300,	.3500,	.2100,	.0500,	.0700,
6,	.7200,	.7200,	.7200,	.7200,	.7700,	.7500,	.7200,	.6400,	.6600,	.6200,
7,	.8000,	.8000,	.8000,	.8000,	.7900,	.7900,	.8400,	.7900,	.7800,	.7400,
8,	.8400,	.8400,	.8400,	.8400,	.8300,	.8400,	.8500,	.8300,	.7900,	.7900,
9,	.9000,	.9000,	.9000,	.9000,	.8600,	.8900,	.9300,	.9200,	.9100,	.9000,
10,	.9500,	.9500,	.9500,	.9500,	.9200,	.9400,	.9800,	.9800,	.9700,	.9600,
11,	.9900,	.9900,	.9900,	.9900,	.9900,	.9900,	1.0000,	.9900,	.9900,	.9800,
12,	.9900,	.9900,	.9900,	.9900,	.9800,	.9900,	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,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	.0700,	.1200,	.2800,	.3200,	.3800,	.3800,	.4800,	.5700,	.4600,	.3600,
6,	.6000,	.2800,	.4600,	.4900,	.5200,	.4900,	.6000,	.7600,	.7100,	.6600,
7,	.7000,	.3900,	.5200,	.5700,	.6200,	.5900,	.6300,	.7100,	.7100,	.6900,
8,	.6800,	.4900,	.6100,	.6700,	.6700,	.6500,	.7000,	.7300,	.6700,	.5900,
9,	.8500,	.7100,	.8900,	.8900,	.8600,	.7900,	.7900,	.7500,	.6600,	.6000,
10,	.9000,	.9200,	.9500,	.9000,	.9100,	.9000,	.9400,	.8900,	.8700,	.8400,
11,	1.0000,	1.0000,	.9800,	.9800,	.9800,	1.0000,	.9800,	.9500,	.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 8.11

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Lowestoft VPA Version 3.1

  28/08/2000  10:16

Extended Survivors Analysis

Arctic Green.halibut (run: XSAAAG06/X06)

CPUE data from file fleet

Catch data for  36 years. 1964 to 1999. Ages  5 to  15.

     Fleet,             First, Last, First, Last, Alpha,  Beta
                   ,     year, year,  age ,  age
FLT03: Norwegian G. ,    1994, 1999,   5,    14,   .620,   .670
FLT04: Experimental ,    1992, 1999,   5,    14,   .380,   .440
FLT05: Russian trawl,    1984, 1999,   5,    14,   .750,   .920


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 >=   10


Terminal population estimation :

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

     S.E. of the mean to which the estimates  are shrunk =    .500

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

     Prior weighting not applied


Tuning converged after   45 iterations


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

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

     5,  .173,  .318,  .114,  .099,  .037,  .050,  .063,  .021,  .028,  .048
     6,  .431,  .508,  .170,  .150,  .078,  .072,  .160,  .069,  .088,  .180
     7,  .530,  .849,  .237,  .343,  .243,  .261,  .404,  .194,  .252,  .459
     8,  .415,  .531,  .296,  .394,  .277,  .292,  .340,  .157,  .223,  .309
     9,  .423,  .384,  .133,  .075,  .169,  .203,  .110,  .120,  .116,  .197
    10,  .328, 1.033,  .380,  .593,  .535,  .695,  .550,  .551,  .508,  .735
    11,  .240, 1.201,  .368,  .507,  .512,  .892,  .568,  .357,  .283,  .427
    12,  .548, 1.628,  .740,  .504,  .845, 1.182,  .651,  .680,  .305,  .443
    13,  .091,  .650,  .817,  .365,  .627, 1.273,  .230,  .157,  .120,  .272
    14,  .431, 1.195,  .766,  .464,  .806, 1.035,  .556,  .553,  .384,  .520
```

Table 8.11 (Continued)

XSA population numbers (Thousands)

YEAR	AGE 5	6	7	8	9	10	11	12	13	14
1990	1.45E+04	1.59E+04	1.22E+04	6.13E+03	3.81E+03	1.92E+03	1.33E+03	8.02E+02	5.23E+02	2.95E+02
1991	1.31E+04	1.05E+04	8.88E+03	6.16E+03	3.49E+03	2.15E+03	1.19E+03	9.03E+02	3.99E+02	4.11E+02
1992	1.10E+04	8.22E+03	5.45E+03	3.27E+03	3.12E+03	2.04E+03	6.58E+02	3.09E+02	1.53E+02	1.79E+02
1993	1.30E+04	8.43E+03	5.96E+03	3.70E+03	2.09E+03	2.35E+03	1.20E+03	3.92E+02	1.27E+02	5.80E+01
1994	1.85E+04	1.01E+04	6.25E+03	3.64E+03	2.15E+03	1.67E+03	1.12E+03	6.24E+02	2.04E+02	7.59E+01
1995	1.85E+04	1.54E+04	8.06E+03	4.22E+03	2.38E+03	1.56E+03	8.42E+02	5.77E+02	2.31E+02	9.36E+01
1996	1.84E+04	1.52E+04	1.23E+04	5.34E+03	2.71E+03	1.67E+03	6.72E+02	2.97E+02	1.52E+02	5.56E+01
1997	1.69E+04	1.49E+04	1.11E+04	7.08E+03	3.27E+03	2.09E+03	8.30E+02	3.28E+02	1.33E+02	1.04E+02
1998	1.40E+04	1.42E+04	1.19E+04	7.89E+03	5.21E+03	2.50E+03	1.04E+03	5.00E+02	1.43E+02	9.81E+01
1999	9.45E+03	1.17E+04	1.12E+04	7.99E+03	5.43E+03	3.99E+03	1.29E+03	6.72E+02	3.17E+02	1.09E+02

Estimated population abundance at 1st Jan 2000

	0.00E+00	7.75E+03	8.43E+03	6.10E+03	5.05E+03	3.84E+03	1.65E+03	7.27E+02	3.72E+02	2.08E+02

Taper weighted geometric mean of the VPA populations:

	1.56E+04	1.30E+04	9.30E+03	5.50E+03	3.32E+03	2.21E+03	1.09E+03	5.84E+02	2.69E+02	1.56E+02

Standard error of the weighted Log(VPA populations) :

	.2574	.2561	.2876	.3050	.3185	.2779	.3256	.4823	.6770	.8348

1

Log catchability residuals.

Fleet : FLT03: Norwegian G.

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
5	99.99	99.99	99.99	99.99	.23	.23	.03	-.06	-.27	-.15
6	99.99	99.99	99.99	99.99	.00	-.26	.17	.05	-.21	.25
7	99.99	99.99	99.99	99.99	.15	.20	.04	-.26	-.08	-.04
8	99.99	99.99	99.99	99.99	.32	.27	.25	-.56	-.48	.22
9	99.99	99.99	99.99	99.99	.26	.65	.16	-.31	-.50	-.24
10	99.99	99.99	99.99	99.99	.10	.46	-.01	-.22	-.15	-.16
11	99.99	99.99	99.99	99.99	-.43	.05	-.46	-.67	-.66	-.85
12	99.99	99.99	99.99	99.99	-.82	-.14	-.32	.02	-.16	-.16
13	99.99	99.99	99.99	99.99	-1.08	-.62	-1.02	-1.35	-3.34	-1.00
14	99.99	99.99	99.99	99.99	-.44	-.26	-.08	-.21	-.15	-.17

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

Age	5	6	7	8	9	10	11	12	13	14
Mean Log q	-.1943	.2304	1.0176	.4840	-.6041	1.1202	1.1202	1.1202	1.1202	1.1202
S.E(Log q)	.2020	.2049	.1692	.4080	.4268	.2512	.6376	.4071	1.8317	.2669

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
5	.66	1.821	3.39	.88	6	.11	-.19
6	1.66	-.689	-6.67	.22	6	.36	.23
7	1.71	-1.727	-8.24	.60	6	.24	1.02
8	4.74	-1.676	-34.69	.05	6	1.65	.48
9	8.86	-2.892	-58.34	.03	6	2.39	-.60
10	1.78	-1.586	-8.00	.51	6	.39	1.12
11	2.49	-1.015	-11.74	.11	6	.78	.61
12	1.38	-.689	-3.54	.45	6	.42	.86
13	.40	1.167	3.24	.49	6	.38	-.29
14	1.05	-.203	-1.18	.80	6	.14	.90

Table 8.11 (Continued)

Fleet : FLT04: Experimental

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
5	99.99	99.99	-.30	.31	.05	.15	.43	.54	-.89	-.29
6	99.99	99.99	-.37	-.11	.06	-.23	.58	.04	-.09	.07
7	99.99	99.99	-.52	.00	.03	.09	.30	-.04	.01	.07
8	99.99	99.99	-.17	.19	.19	.21	.18	-.23	-.17	-.18
9	99.99	99.99	-.79	-.75	-.27	.82	.34	.64	.43	-.56
10	99.99	99.99	-.44	.09	.31	.75	-.17	.34	-1.06	.17
11	99.99	99.99	-.19	-.13	-.20	.23	-.67	.22	-1.22	-1.13
12	99.99	99.99	.18	-.16	-.82	.19	-.67	.45	-1.33	.16
13	99.99	99.99	-.34	.06	-.71	-.16	99.99	.22	99.99	-1.29
14	99.99	99.99	-1.21	-.21	-.34	.24	-.13	-.06	99.99	-.12

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

Age	5	6	7	8	9	10	11	12	13	14
Mean Log q	-4.5089	-3.9389	-3.2373	-3.7134	-5.1912	-3.5989	-3.5989	-3.5989	-3.5989	-3.5989
S.E(Log q)	.4792	.2804	.2248	.2039	.6484	.5617	.7126	.6864	.7018	.5184

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
5	.52	1.405	6.95	.60	8	.23	-4.51
6	.68	1.186	5.70	.70	8	.18	-3.94
7	.71	1.822	4.91	.88	8	.14	-3.24
8	1.52	-1.866	1.22	.70	8	.26	-3.71
9	.95	.074	5.34	.27	8	.67	-5.19
10	1.91	-.646	-.09	.08	8	1.12	-3.60
11	4.22	-.876	-5.17	.01	8	2.46	-3.99
12	1.42	-.380	2.91	.12	8	.96	-3.85
13	-2.87	-3.219	8.80	.16	6	.94	-3.97
14	2.69	-1.492	2.76	.14	7	1.08	-3.85

1

Fleet : FLT05: Russian trawl

Age	1984	1985	1986	1987	1988	1989
5	-.42	.27	.22	-.27	-.67	.00
6	.30	.62	.21	-.49	-.42	.07
7	.12	.59	.03	-.75	-.40	-.28
8	-.05	.00	-.61	-.95	-.75	-.60
9	.16	.16	-.17	-.77	-.44	-.38
10	.76	.45	.26	-.20	.03	-.36
11	.42	.10	-.45	-.55	-.27	-1.20
12	-.23	.01	-.58	-.90	-.80	-.98
13	-.88	-1.24	-.70	-1.64	-1.74	-1.44
14	-1.07	-2.44	-2.07	99.99	-.64	-1.47

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
5	.62	1.29	1.57	.47	-.24	-.77	-.60	-1.06	-.21	-.06
6	-.14	.67	.79	.49	.13	-.25	-.14	-.63	-.32	-.28
7	-.41	.46	.56	.52	.03	.07	.12	-.27	-.23	-.17
8	-.90	.02	.54	.50	.14	.40	.35	.13	.15	.11
9	-.72	-.45	-.41	.16	.22	.40	.85	.05	.33	.16
10	-.37	.15	-.30	.13	.42	.34	-.93	-.06	.31	.19
11	-1.41	.26	.52	.00	-.32	.14	-.52	.10	.62	-.07
12	-1.08	-.63	.51	.56	.11	.23	-.63	-.27	.18	-.28
13	-2.26	-1.03	-.28	-.04	-.20	-.09	-.23	.70	.54	.06
14	-1.88	-2.39	99.99	.90	.94	-1.42	-.11	-.13	.04	-.09

Table 8.11 (Continued)

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

Age	5	6	7	8	9	10	11	12	13	14
Mean Log q	-.2364	.6076	.9136	.9722	.5091	.2630	.2630	.2630	.2630	.2630
S.E(Log q)	.7736	.4485	.3733	.4880	.4593	.4068	.5948	.5988	.9998	1.3028

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
5	-1.46	-2.145	23.37	.07	16	.98	-.24
6	-5.50	-2.911	64.90	.02	16	1.90	.61
7	8.70	-2.968	-78.24	.01	16	2.48	.91
8	2.98	-1.423	-19.93	.05	16	1.39	.97
9	1.40	-.620	-3.94	.20	16	.66	.51
10	.65	1.178	2.49	.54	16	.26	.26
11	1.97	-.856	-6.97	.07	16	1.14	.12
12	2.22	-1.702	-7.80	.16	16	1.11	.02
13	-11.94	-4.580	69.69	.01	16	6.17	-.21
14	-32.97	-3.772	158.29	.00	14	24.24	-.34

Terminal year survivor and F summaries :

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

Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT03: Norwegian G.	6680.	.300	.000	.00	1	.537	.056
FLT04: Experimental	5818.	.509	.000	.00	1	.186	.063
FLT05: Russian trawl	7295.	.806	.000	.00	1	.074	.051
F shrinkage mean	15265.	.50				.203	.025

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7748.	.22	.22	4	1.013	.048

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

Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT03: Norwegian G.	8400.	.212	.261	1.23	2	.460	.181
FLT04: Experimental	7102.	.259	.416	1.61	2	.312	.211
FLT05: Russian trawl	6488.	.404	.032	.08	2	.128	.229
F shrinkage mean	20309.	.50				.101	.079

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
8429.	.15	.18	7	1.225	.180

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

Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLT03: Norwegian G.	5511.	.174	.056	.32	3	.419	.497
FLT04: Experimental	6542.	.196	.145	.74	3	.332	.434
FLT05: Russian trawl	4436.	.280	.192	.69	3	.164	.588
F shrinkage mean	14171.	.50				.085	.224

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6101.	.12	.11	10	.986	.459

Table 8.11 (Continued)

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

 Year class = 1991

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT03: Norwegian G. ,      5230.,   .163,       .058,    .36,   4,  .373,     .299
 FLT04: Experimental ,      4968.,   .166,       .096,    .58,   4,  .387,     .313
 FLT05: Russian trawl,      3895.,   .248,       .165,    .67,   4,  .170,     .384

   F shrinkage mean  ,      8698.,    .50,,,,                        .069,     .191

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      5051.,       .10,      .07,   13,    .695,   .309


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

 Year class = 1990

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT03: Norwegian G. ,      3498.,   .157,       .132,    .84,   5,  .376,     .215
 FLT04: Experimental ,      3968.,   .163,       .168,   1.03,   5,  .355,     .192
 FLT05: Russian trawl,      3601.,   .224,       .125,    .56,   5,  .203,     .209

   F shrinkage mean  ,      6701.,    .50,,,,                        .065,     .118

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      3839.,       .10,      .08,   16,    .840,   .197


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

 Year class = 1989

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT03: Norwegian G. ,      1387.,   .145,       .110,    .76,   6,  .399,     .828
 FLT04: Experimental ,      1645.,   .161,       .114,    .70,   6,  .293,     .736
 FLT05: Russian trawl,      1879.,   .204,       .079,    .39,   6,  .213,     .668

   F shrinkage mean  ,      2539.,    .50,,,,                        .096,     .533

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1648.,       .10,      .07,   19,    .697,   .735


 Age 11   Catchability constant w.r.t. time and age (fixed at the value for age) 10

 Year class = 1988

 Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
 FLT03: Norwegian G. ,       641.,   .163,       .139,    .85,   6,  .355,     .472
 FLT04: Experimental ,       656.,   .167,       .224,   1.34,   7,  .289,     .463
 FLT05: Russian trawl,       841.,   .206,       .066,    .32,   7,  .243,     .378

   F shrinkage mean  ,      1021.,    .50,,,,                        .113,     .321

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       727.,       .11,      .09,   21,    .826,   .427
```

Table 8.11 (Continued)

```
Age 12   Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1987

Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT03: Norwegian G. ,       333.,   .185,       .111,    .60,   6,  .351,     .484
FLT04: Experimental ,       364.,   .178,       .162,    .91,   8,  .273,     .450
FLT05: Russian trawl,       478.,   .210,       .167,    .79,   8,  .249,     .360

  F shrinkage mean  ,       323.,    .50,,,,                        .127,     .496

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      372.,       .12,      .08,   23,    .699,   .443


Age 13   Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1986

Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT03: Norwegian G. ,       196.,   .215,       .162,    .75,   6,  .305,     .287
FLT04: Experimental ,       143.,   .212,       .260,   1.23,   8,  .283,     .375
FLT05: Russian trawl,       218.,   .227,       .182,    .80,   9,  .259,     .261

  F shrinkage mean  ,       435.,    .50,,,,                        .153,     .139

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      208.,       .13,      .13,   24,    .987,   .272


1
Age 14   Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1985

Fleet,                Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FLT03: Norwegian G. ,        49.,   .222,       .194,    .87,   6,  .469,     .575
FLT04: Experimental ,        53.,   .309,       .144,    .47,   7,  .187,     .537
FLT05: Russian trawl,        61.,   .288,       .133,    .46,  10,  .148,     .482

  F shrinkage mean  ,        74.,    .50,,,,                        .197,     .417

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       56.,       .16,      .08,   24,    .527,   .520
```

Table 8.12

Run title : Arctic Green.halibut (run: XSAAAG06/X06)

At 28/08/2000 10:17

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,
AGE						
5,	.0094,	.0053,	.0032,	.0024,	.0019,	.0207,
6,	.0484,	.0255,	.0138,	.0072,	.0051,	.0484,
7,	.1146,	.0699,	.0397,	.0180,	.0116,	.0691,
8,	.2531,	.2160,	.1411,	.0892,	.0694,	.2082,
9,	.4566,	.2848,	.3476,	.2356,	.2381,	.2333,
10,	.7003,	.7255,	.2583,	.3382,	.3302,	.4350,
11,	.6375,	.7606,	.5421,	.2684,	.5685,	.4572,
12,	.5666,	.8215,	.8585,	.8373,	.1802,	.3906,
13,	.4065,	.3910,	.4515,	1.0093,	.2946,	.0686,
14,	.5568,	.6004,	.4944,	.5409,	.3237,	.3183,
+gp,	.5568,	.6004,	.4944,	.5409,	.3237,	.3183,
0 FBAR 6–10,	.3146,	.2643,	.1601,	.1376,	.1309,	.1988,

Table 8 Fishing mortality (F) at age

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
5,	.0139,	.0027,	.0363,	.0074,	.0380,	.0412,	.0417,	.0991,	.1050,	.1310,
6,	.0660,	.1492,	.1512,	.0443,	.1081,	.1216,	.1908,	.2159,	.2398,	.2408,
7,	.2865,	.4474,	.5114,	.2374,	.3454,	.4205,	.4692,	.4215,	.4371,	.2734,
8,	.6558,	.6024,	.4035,	.3338,	.3633,	.3829,	.6271,	.3588,	.4200,	.2118,
9,	.5605,	.4394,	.2446,	.2598,	.2748,	.3572,	.5024,	.3947,	.3564,	.1358,
10,	.5341,	.4741,	.2001,	.2518,	.3044,	.4025,	.3528,	.3272,	.4011,	.1111,
11,	.4458,	.4039,	.2513,	.2587,	.3302,	.5030,	.3835,	.4888,	.4787,	.1977,
12,	.4363,	.5629,	.3065,	.3194,	.3551,	.5629,	.6846,	.7116,	.3596,	.2053,
13,	.5467,	.7566,	.4417,	.2768,	.3351,	.5367,	.5092,	.8226,	.6738,	.1258,
14,	.5075,	.5305,	.2900,	.2744,	.3213,	.4750,	.4892,	.5523,	.4563,	.1555,
+gp,	.5075,	.5305,	.2900,	.2744,	.3213,	.4750,	.4892,	.5523,	.4563,	.1555,
0 FBAR 6–10,	.4206,	.4225,	.3022,	.2254,	.2792,	.3369,	.4284,	.3436,	.3709,	.1946,

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
5,	.0451,	.1237,	.0780,	.0919,	.0570,	.0684,	.0952,	.0696,	.0435,	.1147,
6,	.0871,	.1516,	.1285,	.1447,	.3119,	.2407,	.2549,	.2311,	.1931,	.2924,
7,	.1827,	.1965,	.1353,	.2198,	.3931,	.3489,	.3544,	.4482,	.3845,	.4401,
8,	.1981,	.1398,	.1729,	.3593,	.3554,	.2991,	.3425,	.3829,	.4870,	.3388,
9,	.2353,	.0963,	.3271,	.3156,	.2661,	.2859,	.3498,	.2654,	.4572,	.3265,
10,	.1760,	.1582,	.3644,	.4617,	.4222,	.4235,	.5016,	.4419,	.5173,	.1999,
11,	.2468,	.2586,	.4658,	.3418,	.4067,	.3779,	.3756,	.3213,	.4701,	.2341,
12,	.2691,	.2768,	.4419,	.5133,	.2559,	.4332,	.4733,	.2254,	.4790,	.2017,
13,	.3061,	.6953,	.3798,	.3822,	.3189,	.1749,	.7874,	.3587,	.2150,	.3198,
14,	.2476,	.2982,	.3977,	.4049,	.3411,	.3657,	.5458,	.3274,	.4737,	.3472,
+gp,	.2476,	.2982,	.3977,	.4049,	.3411,	.3657,	.5458,	.3274,	.4737,	.3472,
0 FBAR 6–10,	.1758,	.1485,	.2257,	.3002,	.3498,	.3196,	.3606,	.3539,	.4078,	.3195,

Table 8 Fishing mortality (F) at age

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	FBAR 97–99
AGE											
5,	.1727,	.3176,	.1140,	.0994,	.0374,	.0504,	.0625,	.0213,	.0280,	.0480,	.0324,
6,	.4314,	.5077,	.1705,	.1497,	.0784,	.0721,	.1601,	.0691,	.0883,	.1804,	.1126,
7,	.5299,	.8495,	.2373,	.3433,	.2433,	.2614,	.4039,	.1941,	.2518,	.4588,	.3016,
8,	.4148,	.5308,	.2964,	.3937,	.2768,	.2918,	.3396,	.1569,	.2231,	.3086,	.2295,
9,	.4235,	.3838,	.1328,	.0749,	.1689,	.2029,	.1100,	.1195,	.1155,	.1974,	.1441,
10,	.3278,	1.0335,	.3803,	.5931,	.5349,	.6946,	.5495,	.5515,	.5084,	.7347,	.5982,
11,	.2401,	1.2005,	.3682,	.5071,	.5124,	.8916,	.5680,	.3568,	.2830,	.4269,	.3556,
12,	.5481,	1.6276,	.7398,	.5044,	.8449,	1.1824,	.6515,	.6803,	.3053,	.4426,	.4761,
13,	.0905,	.6502,	.8166,	.3645,	.6270,	1.2725,	.2300,	.1572,	.1202,	.2718,	.1831,
14,	.4312,	1.1948,	.7660,	.4643,	.8065,	1.0348,	.5561,	.5529,	.3838,	.5200,	.4856,
+gp,	.4312,	1.1948,	.7660,	.4643,	.8065,	1.0348,	.5561,	.5529,	.3838,	.5200,	
FBAR 6–10,	.4255,	.6610,	.2435,	.3109,	.2605,	.3046,	.3126,	.2182,	.2374,	.3760,	

Table 8.13

Run title : Arctic Green.halibut (run: XSAAAG06/X06)

At 28/08/2000 10:17

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	1969
AGE						
5	42837	51677	57817	70427	64263	55918
6	33791	36525	44244	49606	60472	55206
7	27960	27711	30646	37559	42388	51786
8	27351	21460	22241	25351	31749	36064
9	14559	18277	14882	16624	19959	25493
10	8521	7937	11832	9048	11306	13539
11	4237	3641	3307	7866	5553	6994
12	2537	1928	1465	1655	5176	2707
13	1175	1239	730	534	617	3720
14	634	673	721	400	168	395
+gp	190	118	77	49	27	118
0 TOTAL	163791	171187	187962	219119	241678	251943

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

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AGE										
5	41095	31503	33503	31021	26542	22407	21891	23275	20506	19469
6	47142	34883	27041	27807	26503	21994	18507	18072	18143	15890
7	45271	37985	25862	20008	22898	20474	16763	13163	12535	12286
8	41597	29257	20901	13349	13581	13952	11574	9024	7433	6968
9	25207	18582	13787	12017	8228	8129	8189	5321	5426	4203
10	17377	12387	10306	9292	7976	5381	4895	4265	3086	3270
11	7542	8768	6636	7262	6217	5063	3097	2961	2646	1779
12	3811	4157	5039	4443	4826	3846	2635	1816	1563	1411
13	1577	2120	2038	3192	2778	2912	1886	1144	767	939
14	2990	785	856	1128	2083	1710	1466	975	432	337
+gp	755	372	341	564	843	1042	990	454	327	381
0 TOTAL	234364	180799	146309	130080	122476	106912	91891	80469	72865	66933

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AGE										
5	17855	17561	18736	18945	17810	19879	19841	19424	22974	20696
6	14700	14690	13356	14916	14874	14480	15979	15526	15594	18933
7	10750	11596	10865	10109	11109	9372	9797	10659	10607	11066
8	8045	7707	8201	8168	6984	6454	5690	5916	5860	6215
9	4853	5680	5768	5938	4909	4213	4119	3477	3472	3099
10	3158	3301	4440	3580	3727	3238	2725	2498	2295	1892
11	2519	2280	2426	2654	1942	2103	1825	1420	1382	1178
12	1256	1694	1515	1310	1623	1113	1241	1079	886	744
13	989	826	1105	838	675	1082	621	665	741	473
14	713	627	355	651	492	422	782	243	400	514
+gp	382	258	150	206	263	221	608	27	133	102
0 TOTAL	65219	66220	66916	67315	64408	62575	63226	60936	64346	64912

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

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	GMST	AMST
							64–97		64–97				
AGE													
5	14539	13118	10981	12989	18541	18548	18386	16893	14014	9445	0	24190	27408
6	15884	10529	8218	8432	10122	15373	15179	14866	14234	11729	7748	20006	23161
7	12164	8881	5454	5965	6248	8055	12311	11132	11941	11216	8429	15085	18277
8	6133	6163	3269	3703	3642	4217	5339	7076	7891	7990	6101	9936	12960
9	3812	3487	3120	2092	2150	2377	2711	3272	5206	5434	5051	6357	8454
10	1925	2148	2045	2351	1671	1563	1670	2090	2499	3992	3839	4244	5492
11	1333	1194	658	1203	1118	842	672	830	1036	1294	1648	2487	3269
12	802	903	309	392	624	577	297	328	500	672	727	1439	1933
13	523	399	153	127	204	231	152	133	143	317	372	765	1097
14	295	411	179	58	76	94	56	104	98	109	208	437	654
+gp	135	787	112	12	6	13	3	3	50	11	61		
TOTAL	57545	48020	34497	37324	44402	51889	56775	56726	57612	52207	34184		

Table 8.14

Run title : Arctic Green.halibut (run: XSAAAG06/X06)

At 28/08/2000 10:17

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,
AGE						
5,	17991,	21704,	24283,	29579,	26991,	23486,
6,	21626,	23376,	28316,	32244,	39912,	35332,
7,	25164,	24940,	27888,	34930,	40693,	47126,
8,	32822,	26181,	27579,	32196,	41591,	45081,
9,	23731,	30341,	25300,	28428,	34728,	41809,
10,	19258,	17701,	26268,	19906,	24759,	30463,
11,	13178,	10923,	9724,	22339,	15493,	20912,
12,	9488,	6728,	4965,	5463,	16512,	9826,
13,	5368,	5452,	3196,	2281,	2634,	17412,
14,	3175,	3306,	3491,	1951,	838,	2127,
+gp,	1131,	697,	452,	282,	163,	707,
0 TOTALBIO,	172930,	171348,	181462,	209599,	244313,	274280,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
5,	23301,	17862,	18996,	17589,	15049,	12705,	12412,	13197,	11627,	17522,
6,	34744,	25708,	19929,	20494,	19533,	16210,	13640,	13319,	13371,	19068,
7,	48848,	40986,	27905,	21588,	24707,	22092,	18087,	14202,	13525,	18429,
8,	59109,	41575,	29700,	18968,	19299,	19826,	16446,	12824,	10562,	12543,
9,	46583,	34339,	25478,	22207,	15206,	15022,	15132,	9833,	10027,	9247,
10,	39637,	28255,	23509,	21195,	18193,	12273,	11166,	9728,	7039,	8502,
11,	21775,	25312,	19159,	20966,	17949,	14618,	8940,	8548,	7640,	5336,
12,	12374,	13497,	16360,	14426,	15669,	12489,	8557,	5898,	5076,	4940,
13,	6784,	9124,	8768,	13735,	11955,	12531,	8114,	4922,	3302,	3850,
14,	14742,	3873,	4223,	5560,	10272,	8434,	7227,	4810,	2133,	1616,
+gp,	4377,	2171,	2059,	3385,	5029,	6157,	5867,	2734,	1933,	2350,
0 TOTALBIO,	312274,	242702,	196086,	180111,	172860,	152357,	125586,	100014,	86235,	103403,

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
5,	12534,	11590,	12928,	14208,	11220,	11927,	12302,	13772,	17001,	15729,
6,	12818,	12340,	11219,	15513,	14279,	12887,	14700,	15573,	15002,	19501,
7,	12265,	13336,	11191,	13547,	13109,	11246,	12540,	13494,	13248,	14607,
8,	11810,	12024,	10743,	12824,	10685,	11940,	10811,	9957,	9529,	11187,
9,	8628,	11588,	10037,	11697,	11339,	10912,	10214,	8631,	7514,	7501,
10,	7271,	8484,	9945,	9773,	10697,	10296,	8473,	7450,	6649,	5922,
11,	6710,	6793,	6719,	8733,	6719,	7614,	6113,	5037,	4708,	3969,
12,	3826,	5809,	5105,	5529,	6119,	4396,	4615,	4099,	3245,	3011,
13,	3332,	3412,	4775,	3948,	2693,	4846,	2484,	3033,	3147,	2027,
14,	3054,	2934,	1898,	3956,	2142,	1795,	3267,	1217,	1675,	2315,
+gp,	2041,	1547,	876,	1261,	1192,	1064,	2751,	160,	595,	483,
0 TOTALBIO,	84290,	89856,	85436,	100989,	90195,	88922,	88271,	82423,	82313,	86252,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	10322,	10101,	7467,	10261,	13349,	13540,	14157,	13007,	10230,	6517,
6,	16837,	11056,	7972,	8601,	9515,	14451,	14724,	13974,	13237,	11142,
7,	15692,	12256,	6927,	8052,	7936,	10069,	16128,	14249,	15523,	14132,
8,	10427,	10786,	5753,	6962,	6264,	7337,	9289,	11604,	12705,	12384,
9,	8005,	7671,	6895,	5146,	4708,	4968,	6072,	6773,	11037,	10868,
10,	5023,	5586,	5234,	6278,	4210,	3923,	4325,	5413,	6422,	9860,
11,	3827,	3330,	2046,	4127,	3322,	2485,	2210,	2738,	3368,	4269,
12,	2767,	2961,	1110,	1681,	2052,	1926,	1195,	1314,	1954,	2561,
13,	1946,	1552,	584,	645,	782,	883,	723,	644,	700,	1458,
14,	1208,	1801,	762,	367,	376,	466,	347,	619,	555,	641,
+gp,	608,	4163,	536,	103,	39,	108,	15,	16,	248,	70,
0 TOTALBIO,	76663,	71262,	45286,	52223,	52552,	60154,	69185,	70352,	75979,	73902,

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Table 8.15

Run title : Arctic Green.halibut (run: XSAAAG06/X06)

At 28/08/2000 10:17

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1964,	1965,	1966,	1967,	1968,	1969,
AGE						
5,	6477,	7814,	8742,	10649,	9717,	8455,
6,	15571,	16831,	20388,	23216,	28736,	25439,
7,	20131,	19952,	22310,	27944,	32554,	37700,
8,	27570,	21992,	23166,	27044,	34937,	37868,
9,	21357,	27307,	22770,	25585,	31255,	37628,
10,	18295,	16815,	24954,	18911,	23521,	28940,
11,	13046,	10813,	9626,	22115,	15338,	20703,
12,	9393,	6661,	4916,	5408,	16347,	9728,
13,	5368,	5452,	3196,	2281,	2634,	17412,
14,	3175,	3306,	3491,	1951,	838,	2127,
+gp,	1131,	697,	452,	282,	163,	707,
0 TOTSPBIO,	141513,	137640,	144012,	165386,	196040,	226707,

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

YEAR,	1970,	1971,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,
AGE										
5,	8388,	6430,	6839,	6332,	5418,	4574,	4468,	4751,	4186,	6308,
6,	25015,	18510,	14349,	14756,	14064,	11671,	9821,	9590,	9627,	13729,
7,	39078,	32789,	22324,	17271,	19765,	17673,	14469,	11362,	10820,	14743,
8,	49651,	34923,	24948,	15933,	16211,	16654,	13815,	10772,	8872,	10536,
9,	41925,	30905,	22930,	19986,	13685,	13520,	13619,	8850,	9024,	8322,
10,	37655,	26842,	22334,	20135,	17284,	11659,	10608,	9241,	6687,	8077,
11,	21557,	25059,	18967,	20756,	17770,	14472,	8851,	8463,	7564,	5282,
12,	12250,	13362,	16197,	14281,	15512,	12364,	8471,	5839,	5025,	4890,
13,	6784,	9124,	8768,	13735,	11955,	12531,	8114,	4922,	3302,	3850,
14,	14742,	3873,	4223,	5560,	10272,	8434,	7227,	4810,	2133,	1616,
+gp,	4377,	2171,	2059,	3385,	5029,	6157,	5867,	2734,	1933,	2350,
0 TOTSPBIO,	261424,	203988,	163937,	152130,	146963,	129710,	105328,	81332,	69173,	79704,

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

YEAR,	1980,	1981,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,
AGE										
5,	4512,	4172,	4654,	5115,	5049,	5129,	4306,	2892,	850,	1101,
6,	9229,	8884,	8078,	11169,	10995,	9665,	10584,	9967,	9901,	12090,
7,	9812,	10669,	8953,	10837,	10356,	8884,	10533,	10660,	10333,	10809,
8,	9920,	10100,	9024,	10772,	8869,	10029,	9190,	8264,	7528,	8838,
9,	7765,	10429,	9033,	10528,	9751,	9712,	9499,	7940,	6837,	6751,
10,	6907,	8059,	9448,	9284,	9842,	9678,	8304,	7301,	6450,	5685,
11,	6643,	6726,	6652,	8646,	6652,	7538,	6113,	4987,	4661,	3889,
12,	3788,	5751,	5054,	5474,	5997,	4352,	4615,	4099,	3245,	3011,
13,	3332,	3412,	4775,	3948,	2693,	4846,	2484,	3033,	3147,	2027,
14,	3054,	2934,	1898,	3956,	2142,	1795,	3267,	1217,	1675,	2315,
+gp,	2041,	1547,	876,	1261,	1192,	1064,	2751,	160,	595,	483,
0 TOTSPBIO,	67004,	72684,	68445,	80990,	73537,	72691,	71646,	60521,	55223,	57000,

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

YEAR,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,
AGE										
5,	723,	1212,	2091,	3284,	5073,	5145,	6796,	7414,	4706,	2346,
6,	10102,	3096,	3667,	4215,	4948,	7081,	8834,	10620,	9398,	7354,
7,	10984,	4780,	3602,	4590,	4920,	5941,	10160,	10117,	11021,	9751,
8,	7090,	5285,	3509,	4664,	4197,	4769,	6502,	8471,	8512,	7307,
9,	6805,	5446,	6137,	4580,	4049,	3924,	4797,	5080,	7284,	6521,
10,	4521,	5139,	4972,	5650,	3831,	3531,	4066,	4818,	5587,	8282,
11,	3827,	3330,	2005,	4044,	3255,	2485,	2165,	2601,	3200,	4056,
12,	2767,	2961,	1110,	1681,	2052,	1926,	1195,	1314,	1954,	2561,
13,	1946,	1552,	584,	645,	782,	883,	723,	644,	700,	1458,
14,	1208,	1801,	762,	367,	376,	466,	347,	619,	555,	641,
+gp,	608,	4163,	536,	103,	39,	108,	15,	16,	248,	70,
0 TOTSPBIO,	50581,	38765,	28976,	33822,	33521,	36258,	45601,	51714,	53166,	50346,

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Table 8.16

Run title : Arctic Green.halibut (run: XSAAAG06/X06) ,

At 28/08/2000 10:17

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 5	TOTALBIO,	TOTSPBIO,	SSB 10+	LANDINGS,	YIELD/SSB,	FBAR 6–10,
1964,	42837,	172930,	141513,	50408,	40391,	.2854,	.3146,
1965,	51677,	171348,	137640,	43744,	34751,	.2525,	.2643,
1966,	57817,	181462,	144012,	46635,	26321,	.1828,	.1601,
1967,	70427,	209599,	165386,	50948,	24267,	.1467,	.1376,
1968,	64263,	244313,	196040,	58841,	26168,	.1335,	.1309,
1969,	55918,	274280,	226707,	79617,	43789,	.1932,	.1988,
1970,	41095,	312274,	261424,	97365,	89484,	.3423,	.4206,
1971,	31503,	242702,	203988,	80431,	79034,	.3874,	.4225,
1972,	33503,	196086,	163937,	72548,	43055,	.2626,	.3022,
1973,	31021,	180111,	152130,	77852,	29938,	.1968,	.2254,
1974,	26542,	172860,	146963,	77822,	37763,	.2570,	.2792,
1975,	22407,	152357,	129710,	65617,	38172,	.2943,	.3369,
1976,	21891,	125586,	105328,	49138,	36074,	.3425,	.4284,
1977,	23275,	100014,	81332,	36009,	28827,	.3544,	.3436,
1978,	20506,	86235,	69173,	26644,	24617,	.3559,	.3709,
1979,	19469,	103403,	79704,	26065,	17312,	.2172,	.1946,
1980,	17855,	84290,	67004,	25765,	13284,	.1983,	.1758,
1981,	17561,	89856,	72684,	28429,	15018,	.2066,	.1485,
1982,	18736,	85436,	68445,	28703,	16789,	.2453,	.2257,
1983,	18945,	100989,	80990,	32569,	22147,	.2735,	.3002,
1984,	17810,	90195,	73537,	28518,	21883,	.2976,	.3498,
1985,	19879,	88922,	72691,	29273,	19945,	.2744,	.3196,
1986,	19841,	88271,	71646,	27534,	22875,	.3193,	.3606,
1987,	19424,	82423,	60521,	20797,	19112,	.3158,	.3539,
1988,	22974,	82313,	55223,	19773,	19587,	.3547,	.4078,
1989,	20696,	86252,	57000,	17410,	20138,	.3533,	.3195,
1990,	14539,	76663,	50581,	14877,	23183,	.4583,	.4255,
1991,	13118,	71262,	38765,	18946,	33320,	.8595,	.6610,
1992,	10981,	45286,	28976,	9969,	8602,	.2969,	.2435,
1993,	12989,	52223,	33822,	12490,	12462,	.3685,	.3109,
1994,	18541,	52552,	33521,	10335,	9318,	.2780,	.2605,
1995,	18548,	60154,	36258,	9399,	11665,	.3217,	.3046,
1996,	18386,	69185,	45601,	8511,	14269,	.3129,	.3126,
1997,	16893,	70352,	51714,	10012,	9574,	.1851,	.2182,
1998,	14014,	75979,	53166,	12244,	11927,	.2243,	.2374,
1999,	9445,	73902,	50346,	17068,	19389,	.3851,	.3760,
Arith.12385.1 Mean ,	26537,	123668,	97430,	26790,	.2982,	.3012,	
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),			

1

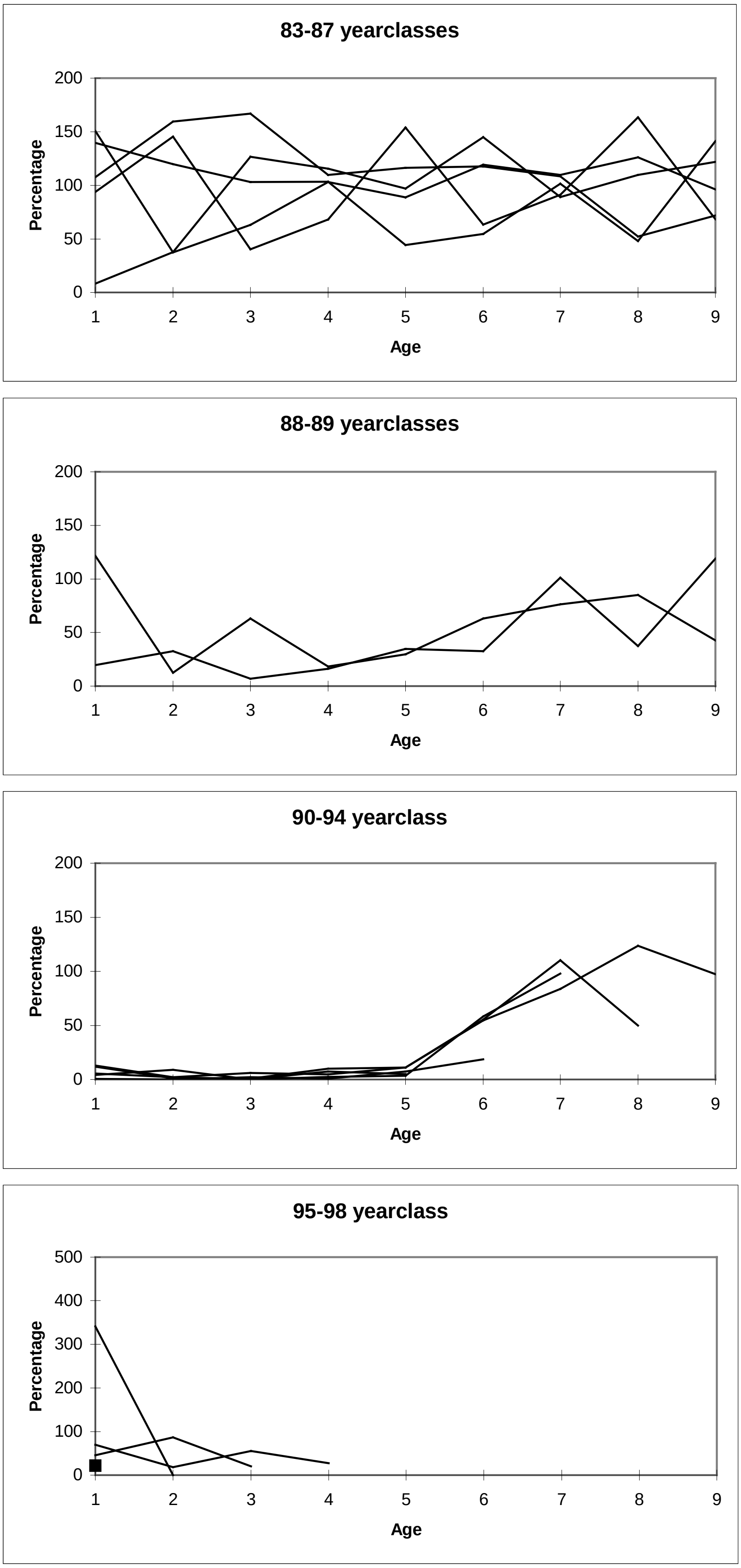

Figure 8.1. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Norwegian bottom-trawl survey in the Svalbard area (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 yearclsasses.

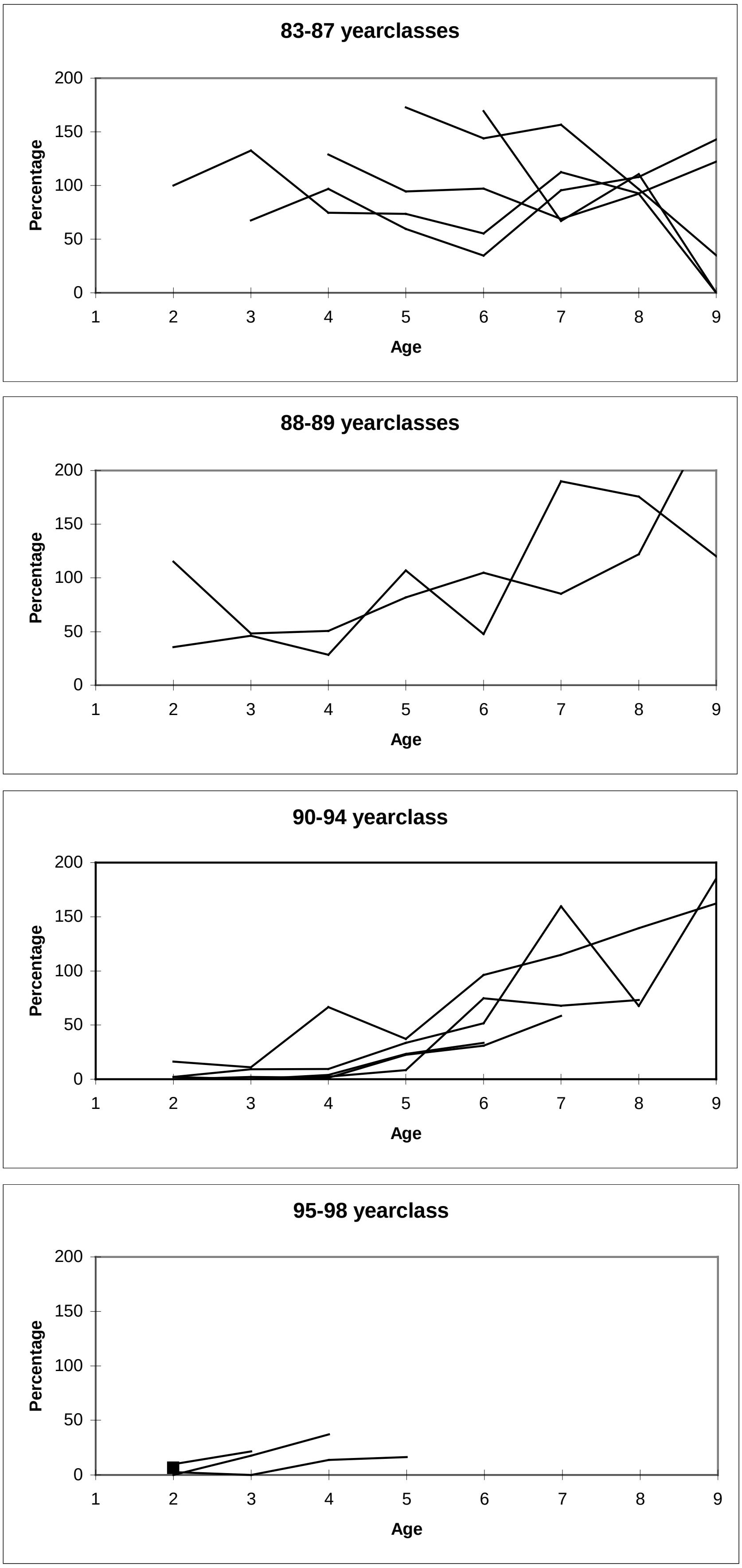

Figure 8.2. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Norwegian bottom-trawl survey in the Barents Sea (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 yearclsasses.

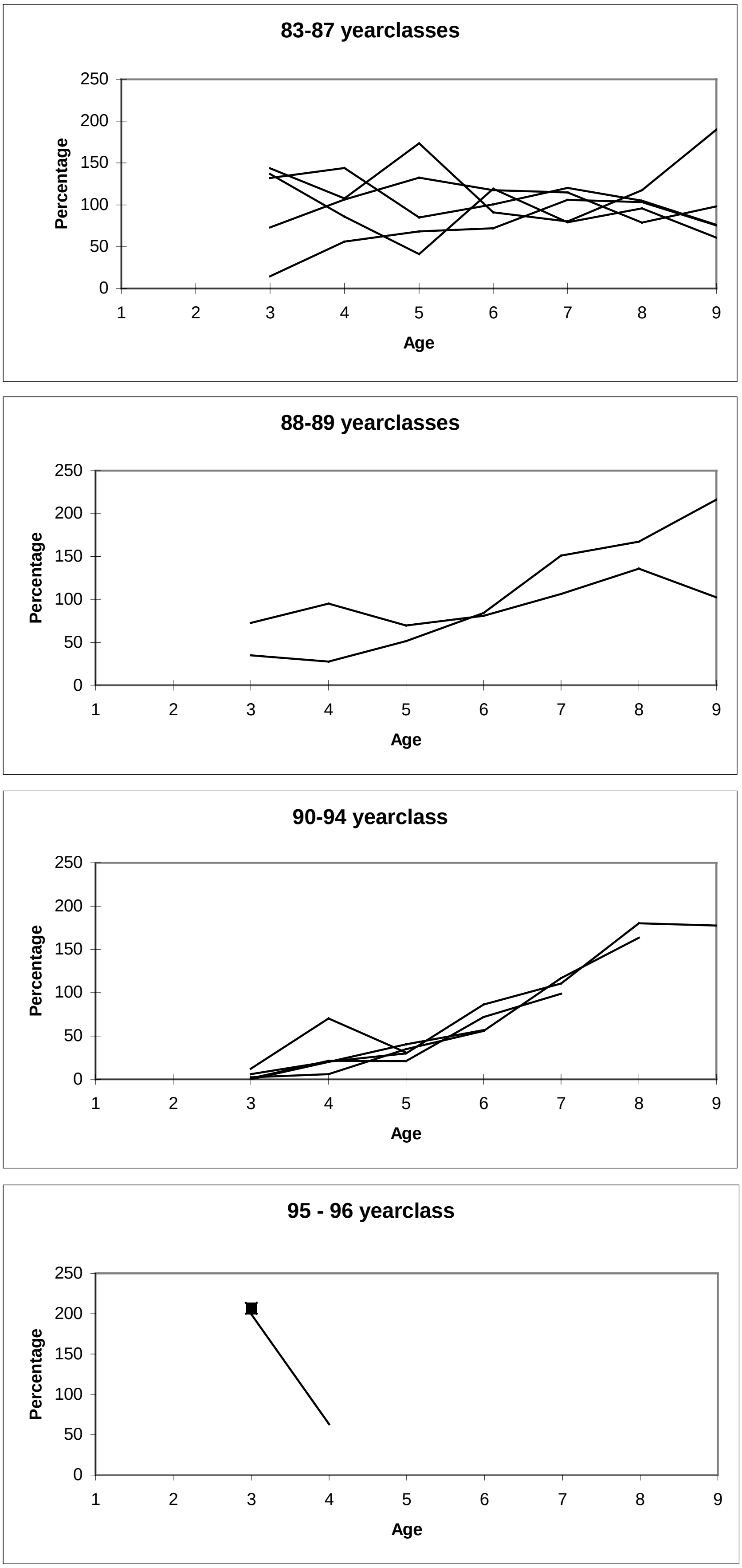

Figure 8.3. GREENLAND HALIBUT in Sub-area I and II:
Relative abundance at age for each yearclass from Russian bottom-trawl survey in the Barents Sea (one line for each yearclass). Values as percentage of mean abundance at age for the 1983-87 yearclsasses.

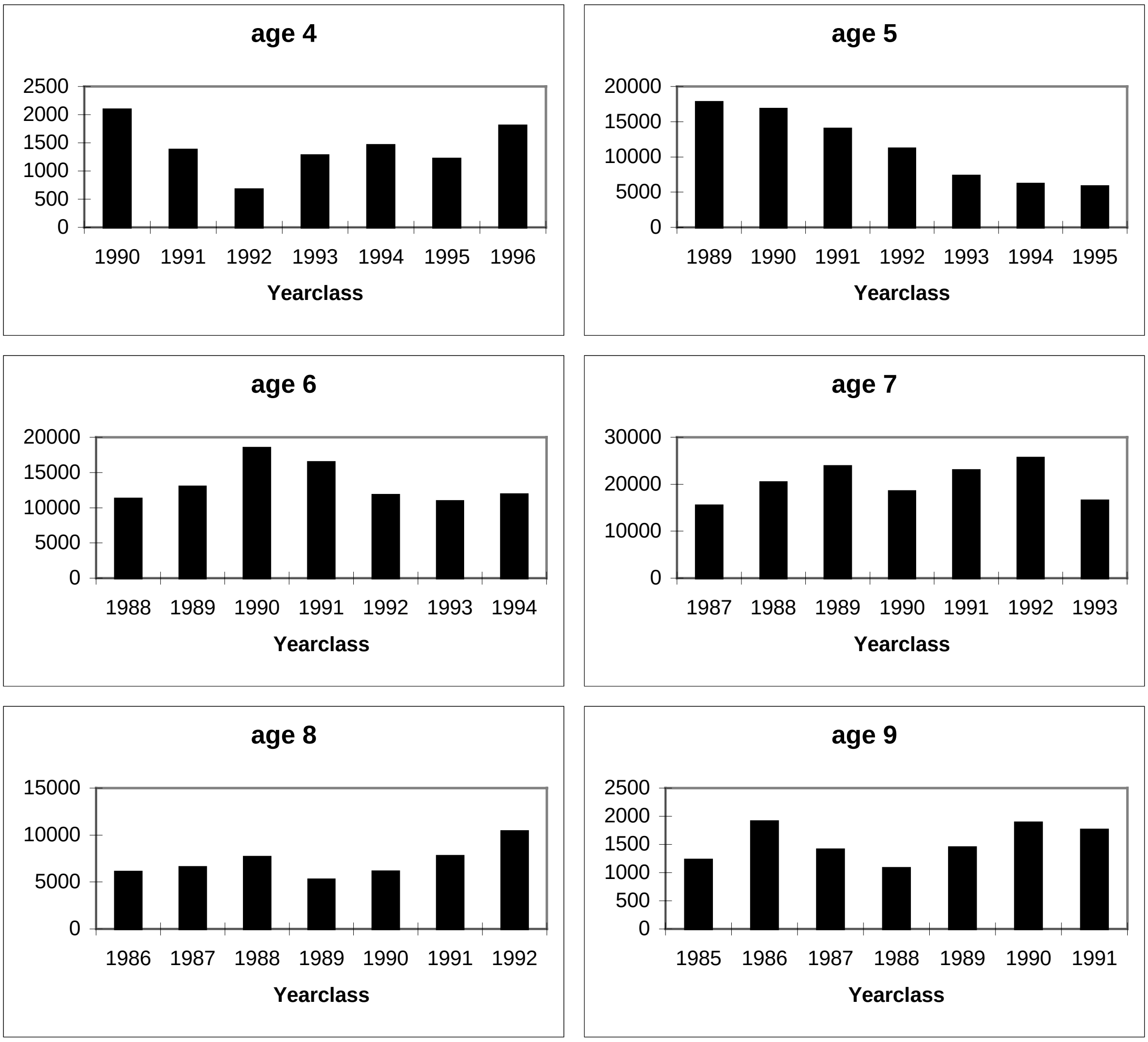

Figure 8.4. GREENLAND HALIBUT in Sub-area I and II:
Abundance at age from the Norwegian stratified Greenland halibut survey. Data for consecutive yearclasses at selected ages. The last bar in each figure is based on preliminary data from 2000.

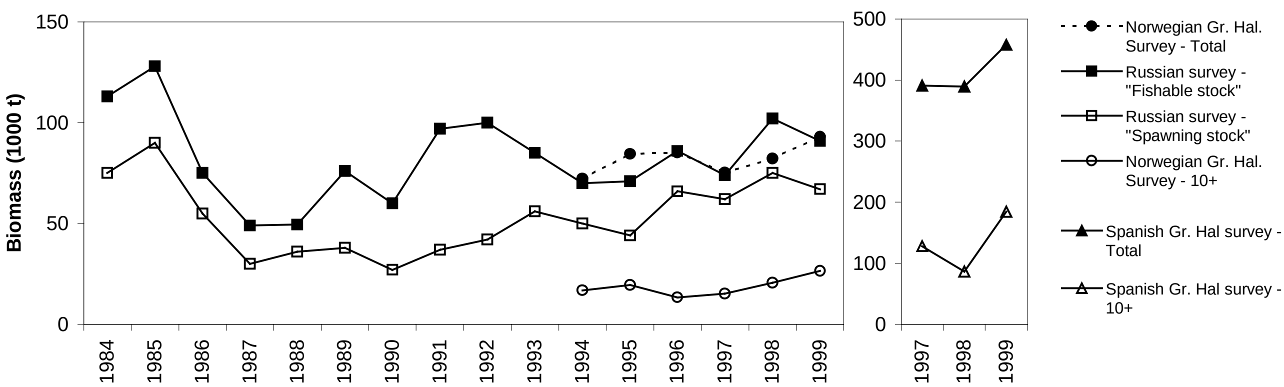

Figure 8.5. Biomass estimates of North-east Arctic Greenland halibut (*Reinhardtius hippoglossoides*) based on swept area calculations from Russian, Norwegian and Spanish surveys along the continental slope

Fleet 3. Greenland halibut survey

Fleet 4. Experimental CPUE

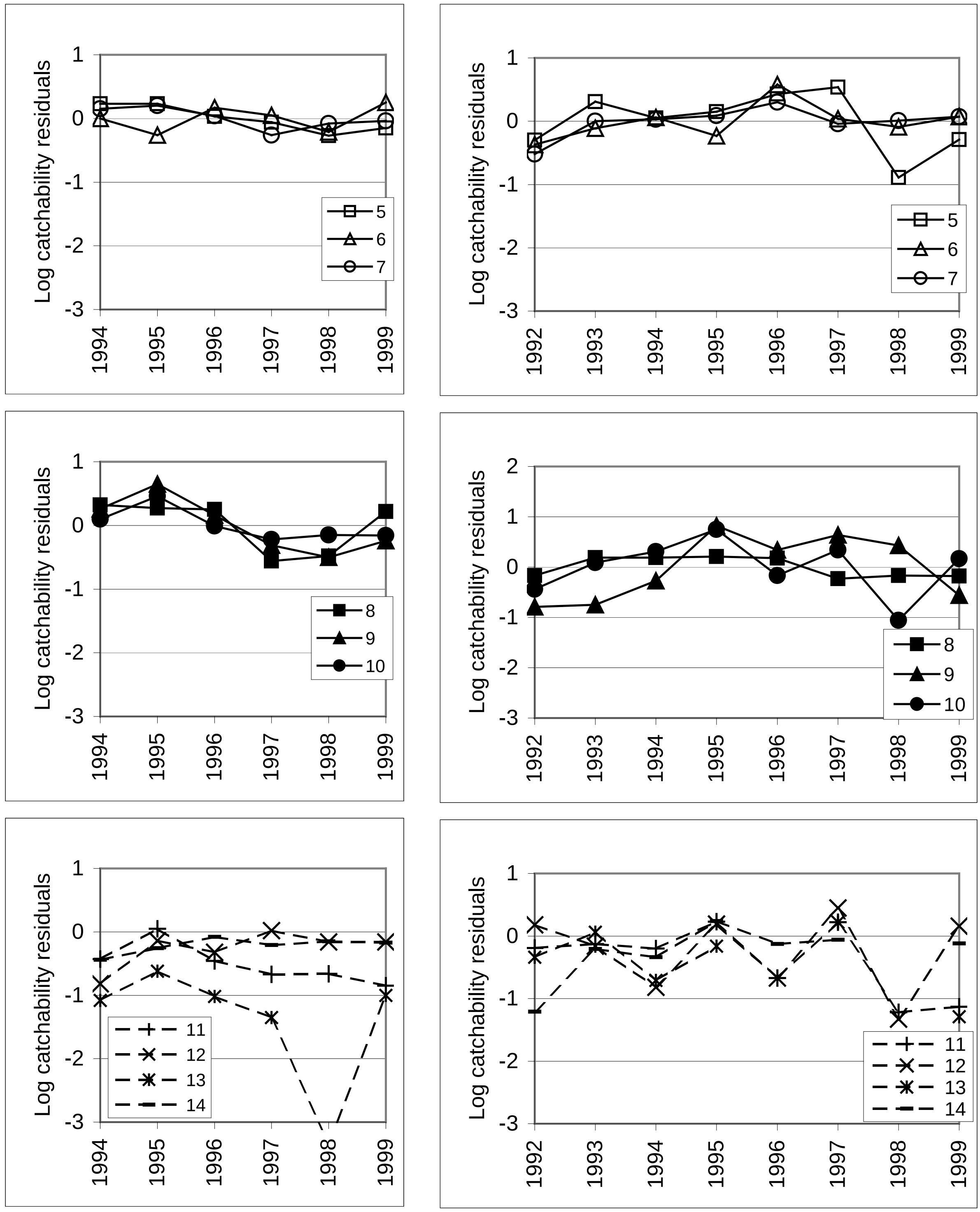

Figure 8.6. Log catchability residuals by age and year for tuning fleet 3 and 4.

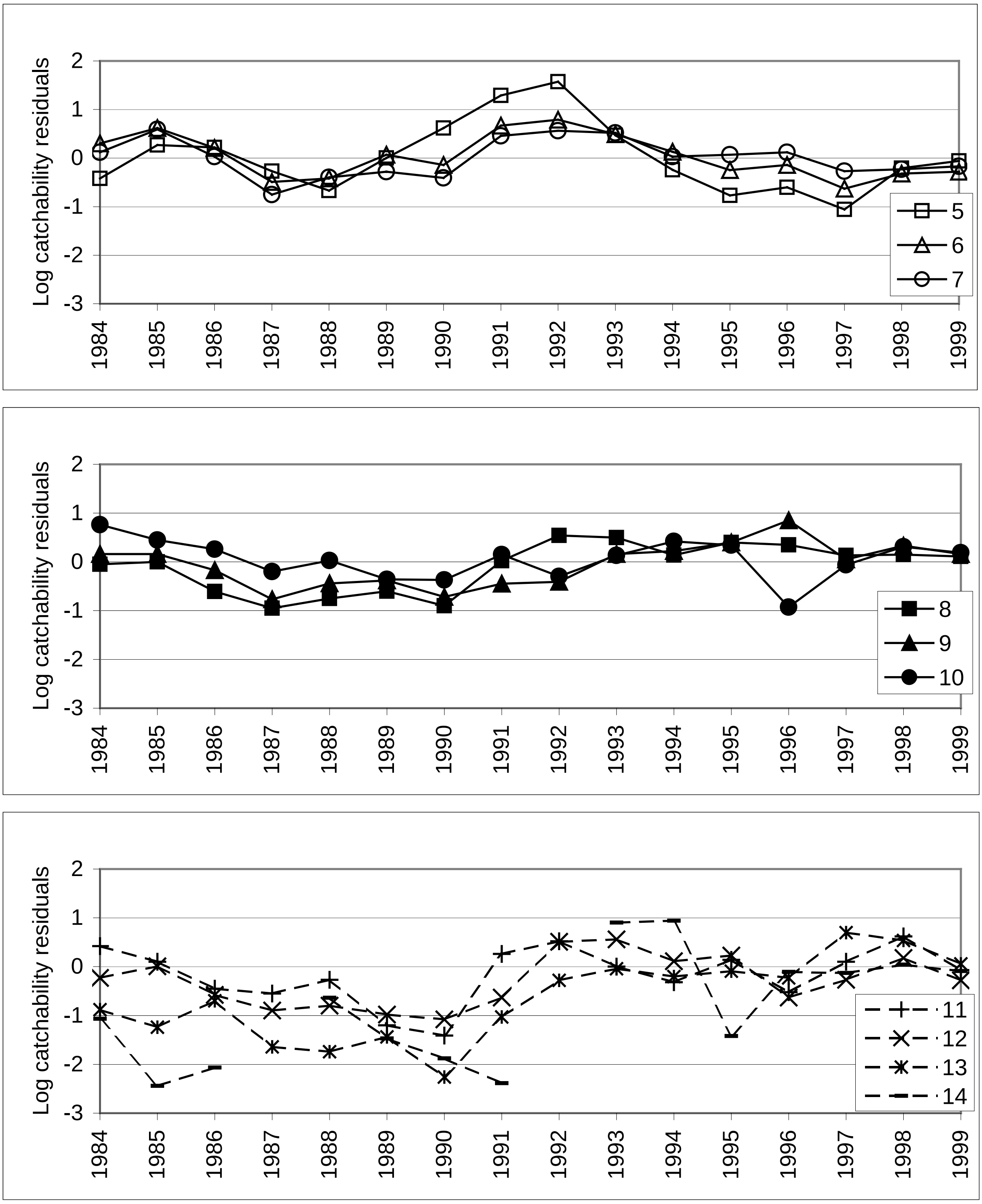

Figure 8.7. Log catchability residuals by age and year for tuning fleet 5.

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 <20 cm [2]	Age									Total
		1	2	3	4	5	6	7	8	9+	
1981	2.1	No age data									20 100
1982	0.7										2 600
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	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	40 318
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]	0.1	76	+	+	322	886	1 200	1 950	487	497	5 418
1996 [1]	0.4	410	61	104	171	881	2 052	2 587	862	976	8 104
1997 [1]	0.4	268	484	21	65	284	2 089	2 143	379	295	6 028
1998 [1]	2.5	1 999	2 351	2 715	493	609	2 192	2 814	1 252	822	15 247
1999 [1]	1.3	126	+	995	1 789	415	709	2 501	507	674	7 716

[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	1 078	788	1 056	2 284	3 655	2 655	864	971	210	-	19	76	56	13 712
1990	66	907	2 071	1 716	1 996	2 262	1 046	365	175	-	30	119	165	10 918
1991	-	279	755	1 323	1 257	1 526	2 440	906	450	457	-	55	127	9 575
1992	63	128	719	897	1 554	543	1 069	791	-	648	135	40	53	6 640
1993	-	17	168	502	1 730	868	1 490	758	88	655	382	31	35	6 724
1994	-	16	142	1 178	2 259	1 644	1 750	885	-	506	38	25	-	8 443
1995	-	-	-	168	786	749	1 331	760	359	486	60	199	-	4 898
1996	1 816	-	28	40	709	1 510	2 964	1 000	307	808	154	152	45	9 533
1997	-	21	-	21	176	812	1 788	1 440	653	209	94	73	-	5 287
1998	-	-	-	67	474	1 172	2 491	1 144	302	401	89	19	4	6 163
1999	-	77	276	243	495	485	1 058	555	408	152	75	56	-	3 880
2000	-	40	56	396	719	519	1 187	261	290	531	131	23	55	4 208

B

Year	Age													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13+	
1993	-	17	279	1 002	3 129	2 818	3 895	1 632	309	1 406	616	31	35	15 169
1994	-	16	152	1 482	3 768	2 698	3 420	1 615	-	1 171	135	25	-	14 482
1995	-	-	-	216	2 824	6 229	10 624	2 727	1 250	1 902	172	718	57	26 719
1996	3 149	-	28	102	1 547	3 043	4 991	1 599	472	1 211	317	250	72	16 781
1997 [1]	-	163	-	203	624	2 742	5 759	4 170	1 653	562	240	181	66	16 363
1998 [1]	220	501	2 797	1 011	1 847	3 477	6 539	3 057	867	1 179	301	96	57	21 949
1999	41	195	691	825	829	1 531	3 130	1 496	1 011	500	115	129	101	10 594
2000	169	482	947	5 425	2 575	1 310	3 035	553	796	1 109	284	27	55	16 767

[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	4 124	5 359	7 788	24 951	19 863	11 499	6 750	5 416	2 420	1 196	247	146	143	89 902
1985	3 331	4 371	17 076	35 648	27 826	11 717	5 722	4 090	1 937	895	311	31	131	113 086
1986	2 687	6 600	15 853	25 696	16 468	5 436	3 811	2 660	974	539	184	72	6	80 986
1987	289	6 761	9 724	12 703	7 633	3 867	1 903	1 627	721	416	110	0	38	45 792
1988	2 591	4 409	7 891	14 181	11 311	4 308	2 253	1 756	820	307	125	163	54	50 169
1989	1 429	11 310	13 124	25 881	12 782	5 989	2 381	1 285	334	271	98	102	118	75 104
1990	2 820	8 360	16 252	15 621	11 393	4 120	1 911	1 158	307	198	58	36	0	62 234
1991 [1]	1 422	8 455	25 408	21 843	15 235	9 419	2 369	1 211	655	142	95	16	26	86 296
1992	685	7 461	33 341	25 498	17 272	10 178	2 720	1 262	938	318	67	0	0	99 740
1993	114	2 166	13 317	19 752	16 528	10 305	3 370	1 868	903	519	103	111	111	69 167
1994	49	1 604	9 868	17 549	11 533	7 746	3 401	1 876	605	394	114	114	57	54 910
1995	19	467	5 759	18 222	15 296	11 539	4 393	1 413	529	312	84	11	32	58 076
1996 [2]	0	1 670	6 680	18 722	21 714	13 354	8 512	476	284	106	115	36	20	71 689
1997	235	1 575	4 023	12 165	15 919	16 452	4 591	1 432	779	162	271	66	88	57 758
1998	3 917	5 542	7 768	15 589	16 842	17 727	9 676	2 548	1 752	535	254	85	72	82 307
1999	4 057	4 961	5 951	12 350	14 255	16 078	7 952	3 009	965	494	307	74	-	70 453

[1] Age composition based on combined age-length-keys for 1990 and 1992.

[2] 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 1998-1999. Numbers in thousands.

A: Only western area for the years 1988-97; **B**: Including areas east of Bear Island for the years 1992-98.

A

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]	1 267	67	162	250	882	741	753	63	5	4 190
1997 [3]	111	116	58	45	77	798	321	104	115	1 745

B

Year	Age									Total
	1	2	3	4	5	6	7	8	9+	
1992 [3]	182	144	1 275	2 142	5 273	6 591	3 399	3 392	2 331	24 729
1993 [3]	104	216	732	970	2 607	1 834	3 498	1 757	1 495	13 211
1994 [3]	+	+	233	158	271	2 134	2 417	1 739	3 075	10 026
1995 [3]	69	77	237	658	2 671	2 157	3 790	1 500	2 057	13 216
1996 [3]	924	63	212	309	1 548	3 448	5 360	1 709	1 826	15 401
1997 [3]	7 109	1 110	252	254	749	5 168	5 949	938	1 220	22 750
1998 [3]	3 131	2 280	2 462	1 501	1 508	3 100	3 243	1 495	1 349	20 068
1999 [3]	1 981	1 923	3 198	3 787	2 295	2 720	6 789	1 200	1 898	25 790

[1] The length distribution was split on age according to Macdonald and Pitcher (1979).

[2] An age-length key from the bottom trawl survey for cod at Svalbard in September 1989 was used to convert the indices from length to age.

[3] An age-length key from the bottom trawl survey for cod at Svalbard in August-September the same year was used to convert the indices from length to age.

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 400-1500 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	1	2 001	16 980	11 008	15 552	6 173	1 241	3 628	1 460	443	129	81	11	58 708
1995	0	0	0	1 432	16 945	12 946	20 925	6 737	1 975	4 393	1 385	648	152	103	21	67 662
1996	0	0	10	704	13 623	18 538	24 908	8 114	1 473	3 223	820	396	131	100	2	72 042
1997	0	0	16	1 446	11 738	17 005	18 927	5 383	1 107	3 261	936	600	87	165	16	60 687
1998	0	0	66	1 726	7 868	12 399	23 487	6 243	1 458	4 317	1 238	969	13	183	14	59 981
1999	0	0	27	1 300	5 901	15 383	20 209	12 019	1 872	5 913	1 167	1 198	273	183	15	65 460
2000 [1]	0	0	24	1 804	5 793	11 885	16 455	10 391	1 758	5 079	898	892	184	138	14	55 315

[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).

A: Survey area, Russian EEZ excluded **B:** Including Russian EEZ

A Year	Age						Total
	1	2	3	4	5	6+	
1996	15 655	14 510	10 025	3 487	1 593	3 349	48 619
1997	3 415	15 356	14 097	2 746	417	434	36 465
1998	8 817	19 017	9 443	5 268	1 191	961	44 697
1999	8 232	11 541	9 321	7 354	2 479	1 293	40 220

B Year	Age						Total
	1	2	3	4	5	6+	
1998	10 548	28 316	17 357	6 512	1 584	961	65 278
1999	10 377	18 627	14 038	8 150	3 389	1 293	55 874

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	2000*
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	1.2
5	19.1	25.0	24.7	22.5	19.5	24.8	6.6	7.7	10.8
6	23.0	18.4	23.8	22.6	31.6	22.9	25.5	23.0	17.1
7	25.9	27.1	26.8	30.2	35.6	30.5	44.5	39.6	43.0
8	13.3	12.4	11.2	11.0	8.7	10.1	15.5	14.5	12.3
9	1.7	0.7	1.0	2.7	1.3	2.6	4.5	1.6	4.5
10	6.8	7.4	5.9	6.6	2.0	5.0	2.0	9.7	8.5
11	2.9	3.1	2.4	2.0	0.5	1.9	0.8	1.0	0.9
12	1.7	1.0	0.6	1.1	0.2	0.8	0.3	1.8	1.1
13	0.5	0.4	0.2	0.3	0.0	0.3		0.2	0.6
14	0.2	0.2	0.1	0.2	0.1	0.2		0.2	0.0
15	0.1					0.0		0.0	0.0

Mean individual weight (kg)									
Age	1992	1993	1994	1995	1996	1997	1998	1999	2000*
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	0.5
5	0.71	0.76	0.73	0.70	0.74	0.69	0.76	0.74	0.69
6	0.96	0.98	0.95	0.94	0.94	0.88	0.96	0.92	0.98
7	1.29	1.33	1.28	1.24	1.23	1.15	1.19	1.25	1.23
8	1.77	1.85	1.79	1.71	1.66	1.55	1.79	1.64	1.57
9	2.00	2.28	2.23	2.03	2.00	1.87	2.26	2.18	1.9
10	2.46	2.65	2.55	2.50	2.50	2.34	2.54	2.38	2.4
11	3.10	3.43	3.37	3.28	3.16	2.95	3.47	3.17	3.13
12	3.86	4.32	4.22	3.71	3.70	3.46	4.16	3.79	4.04
13	4.44	5.18	5.01	4.62		4.52		5.07	4.47
14	6.00	6.44	6.29	5.59		5.47		5.60	6.00
15	5.22								8.79

CPUE (N) on age									
	1992	1993	1994	1995	1996	1997	1998	1999*	2000*
1									
2									
3	0			1	0	0	0	0	0
4	19	30	26	7	7	11	2	7	14
5	80	176	198	219	286	298	59	72	132
6	97	130	191	220	463	275	229	214	208
7	109	191	215	294	521	366	400	369	524
8	56	87	90	107	127	121	139	135	150
9	7	5	8	26	19	31	40	15	55
10	29	52	47	64	29	60	18	90	104
11	12	22	19	19	7	23	7	9	11
12	7	7	5	11	3	10	3	17	13
13	2	3	2	3	0	4	0	2	7
14	1	1	1	2	1	2	0	2	0
15	0			0	0	0	0	0	0

CPUE (kg) on age									
	1992	1993	1994	1995	1996	1997	1998	1999*	2000*
1									
2									
3	0			0	0	0	0	0	0
4	10	16	13	3	4	5	1	3	7
5	57	134	145	153	211	207	45	53	91
6	93	127	182	207	435	243	220	197	204
7	140	254	276	364	641	423	476	461	645
8	99	162	161	183	211	189	249	221	236
9	14	11	18	53	38	59	91	32	105
10	70	138	121	161	73	141	46	215	250
11	38	75	65	64	23	68	25	30	33
12	28	30	20	40	11	33	11	64	53
13	9	15	8	13	0	16	0	9	32
14	5	9	5	11	0	13		10	2
15	2			0	0	0			3

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Overall mean individual weight (kg)	1.35	1.38	1.27	1.29	1.12	1.16	1.30	1.39	1.35
CPUE (kg round weight per trawlhour)**	567	973	1020	1255	1640	1393	1169	1294	1647
CPUE (Number fish per trawlhour)**	420	705	803	973	1464	1201	899	931	1220
Catch (in tonnes)	695	862	811	368	436	274	272	269	295

*) 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	Ireland	Norway	Russia	UK England & Wales	UK Scotland	Total
1973	-	-	-	4	-	9	8	28	-	49
1974	-	-	-	2	-	2	-	30	-	34
1975	-	-	-	1	-	4	-	12	-	17
1976	-	-	-	1	-	2	-	18	-	21
1977	-	-	-	2	-	2	-	8	-	12
1978	-	-	2	30	-	-	-	1	-	33
1979	-	-	2	16	-	2	-	1	-	21
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	-	239
1990	-	10	30 [1]	3	-	29	-	4	-	77
1991	-	48	291 [1]	1	-	216	-	2	-	559
1992	1	15	416 [1]	3	-	626	-	+	1	1 063
1993	1	-	78 [1]	1	-	858	-	10	+	949
1994	+	103	84 [1]	4	-	724	-	6	-	922
1995	+	706	165	2	-	460	-	52	283	1 668
1996	+	-	249	1	-	1 496	-	105	159	2 010
1997	+	-	316	3	-	1 028 [1]	-	1	162	1 511
1998	+	-	71	10	10	804 [1]	-	35	435	1 366
1999 [1]	+			1		2 174 [1]		43	358	2 577

[1] Provisional figures

9 SHRIMP (*PANDALUS BOREALIS*) (SUB-AREAS I AND II)

9.1 Status of the Fisheries

9.1.1 Historical development of the fisheries (Table 9.1, Figure 9.1–9.2)

Norwegian vessels began to exploit the shrimp fisheries in the Barents Sea and Svalbard area in 1970. Russian vessels entered the shrimp fishery in 1974. The catches increased continuously (Table 9.1 and Figure 9.1) until 1984 when the total catch reached a maximum of 128,000 t. By that time vessels from other countries had entered the fishery. As a result of biomass declines, catches decreased until 1987 when 43,000 t were taken. Since then, biomass and catch levels have fluctuated. Catches peaked at 81,000 t in 1990, then declined to below 1987 levels during 1994–1996. Decreased catches were especially dramatic for the Russian fleet. Annual catches have since recovered, reaching 53,000 t in 1998 and 69,000 t in 1999. The Norwegian annual catch by statistical grid area in 1995–1998 is presented in Figure 9.2.

9.1.2 Regulation

In the Svalbard area the shrimp fisheries are regulated by number of effective fishing days and number of vessels by country. In the Barents Sea and Svalbard area, Norwegian rules stipulate that the fisheries are to be regulated by smallest allowable shrimp size (maximum 10% of catch weight may be < 15 mm carapace length, CL) and by provisions of the fishing licences. The Russian Economic Zone TAC is established each year by Russian authorities.

Fishing grounds are closed if bycatch limits for cod, haddock, redfish or Greenland halibut are exceeded.

9.1.3 Landings (Table 9.1, Figure 9.1)

Final reported landings for all countries show a doubling of catches between 1996 (33,000 t) and 1999 (69,000 t) (Table 9.1 and Figure 9.1). Preliminary results indicate that during the first six months of 2000 there were slight decreases in Norwegian catches, while Russian catches have increased. According to 1999 catch patterns, it is forecast that Norwegian vessels will catch 47,000 t in 2000 compared to 53,000 t in 1999.

9.2 Status of Research

9.2.1 Surveys

In the Barents Sea and the Svalbard area, standard shrimp surveys have been conducted by Norway since 1982 and by Russia since 1984. However, during the 90's, both surveys have suffered from reductions in survey time. The Russian vessels have not surveyed the Svalbard area for many years. The amount of time available for the Norwegian survey has been reduced from 50 days to 27 days.

Detailed information pertaining to the status of the stock is described in 1981–1991 Norwegian reports (Tavares and Øynes 1980, Teigsmark and Øynes 1981, 1983a, 1983b, Hylen *et al.* 1984, Tveranger and Øynes 1985, Hylen and Øynes 1986, Hylen *et al.* 1987, Hylen and Øynes 1988, Hylen *et al.* 1989, Hylen and Ågotnes 1990) and Russian reports (Berenboim *et al.* 1986, Berenboim *et al.* 1989, Berenboim *et al.* 1990, Mukhin and Sheveleva 1991). Annual joint Norwegian-Russian papers have been produced since 1991 (Berenboim *et al.* 1992, Aschan *et al.* 1993,1994,1995, 1996). Since 1997 the status of the stock has been summarised in annual protocols (Anon 1997, 1998, 1999). Additionally evaluations of the Norwegian surveys have been conducted (Aschan and Sunnanå 1997, Harbitz *et al.* 1998).

9.2.2 Fishing effort and CPUE (Table 9.2, Figure 9.3)

Catch, effort, and annual CPUE series for Norway and Russia are presented in Table 9.2 and Figure 9.3. Data from Russia and Norway show an increase in effort, but a decrease in CPUE from 1998 to 1999.

Catch increases from 1994–1999 encouraged Norwegian ship owners to investment in larger vessels and new technology. During 1996 only three vessels used double trawls; in 1998, 12 vessels used this technology, and now more than 20 vessels are using double or triple trawls. Due to improved technology, the Norwegian catch per hour (CPUE) has increased at a rate that exceeds the rate at which shrimp biomass is increasing (Figure 9.3). The CPUE of the Russian fleet has increased in accordance with the shrimp biomass (Berenboim *et al.* 2000). It should be noted that the Russian fleet is also under development.

9.2.3 Survey results (Tables 9.3–9.4, Figure 9.3–9.4)

In general, there is good agreement between the Norwegian and Russian survey results. Biomass indices were highest during 1984, and have since fluctuated between 30% and 60% of this level (Tables 9.3 and 9.4 and Figure 9.3).

Norwegian bottom trawl surveys indicate that shrimp biomasses in the Barents Sea and Svalbard area have decreased since 1998 while the Russian indices show decreases since 1999 (Tables 9.3–9.4 and Figure 9.3). The main survey areas are shown in Figure 9.4. Decreases were evident in the East Finnmark, the Hopen area, the Storfjord trench, and the Spitsbergen area, as well as along the Kola coast. Reductions in biomass may be explained by the fact that the 1996 year class is very weak according to Norwegian surveys, and cod consumed many individuals of this year class during 1997 (Aschan *et al.* 2000). The Goose Bank is the only area to show an increase in biomass in 2000.

9.2.4 Population structure

Genetic investigations have been conducted by Kartavtsev *et al.* (1991) on *Pandalus borealis* in the Barents Sea and the Bering Sea. Researchers in Tromsø conducted both allozyme electrophoresis and DNA-fingerprinting in an attempt to identify potential sub-populations of shrimp in the Northeast-Atlantic including the Jan Mayen area, the Norwegian coast, the Barents Sea, and the Svalbard area (Rasmussen *et al*. 1993, Drengstig *et al.* 2000, Martinez *et al*. 1997). These analyses showed that there are no distinct sub-populations in the open sea, and that there is a high degree of genetic variance between individuals within each location. However, genetic gradients related to geographic distance and sea currents have been identified.

There may be mother populations responsible for the recruitment to other areas, as is claimed by Russian scientists (Lysy 1981, 1983). Knowledge pertaining to the presence of such mother populations is of great importance when managing the shrimp resources. Current models have been developed for dispersal of particles (e.g., plankton) in the sea. Data on larval hatching, development, and behaviour of shrimp larvae have been obtained from field and laboratory experiments and will be used as input data for particle tracking and biological models (Ådlandsvik and Sundby 1994, Hanssen and Ådlandsvik 1996). Preliminary results will be available in spring 2001.

9.2.5 Age-reading

The Norwegian and Russian scientists agreed upon the procedures for obtaining shrimp biological data in 1993 (Aschan *et al*. 1993). In order to obtain good length frequency distributions for age analyses, oblique carapace lengths (CL) (from the posterior margin of eyestalk to the posterior mid-dorsal edge) of approximately 300 individuals from each trawl station are measured to the nearest 0.01 mm with an electronic calliper (Mitutoyo, Japan). The data are saved in the database in intervals of 0.1 mm.

Shrimp ageing is completed by modal analysis using MIX 3.0 (MacDonald and Pitcher 1979). Annual age determinations have been conducted for 15 areas in the Barents Sea and 7 areas in the Svalbard area since 1991 (Aschan in press, Hansen and Aschan in press).

9.2.6 Maturity-at-age

The biological development of shrimp is divided into several stages. Shrimp starts off as males (Stage 2) after the juvenile stage (Stage 1). Thereafter they reach intersex (Stage 3) before they develop into females with headroe (Stage 4). When the females mate, the roe is moved under the abdomen (Stage 5) where it stays until hatched (Stage 6). Some females then take a resting period (Stage 7), but others start on a new cycle with headroe (Stage 8). The Russian and the Norwegian coding of the stages are given in Aschan *et al.* (1993).

The life history of shrimp varies geographically, from the south to the north, as well as over time (Berenboim 1982, Teigsmark 1983, Hansen and Aschan in press). Nilssen and Hopkins (1991) show that, although significant latitudinal trends are present, the effects of specific environmental conditions (e.g., warm or cold current systems at a given latitude, seasonal production cycles, and more recent trends toward increased fishing effort on previously unexploited stocks at high latitudes) are important factors modifying “latitudinal life cycle strategies” of this species.

Analyses of data from the 90’s suggest that shrimp in the southern Barents Sea grew quickly and changed sex at an age of four years, whereas shrimp in the central and northern Barents Sea grew slowly and changed sex at an age of 5 years or greater (Aschan in press). In the Svalbard area, shrimp were between 6 and 10 years at sex change (Hansen and Aschan in press). The life strategy has changed over time. In the 80’s, when the water was cold, the shrimp in the Barents Sea grew slowly and changed sex later than in the 90’s when the water was warmer (Teigsmark 1983, Grimsmo

1993). These large variations in life history cause problems when applying traditional fishery models based on time series.

9.2.7 Recruitment

Since the growth performance of shrimp varies in time and space, it is difficult to decide on a good recruitment index. It may be reasonable to use an age-length key constructed from the Hopen area to define the number of recruits of 1, 2, and 3 year old shrimp in the whole area (Aschan *et al.* 2000). Russian scientists have used an age-length key from the Kola Coast when producing the number of shrimp in age groups (Berenboim 2000 WD 28, Dolgov 2000 WD 27). A common procedure for dividing the shrimp into age groups requires further data analysis and discussions.

Since very few shrimp < 15 mm CL are caught in the trawl, it is suggested that a mesh bag (Aschan and Sunnanå 1997, Nilssen *et al.* 1986) be attached to the underbelly of the survey trawl when sampling young shrimp (5–15 mm CL).

9.2.8 Natural mortality and predation

Predation by cod is the main source of natural mortality. However, it should be noted that other demersal fish species such as Greenland halibut, long rough dab (*Hippoglossoides platessoides*), and thorny skate (*Raja radiata*) also prey on shrimp (Dolgov 1997, Dolgova and Dolgov 1997).

The methods used in estimating cod consumption are described by Bogstad and Mehl (1997), and dos Santos and Jobling (1995). In the Barents Sea, the annual consumption of shrimp was estimated to be over 300,000 t throughout the period 1994–1998 (ICES 2000). Shrimp consumption rates may have been over estimated (Aschan 2000 WD 6). Since all future shrimp assessments have to include cod as predator, it is important to identify and study possible problems with the cod consumption estimates. Aschan (2000 WD 6) identifies the following potential problems:

1) cod feeding on shrimp while in the trawl;
2) calibrating the use of digestion rate;
3) the effect of pooling stomach content data over year classes of cod;
4) the impact of no longer collecting cod stomach data during the April–May Norwegian shrimp cruise; and
5) the effect of not including ambient temperatures in digestion rate estimates.

9.3 Evaluation of the Stock

9.3.1 Assessment methods under progress (Table 9.5)

The great plasticity in growth of shrimp and age at sex change, as well as a lack of biological data from the catches make it difficult to apply traditional analytical fishery assessment methodologies to the data.

Production models

1) stock production model (Steffanson *et al.* 1994, Berenboim and Korzhev 1997);
2) time-dependent stock-production model (Shepherd 1991);biomass dynamic models (Hilborn and Walters 1996)

Cohort population analysis

1) single species virtual population analysis;
2) multi species virtual population analysis.

Ecological models

1) length based population model – Bormicon (Steffansson and Pálsson 1997);
2) Fleksibest (Froeysa *et al.* in press)

Spreadsheet performance reports (Caddy 1999, Koeller *et al.* in press; see Table 9.5).

Some models used in the 90’s are described in detail below.

Production models

A production model elaborated by Stefansson *et al*. (1994) for shrimp of north Icelandic water was applied to Barents Sea shrimp data (Berenboim and Korzhev 1997). This model considers cod and shrimp populations without dividing them into age or length groups and may be described by following equations:

$$B_{t+1} = \alpha B_t - C_t + \beta R_t - \gamma D_t$$
$$CPUE_{est}(t) = \delta * 0.5 (B_t + B_{t+1}),$$

B_t is the total stock biomass, α is used as a proxy for the growth in biomass of the stock, in the absence of recruitment, fishing and consumption by cod, C_t is landings, βR_t is the increase in biomass due to recruitment, γD_t is the loss of biomass due to consumption by cod, and t refers to year.

Parameters α, β, γ, δ are constant values which are estimated by minimisation of the sum of squared errors from the observed CPUE.

Cohort models

For these models it is necessary to estimate in advance the natural mortality coefficient as a function of age and year. These parameters are important in shrimp models because of high cod consumption.

9.3.2 Single species VPA

Single VPA (Lowestoft ICES) may be used in two variants:

- To estimate total natural mortality in advance (for example with the help of some multispecies model), and;

- To estimate in advance residual mortality rate M1 (as is shown in WD 26) with the help of a procedure which maximizes the correlation coefficient between two time series – surveys estimations of shrimp stock biomass and estimates obtained by multispecies model), or to set M1 by other methods. Abundances of shrimp at age, consumed by cod, are included with the catch at age data. After VPA calculations it is necessary to split Z into separate M and F.

This model is used with tuning procedures which may be carried out using the following information:

1) Russian spring survey data for 1985–2000,
2) Norwegian (April – May (Barents Sea) and August (Svalbard area)) survey data for 1982–2000
3) Russian trawl fleet (< 1300 hp) data for 1984–2000.

9.3.3 Multispecies model MSVPA

These models consider M = M1+M2. M1 is the non cod related mortality and is used as an input parameter for the MSVPA model; M2 is cod predation mortality and is estimated inside the model, (Bulgakova 2000 WD 26). This model requires a great deal of predator stomach content data. Cod stomach data may be obtained from the Joint Russian-Norwegian stomach data base. Methodologies used in parameter estimation and preparation of input files are described in Bulgakova *et al.* (1995 a,b,c) and ICES (1996). This model is developed inside MAWG ICES (Sparre 1984). A new version is being developed by H. Gislason (pers. comm.) for the Barents Sea community. This version allows one to input variable parameters (e.g., year, daily consumption rates, weight-at-age, and quarterly mortality rates).

9.4 Status of the Stock (Table 9.2–9.4, Figure 9.3–9.5)

Norwegian and Russian CPUE indices indicated a decline from 1998 to 1999 (Table 9.2, Figure 9.3). The Norwegian biomass index shows a decrease from 1998 to 2000 and is now at the long term mean (1986–2000)(Table 9.3 and Figure 9.3–9.4). The Russian biomass index shows a decrease from 1999 to 2000, but it is above the long term mean (Table 9.4). The 1996 year class which should have recruited to the fishery in 2000 has been almost absent in the 1998–2000 Norwegian surveys. Russian survey data indicate the presence of the 1996 year class. A weak 1996 year class will probably result in a lower survey index in year 2001. However, the 1997 year class appears to be of average strength and will probably contribute as small shrimp to the fishery in 2001. One should take cod consumption into consideration (Figure 9.5).

Recommendations for further work

- Scientists have to agree on how the available length-at-age data should be implemented in the production of recruitment indices, maturity at age data, and catch-at-age data;

- Length and sex data from commercial catches should be provided by nations involved in the fishery;

- Authorities should enforce the accurate completion of logbook data in Norway, and daily vessel reports in Russia, especially the use of double and triple trawls;

- Scientists should evaluate the procedures used in estimating the rates of shrimp consumed by cod (see 9.2.6);

- Work on developing and evaluating assessment methods should be continued;

- National shrimp cruises should survey the entire area of shrimp distribution in the Barents Sea and the Svalbard area; therefore, more vessel time is necessary.

9.5 Further Cooperation

The co-operation between the Norwegian and the Russian scientists is good. Two meetings are held each year, and when necessary additional meetings are arranged. Monthly contact is held by e-mail, telefax, and phone.

Since 1996, Russian and Norwegian scientists have requested that the Russian Norwegian Fisheries Commission ask ICES to include this shrimp stock in a working group (WG) with annual meetings. This was suggested in the Commission protocol of 1996 and 1997. Early during 2000, the Royal Ministry of Fisheries in Norway sent a request for advice on management of shrimp in ICES sub-areas I and II. The request was responded upon by including this shrimp stock in the Arctic Fisheries Working Group.

Methodological problems in shrimp assessment such as ageing analysis, models for assessment, and aspects of fishery management could be worked on in a joint NAFO-ICES Study Group.

Table 9.1 Nominal shrimp catches (t) by country (Sub-areas I and II combined). Norwegian and Russian data were provided by Working Group members while data for other countries were provided by ICES.

Year	Norway	Russia	Others	Total
1970	5,508	0	0	6,000
1971	5,116	0	0	5,000
1972	6,772	0	0	7,000
1973	6,921	0	0	7,000
1974	8,008	992	0	9,000
1975	8,197	0	2	8,000
1976	9,752	548	0	10,000
1977	6,780	12,774	4,854	24,000
1978	20,484	15,859	0	36,000
1979	25,435	10,864	390	37,000
1980	35,061	11,219	0	46,000
1981	32,713	10,897	1,011	45,000
1982	43,451	15,552	3,835	63,000
1983	70,798	29,105	4,903	105,000
1984	76,636	43,180	8,246	128,000
1985	82.123	32,104	10,262	124,000
1986	48,569	10,216	6,538	65,000
1987	31,353	6,690	5,324	43,000
1988	32,021	12,320	4,348	49,000
1989	47,064	12,252	3,432	63,000
1990	54,182	20,295	6,687	81,000
1991	39,272	29,400	6,156	75,000
1992	39,603	20,900	8,021	69,000
1993	33,109	21,290	806	55,000
1994	20,116	8,110	1,063	29,000
1995	19,300	4,300	2,319	26,000
1996	25,000	5,731	1,998	33,000
1997	28,900	2,500	3,412	35,000
1998	43,949	4,900	3,744	53,000
1999	53,182	9,878	6,118	69,000

Table 9.2. Catch (t), effort (h) and CPUE (kg/h) data in ICES sub-areas I, IIa and IIb. Norwegian data based on log books and Russian data based on daily reports from vessels smaller than 13000hp.

Norway

Year	Catch	Effort	CPUE
1980	23,417	126,157	186
1981	23,083	106,424	217
1982	31,088	156,770	198
1983	54,754	240,275	228
1984	60,063	246,738	243
1985	63,715	277,935	229
1986	37,432	245,739	152
1987	22,997	200,545	115
1988	22,803	206,007	111
1989	37,172	264,148	141
1990	44,824	294,896	152
1991	34,541	203,071	170
1992	36,961	176,397	210
1993	60,728	291,435	208
1994	19,539	107,436	182
1995	17,079	113,325	151
1996	22,045	119,298	185
1997	25,298	111,177	228
1998	34,153	112,213	304
1999	47,816	164,319	291

Russia

Year	Catch	Effort	CPUE
1981	2,341	8,100	289
1982	4,966	20,400	243
1983	13,223	48,000	276
1984	33,403	118,900	281
1985	27,974	110,900	252
1986	7,912	33,500	236
1987	3,818	23,900	160
1988	9,010	61,600	146
1989	7,928	53,500	148
1990	17,126	94,500	181
1991	15,532	74,100	210
1992	13,025	57,000	229
1993	11,390	60,000	190
1994	4,521	27,500	164
1995	3,347	26,100	128
1996	5,680	35,300	161
1997	1,507	7,600	198
1998	4,900	21,212	231
1999	6,238	30,900	202

Table 9.3 Indices of shrimp biomass from Norwegian surveys in the years 1982-2000 by main areas.

Main area	A East Finnmark	B Tiddly Bank	C - Thor Iversen Bank	D - Bear Island Trench	E Hopen	F Bear Island	G Storfjord Trench	H Spits-berger	Total	Sum. A,B,C, E
Strata	1 - 4	6 - 7	10 - 12	5, 8, 9, 13	14 - 18, 24	19 - 22/ 31 - 40	41 - 50	51 - 70		
1982	35	34	44	53	66	56	17	22	327	179
1983	40	57	61	53	112	52	21	33	429	270
1984	40	51	64	60	141	66	20	29	471	296
1985	23	17	27	18	96	31	17	17	246	163
1986	10	7	13	25	57	34	10	10	166	87
1987	29	13	18	23	31	10	9	13	146	91
1988	26	18	18	36	32	24	13	14	181	94
1989	41	17	13	17	33	53	22	20	216	104
1990	31	13	25	42	58	43	27	23	262	127
1991	22	28	22	54	120	44	21	10	321	192
1992	18	22	33	37	62	38	14	15	239	135
1993	17	19	32	29	85	20	12	19	233	153
1994	19	8	13	15	52	33	9	12	161	92
1995	10	10	11	17	83	33	16	13	193	114
1996	21	8	26	26	110	42	21	22	276	165
1997	24	34	20	34	116	44	12	16	300	194
1998	18	24	41	26	120	72	12	28	341	203
1999	17	19	23	21	169	31	21	16	316	227
2000	14	29	25	26	102	29	10	12	**247**	170
%99/98	-7	-23	-45	-18	41	-57	69	-43	-7	12
%00/99	-18	58	9	23	-40	-7	-52	-23	-22	-25

Table 9.4 Indices of shrimp biomass (1000 t) from Russian survey in the years 1984-2000 by main areas. Catchability of 0.182 is used in the estimate.

Main area	A East Finnmark	B Tiddly Bank	C - Thor Iversen Bank	E Hopen	F Bear Island	G Storfjord Trench	H Spits-berger	I Kola coast	K Goose bank	Total	Sum. A,B,C, E
Strata	1 - 4	6 - 7	10 - 12	14 - 18, 24	19 - 22/ 31 - 40	41 - 50	51 - 70	2s-6s	7s-8s		
1984	38	137	99	254				133		661	528
1985	14	45	74	255		6	46	19	9	468	388
1986	9	19	44	140		42	127	9	9	399	212
1987	16	17	59	107	45	36	27	25	14	346	199
1988	14	31	39	49		22	29	36	13	233	133
1989	70	128	57	132	6	60	25	105	20	603	387
1990	148	49	119	259	14	110	30	196	15	940	575
1991	98	94	104	541	9	70	27	155	43	1141	837
1992	60	153	92	409				65	77	856	714
1993	73	63	159	382	9		58	37	111	892	677
1994	4	35	48	255	21			14	27	404	342
1995	5	28	15	80	33	53		16	18	248	128
1996	20	98	127		21			67	108	441	245
1997	26	108	130	341				108	52	765	605
1998	14	106	136	172				108	41	577	427
1999	43	139	107	523				93	61	966	812
2000	29	73	109	328	9	39		72	141	**800**	539

Table 9.5 Evaluation of the shrimp (*Pandalus borealis*) stock in Barents Sea and Svalbard area, ICES Sub areas I, IIa and IIb.

Catch	Increased to 128,000 t in 84 followed by a drop to 45,000 t in 87. Catches fluctuated between 81,000 t in 91–92 and 27,000 in 95. During 96–99 catches increased continuously to 69,000 t.
Effort	The total Norwegian and Russian effort was stable (approx. 140,000 h) from 94–98 but increased in 99 to 210,000 h. Since 97 the number of Norwegian vessels using double and triple trawl has increased and the Russian shrimp fleet is beginning to introduce modern technology.
By Catch	The mandatory use of 19 mm sorting grates excludes most fish >18 cm. Areas are closed if the following criteria are exceeded: 10 cod and haddock or 10 redfish or 3 Greenland halibut per 10 kg of shrimp. Low surveillance effort as well as low cod recruitment and a large shrimp stock resulted in very few closed areas during the last year.

INDEX	OBSERVATION	INTERPRETATION	EVALUATION
FISHERY DATA			
CPUE index	Increased for the Norwegian and the Russian fleet from 1995 to 1998 (304 and 231 kg/h respectively) but show a decrease for both fleets in 1999. There are concerns that new technology (e.g. double and triple trawling) is not taken into account in the CPUE index.	Between 95 and 98 the shrimp biomass and usage of new technology increased, however, the biomass decreased during 99.	–
Spatial pattern	The Hopen deep remains the most important fishing area but the role of the areas North of Svalbard increases as the vessels get larger.	Reflects a stable situation for the fishery	+
Temporal pattern	This is an all year fishery with the best catches in March-August and the lowest catches in November-February.	Monthly variation is due to seasonal vertical migrations, presence of ice and weather conditions rather than shrimp abundance.	+
Male/female abundance	No biological data from commercial catch	Norwegian fishermen are observing low numbers of small shrimp in the catches in 2000.	?
Sex inversion	No biological data from commercial catch		?

Table 9.5 cont.

RESEARCH DATA			
Biomass index	Norwegian and Russian biomass indices are well correlated and agree with the commercial CPUE. The Norwegian index indicates a reduction from 98 to 2000 (22%). The Russian index indicates a reduction from 99 to 2000 (17%).	Biomass declining.	–
Spatial pattern	Widely distributed throughout the management area. Distribution/density patterns vary between years. The surveys do not cover the north–eastern part of the distribution area.	Area of distribution appears to be constant.	?
Recruitment (male age structure)	The 96 year class (4 years old) which should have entered the fishery in 2000 disappeared during the autumn and winter of 97 due to high predation by 95 year class of cod (Norwegian data). Russian survey and cod stomach data indicate the presence of the 96 year class. The 97 year class is average whereas the 98 and 99 year classes appear strong.	Norwegian data suggest that biomass of males has declined in 2000 due to the weak 96 year class but should increase when the 97 and 98 year classes enter the stock.	?
Spawning stock (females)	Has been a stable proportion of the stock through the 90's; female abundances vary with the biomass index. Possible decrease in 2001 SSB index due to the weak 96 year class.	Female biomass/abundance are maintained in 2000 by the 95 and 94 year classes but will decline thereafter with the weak 96 year class.	?
Sex inversion	The majority of shrimp change sex at five years. Temporal and spatial distribution of mean length at sex change will be calculated (L_{50}).		?

Table 9.5 cont.

OTHER FACTORS			
Predation	Cod consumption since 1992 has been approximately 10 times higher than the landings. The decline in the cod stock has resulted in a decline in the consumption from 369 to 251 thousand t in 98–99. Other predators are Greenland halibut and thorny skate (*Raja radiata*)	Consumption is still high but shows recent declines.	✚
Environment	The 95–98 temperatures in the Barents Sea were below the long term mean. Since the beginning of 1998, temperatures have increased and this could impact growth, survival and sex change.	Possibly a positive effect on growth and recruitment and thereby on stock size.	?
Industry perspectives	Catch rates in 2000 appear good, though somewhat lower than last year.		?

Table 9.5 cont.

ASSESSMENT			
Exploitation Rate	The ratio of catch to biomass index has been low since 94 (.2) compared to that in the mid 80's (~.5).	Catchability of the Norwegian survey gear is believed to be <1. Russian estimate for catchability is 0.182. Norwegian and Russian surveys do not cover the entire area of distribution.	**?**
Stock Status	**Current status: Biomass and CPUE indices show a decline. Russian biomass index is above, while the Norwegian index is at the long term mean (1985–2000).**	–	
	Prospects: Over the next few years, residual female stock and stronger 97 and 98 year classes will probably buffer the weak 96 year class.	**?**	

Concerns for current status/future prospects ▬

Uncertainty regarding index quality or impact ?

<u>Uncertainty about the absolute stock size and the level of cod consumption</u>

<u>Difficult to defend TAC as long as M ≈ 10 * F</u>

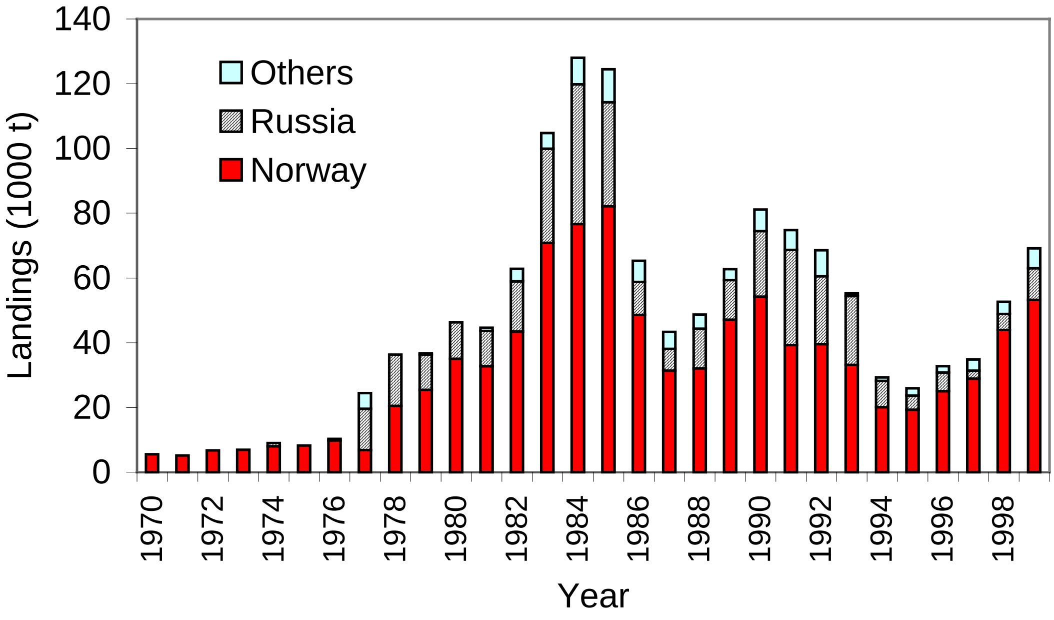

Figure 9.1. Shrimp landings from ICES areas I, IIa and IIb by Norway, Russia and other countries in the period 1970–1999.

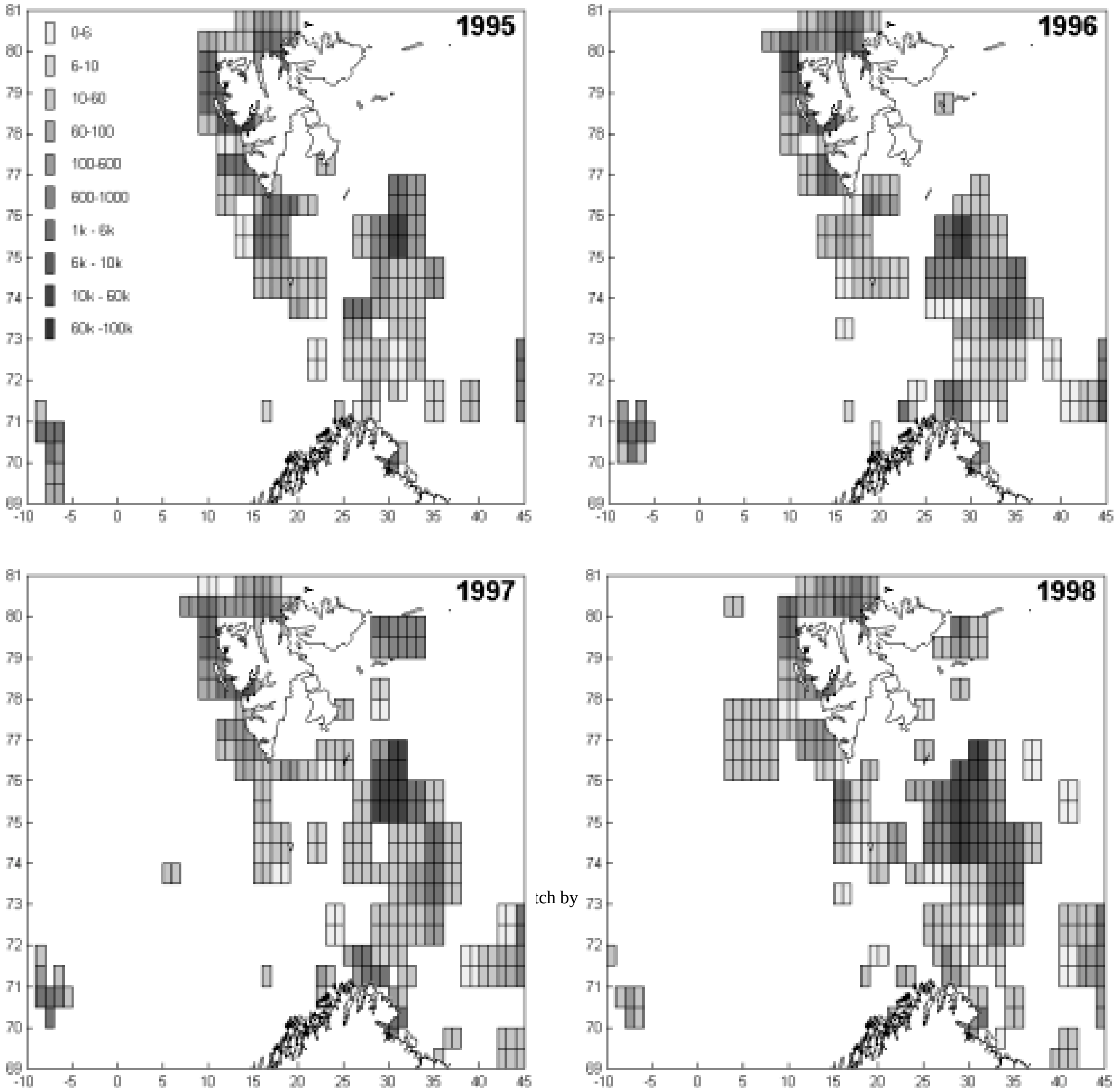

Figure 9.2 Norwegian annual catch by statistical grid in 1995-1998.

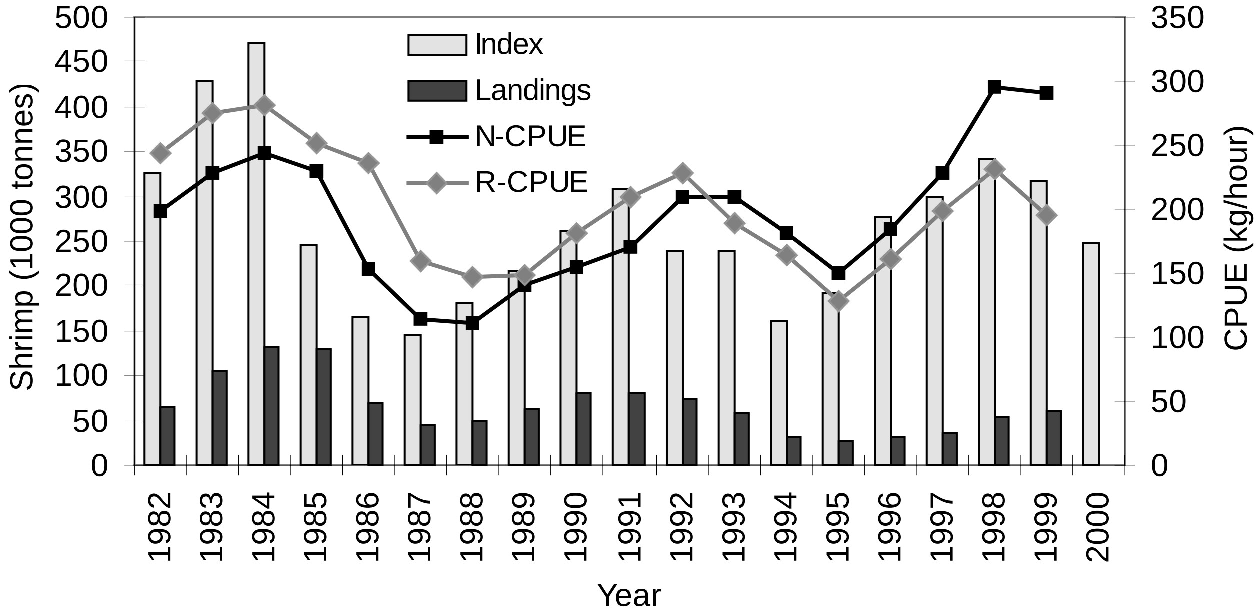

Figure 9.3 Biomass indices from the Norwegian surveys, total landings and Norwegian and Russian CPUE for ICES areas I, IIa and IIb.

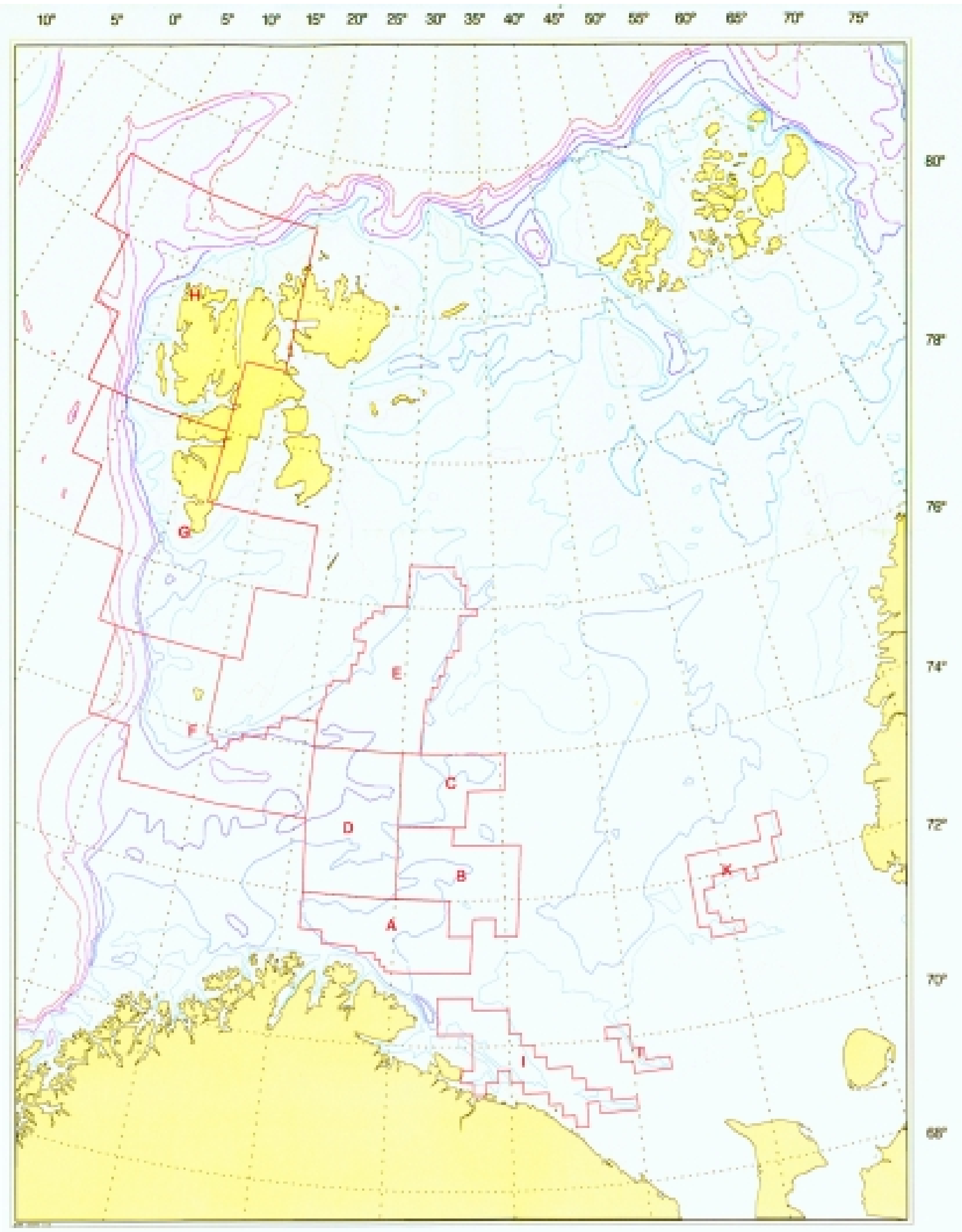

Figure 9.4 Survey strata are combined to 10 larger areas marked with letters A to K. East Finnmark (A), Tiddly Bank (B), Thor Iversen Bank (C), Hopen (E), Bear Island (F), Storfjord Trench (G), Spitsbergen (H), Kola coast (I) and the Goose Bank (K).

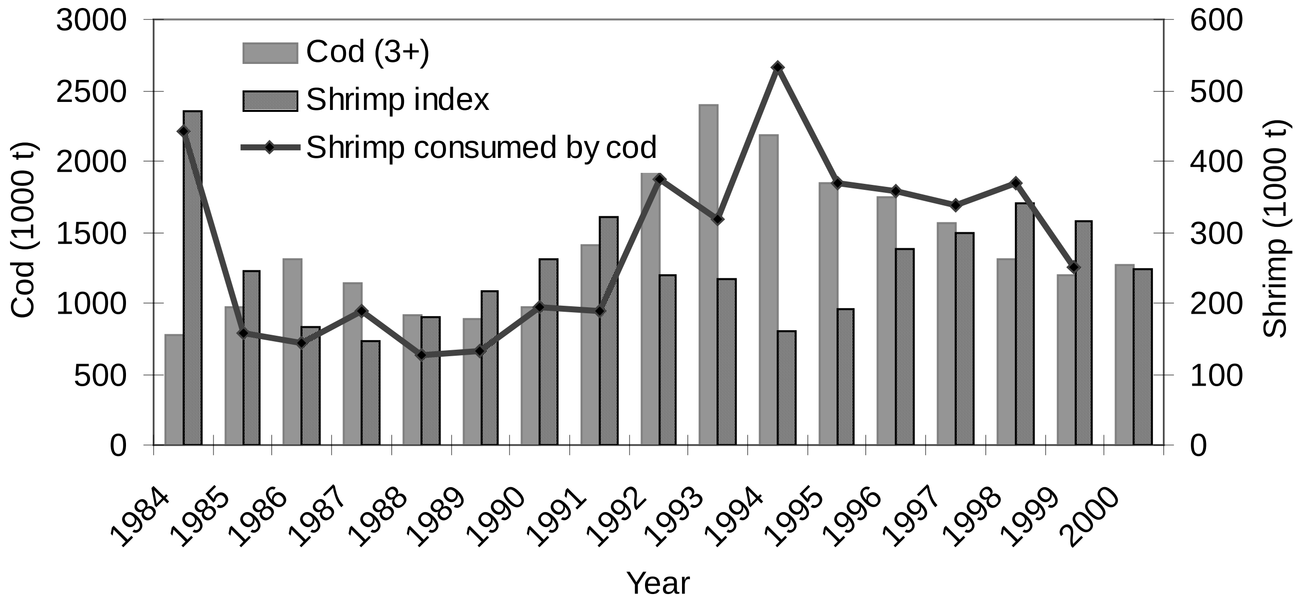

Figure 9.5 Biomass indices from the Norwegian surveys, biomass estimate for cod (age 3 years and older) and the shrimp consumed by the cod in the Barents Sea (ICES 2000).

10 WORKING DOCUMENTS

WD#	Title	Authors
1	Forecasting Barents Sea temperature	Ottersen, G., Loeng, H., Ingvaldsen, R. and Ådlandsvik, B.
2	Ambient temperature of Northeast Arctic cod	Ottersen, G. and Michalsen, K.
3	A standardised CPUE time series from the Norwegian bottom trawl fleet	Salthaug, A.
4	Some alternative xsa tuning choices compared to the May 2000 assessment	Aglen, A.
5	Individual growth prediction of Northeast Arctic cod	Ajiad, A.
6	How much shrimp does cod really eat?	Aschan, M.
7	Northeast Arctic cod – expected catch numbers at age	Nakken, O.
8	Northeast Arctic cod – on the reliability of catch (landing) statistics in recent years	Nakken, O.
9	Northeast Arctic cod – underestimation of F in the assessment	Nakken, O.
10	Assessment of Northeast Arctic cod using Fleksibest	Bogstad, B., Guldbrandsen Frøysa, K. and Nygaard Åsnes, M.
11	Predicting recruitment of Northeast Arctic cod–status of research	Bogstad, B.
12	Condition and reproductive potential of Northeast Arctic cod in 2000 as determined by Norwegian and Russian surveys	Marshall, C.T., Yaragina, N.A., Kjesbu, O.S. and Thorsen, A.
13	Reconstructing the stock/recruit relationship for Northeast Arctic cod using a bioenergetic index of reproductive potential	Marshall, C.T., Yaragina, N.A., Ådlandsvik, B.and Dolgov A.V.
14	The proportional removal of biomass and reproductive potential for the Northeast Arctic cod stock (1946–1996)	Marshall, C.T. and Yaragina, N.A.
15	Variation in abundance of Arcto-Norwegian cod during the twentieth century	Hylen, A.
16	Spawning of cod and haddock in the Bear Island-Spitsbergen area in 2000	Shevelev, M.S. and Tereshchenko, V.V.
17	Correction of a precautionary fishing mortality value F_{pa} for Northeast Arctic cod	Vasilyev, D.A.
18	Modelling of age-dependent instantaneous coefficients of natural mortality for Northeast Arctic cod	Tretyak, V.L.
19	The status of shrimp research in the Barents Sea and Svalbard area	Aschan, M., and Berenboim, B.
20	Revised tuning data for Northeast Arctic saithe	Mehl, S., Salthaug, A., and Overvik, M.
21	Building a maturity model for North East Arctic haddock	Korsbrekke, K.
22	The Norwegian Greenland halibut survey along the continental slope from 68^{o}N to 80^{o}N in August in the period 1994–1999	Høines, Å
23	Investigation of Greenland halibut in the region around Spitsbergen and Frans Josef Land during the period 1996–1999	Bjelland, O., Hylen, A., Gundersen, A.C. and Nedreaas, K.

WD#	Title	Authors
24	Results from Russian investigations of Greenland halibut in the northern Barents Sea in 1999	Smirnov, O.V. and Lepesevich, Yu. M.
25	Results of the Russian survey of Greenland halibut in the Barents Sea in 1999	Smirnov, O.V.
26	Stock assessment of the Barents Sea north shrimp with the help of MSVPA	Bulgakova, T.
27	Commercial prey species consumption by the Barents Sea cod in 1984–1999	Dolgov, A.
28	Input data for estimate of shrimp stock in the Barents Sea by single VPA	Berenboim, B. and Korzhev, V.
29	A review of recent research related to quantifying the reproductive potential of marine fish	Marshall, C.T.
30	Maturity-at-age of Northeast Arctic cod in 2000 as estimated from Norwegian surveys of the Barents Sea and Lofoten region	Marshall,C.T. and Aglen, A.
31	Results from the winter 2000 demersal fish survey in the Barents Sea	Aglen, A.
32	Report on demersal fish surveys in the Barents Sea and Svalbard area during summer/autumn	Aglen, A
33	Trawl acoustic indices and catch rate indices of *Sebastes marinus*, haddock and saithe from the Norwegian coastal surveys 1995–1999	Berg, E., and Albert, O.T.
34	Prognosis for development of the Barents Sea capelin stock	Gjøsæter, H.
35	A conversion of cod abundance from the trawl-acoustic survey data to a number of cod in different age-length groups to be used in the Flexibest model	Gusev, E.V., and Yaragina, N.A.
36	Russian investigations of redfish (*Sebastes mentella* Travin) from the Norwegian-Barents Sea stock in 2000	Drevetnyak, K.
37	Russian investigations and fishery for saithe (*Pollachius virens*) in 1999–2000	Vinnichenko, V.I. and Drevetnyak, K.V.
38	The Spanish NE cod fishery in 1999	Murua, H., Paz, X, and Motos, L.
39	Spanish bottom trawl survey "Fletán Ártico 97–99" in the slope of Svalbard area ICES Division IIb: 1997–99	Paz, X., and Román, E.
40	Reconstruction of NEA cod SSB and recruitment historical series	Tretyak, V.L., Kovalev, Y.A., and Borisov, V.M.
41	About the stock/recruit relationship of the Northeast Arctic cod	V.M. Borisov

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